McKinley/O'Loughlin/Bidle

Anatomy and Physiology: An Integrative Approach, 1/e

Answer Key

Chapter 1

Answers to "What Did You Learn?"

1. Comparative anatomy

2. Anatomy is the study of structure and form. Physiology is the study of how the structures function.

3. Cardiovascular

4. An anatomist will describe various tissues within the esophagus and their arrangement relative to each other. The physiologist will focus on how the tissues are involved in, and possibly interact, during the process of swallowing.

5. The ability of organisms to respond to stimuli such as changes in either their external or internal environment provides them with a mechanism for maintaining a constant internal environment, even as the environment around them changes.

6. A higher level of organization does contain all of the levels beneath it. Each level of organization is a function of the arrangement of its subsequent subunits, which are in turn a function of the organization of their subunits. Therefore, each level organization is dependent on the organization of all of the levels below.

7. The urinary system is responsible for filtering and removing waste products from the blood.

8. A transverse plane, also called a horizontal or cross-sectional plane, would divide the mouth into superior and inferior sections.

9. Proximal

10. The term *antebrachial* refers to the forearm, the portion of the upper limb between the elbow and wrist.

11. The lungs are located within the thoracic cavity. The serous membranes surrounding them consist of a parietal pleura lining the inside of the body wall and a visceral pleura lining the individual lungs.

12. Epigastric

13. A homeostatic system consists of a receptor such as a sensory neuron in the skin or a stretch receptor within a muscle that detects either an internal or external stimulus; a control system that integrates the input from the receptor such as the brain or an endocrine gland; and an effector such as a muscle or a gland that causes changes in response to the stimulus.

14. The body may respond to a drop in temperature by decreasing the diameter of blood vessels carrying blood to the surface of the skin, thereby decreasing the amount of heat lost to external environment. Another response involves stimulation of skeletal muscles, causing "shivering" and thereby generating heat internally.

15. Negative feedback systems involve responses that are in opposition to the stimulus, thereby maintaining the environment near the set point or normal level. Conversely, positive feedback systems entail a series of responses each increasing in intensity until a climax event is reached, at which point the system will return to homeostasis.

16. Diabetes, an inability of the body to maintain blood sugar levels, may result in damage to anatomical structures throughout the body due to high levels of glucose.

Answers to "Do You Know the Basics?"

1. B
Feedback: *Surface anatomy* correlates superficial markings on the surface of the body and skin to deeper anatomical features.

2. C
Feedback: *Organs* are often composed of several tissue types working in concert to perform a common function.

3. A
Feedback: An organism's *metabolism* is the sum of all of its biochemical reactions.

4. C
Feedback: A midsagittal or median plane separates the body into equal *right and left halves* as compared to simply a sagittal section, which separates the body into unequal right and left portions. There can be numerous sagittal planes but only one possible midsagittal section along the midline of the body.

5. D
Feedback: The term *proximal* is used to describe the position of a structure on an appendage closest to the point of attachment to the trunk. Although in standard anatomical position a structure that is proximal is often also superior, proximal is the correct term for describing the position along an appendage. The term superior may be used to describe positions along the axis of the body, closer to the head.

6. A
Feedback: The *patellar* region is the anterior portion of the knee. The popliteal region is the posterior portion of the knee.

7. A
Feedback: The diaphragm comprises the barrier between the superior thoracic cavity and the inferior *abdominal cavity*. The pelvic cavity is located inferior to the superior edges of the pelvic bones.

8. D
Feedback: The pleural cavity surrounding the lungs consists of a parietal pleura lining the internal walls of the thoracic cavity and a *visceral pleura* lining the surface of the lungs.

9. B
Feedback: *Homeostasis* is an automated process for maintaining a constant internal environment.

10. D
Feedback: The *effector* increasing the stimulus is an example of positive feedback. In a negative feedback system, the response moves the system in opposition to the stimulus, back toward the set point.

11. Anatomy is the study of structure and form, whereas physiology is the study of how the structures function. It is important to understand the anatomy of a structure in order to understand how it performs its function. Conversely, understanding the function of an anatomical feature helps to put into perspective the significance of its arrangement.

12. The simplest level of organization within an organism is found at the chemical level and is composed of atoms and molecules. At the cellular level of organization, molecules are organized into cells and subcellular components, forming the basic units of life. Groupings of similar cells performing similar functions are referred to as tissues, and groups of tissues may be found working in concert, forming organs at the organ level of organization. Related groups of organs working together in order to coordinate activities within the organism are called organ systems.

13. A hierarchical organization, metabolism, growth and development, responsiveness, regulation, and reproduction are characteristics common to all living organisms. All living things are arranged in a hierarchical manner with increasing levels of complexity from molecules to cells. They are capable of metabolism, growth and development, and responsiveness to stimuli. They are also able to regulate their internal environment in order to maintain homeostasis, ultimately surviving long enough to reproduce.

14. The human body consists of eleven organ systems. They are the integumentary, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, urinary, digestive, and reproductive systems.

15. A body in anatomical position is standing upright with the feet flat on the floor. The upper limbs are at the side of the body with palms facing anteriorly. The head is level and the eyes are looking forward.

16. The forearm is the antebrachial region, the wrist is the carpal region, the chest is the thoracic region, the armpit is the axillary region, the thigh is the femoral region, and the entire foot is the pes.

17. The cranial cavity and vertebral canal are located within the posterior aspect of the body. The cranial cavity houses the brain and the vertebral canal contains the spinal cord.

18. The serous membranes are found lining the compartments of the ventral cavity of the body. They consist of a parietal layer lining the inside of the body wall and a visceral layer covering internal organs. In between the two membranes is a potential space, the serous cavity, which contains serous fluid.

19. A homeostatic system consists of a receptor that detects an internal or external stimulus, a control system that integrates the input from the receptor, and an effector such as a muscle or a gland that causes changes in response to the stimulus.

20. Negative feedback systems involve responses that are in opposition to the stimulus, thereby maintaining the environment near the set point or normal level. Conversely, positive feedback systems entail a series of responses, each increasing in intensity until a climax event is reached, at which point the system will return to homeostasis.

Answers to "Can You Apply What You've Learned?"

1. B
Feedback: The pain is coming from a region below the umbilicus, hence it is in the lower portion of the abdomen and it is located on the right side. It is therefore in the *right lower quadrant*.

2. D
Feedback: The *right iliac region* is located just medial to the pelvic bones.

3. B
Feedback: X-rays are not absorbed by soft tissue such as the appendix. They are usually used to visualize dense structures.

4. B
Feedback: Sweat glands release heat at the surface of the skin.

5. B
Feedback: Serotonin is a neurotransmitter responsible for regulating both pathways associated with depression in the brain and gastric motility in the stomach. Drugs such as SSRIs are used to treat depression in individuals with low levels of serotonin in the brain by inhibiting its reuptake by neurons. Because the SSRI drugs cannot specifically target the brain, they also have an effect within the digestive system, causing nausea and diarrhea.

Answers to "Can You Synthesize What You've Learned?"

1. Lynn has broken the bones within her forearm, the radius and ulna. She has an abrasion on her chin as well as bruising on her buttocks and thigh.

2. The epinephrine counteracted the effect of the bee sting, acting in opposition to the stimulus; it was therefore an example of negative feedback.

3. X-rays and CT scans are optimal for visualizing dense tissues such as tumors. An MRI or ultrasound would be better suited for examining soft tissues.

Chapter 2
Answers to "What Did You Learn?"

1. The mass of an atom is determined by the combined number of protons and neutrons within its nucleus. The charge is a function of the ratio of protons to electrons.

2. The nucleus of a chlorine atom consists of 17 protons and 17 neutrons. The electrons are arranged into three separate shells; the first shell closest to the nucleus contains two electrons, the second shell contains eight electrons, and the third outer shell contains seven electrons for a total of 17 electrons.

3. Isotopes are atoms of the same element that differ in their number of neutrons. In a radioisotope the extra neutrons will decay and be released as radiation.

4. Elements such as the noble gases have satisfied the octet rule by having a complete outer electron shell and are therefore not reactive. Other elements may form bonds in order to satisfy the octet rule and fill their outer shells.

5. Common cations of the human body include sodium ions (Na^+), potassium ions (K^+), calcium ions (Ca^{2+}), magnesium ions (Mg^{2+}), and hydrogen ions (H^+). Common anions include chloride ions (Cl^-), bicarbonate ions (HCO_3^-), and phosphate ions (PO_4^{3-}).

6. Hydrogen (H), sodium (Na), magnesium (Mg), potassium (K), and chloride (Cl)

7. In order to satisfy the octet rule, atoms with only one electron in their outer shell may give up the electron, resulting in a slightly positive cation with a full outer shell. Conversely, atoms with seven electrons in their outer shell may accept an electron from another atom, becoming a slightly negative anion but with a full outer shell.

8. Ionic bonds are formed due to an attraction between ions with different charges; therefore, two positive cations cannot form an ionic bond with each other, nor can two negatively charged anions.

9. The molecular formula exhibits the type and number of atoms in a molecule; the structural formula also provides information on how the atoms are arranged.

10. Isomers are molecules composed of the same type and number of elements, but are arranged differently.

11. A covalent bond is formed when atoms share electrons in their outer orbitals in order to satisfy the octet rule.

12. Oxygen atoms each contain six electrons in their outer orbitals and each have room for two more. In a double bond they share two pairs of electrons and thereby each satisfies the octet rule.

13. A covalent bond between atoms of the same element will result in an equal distribution of electrons across the molecule since both atoms are equally electronegative, resulting in a nonpolar molecule. Molecules composed of different atoms result in an unequal distribution of charge across the molecule, where more electronegative atoms have a slightly negative charge and less electronegative atoms are slightly less negative. Since oxygen and hydrogen atoms are nearly equal in terms of electronegativity, atoms of these two different elements can also form nonpolar covalent bonds.

14. Both molecular oxygen (O_2) and carbon dioxide (CO_2) are nonpolar molecules.

15. A hydrogen bond is an intermolecular attraction between a slightly positive hydrogen atom and another slightly negative atom.

16. Hydrogen bonding is an important factor behind many of the properties of water molecules.

17. Surfactant is required to break cohesive attraction between water molecules in the alveoli of the lungs. The high heat of vaporization of water molecules makes them an effective mechanism for dissipating heat at the surface of the skin.

18. Nonelectrolytic molecules such as glucose do not dissociate in water. Electrolytes such as sodium chloride (NaCl) disassociate into constituent ions in an aqueous environment, forming a solution capable of conducting electricity.

19. In an aqueous environment, amphipathic molecules such as phospholipids will orient themselves so that their hydrophobic domains face each other while the hydrophilic domains are exposed to water. This is the basis behind the arrangement of phospholipids within a phospholipid bilayer.

20. Each water molecule can disassociate into one negatively charged hydroxyl ion and one positively charged hydrogen ion, leaving it with an equal distribution of positive and negative charges, which is considered neutral.

21. An acid is capable of releasing hydrogen ions in an aqueous environment.

22. pH is the relative measure of hydrogen ions in a solution.

23. Buffers maintain the pH of physiologic solutions within a normal range by absorbing hydrogen ions when an acid is added or hydroxyls when a base is added to the solution.

24. Blood is a suspension of formed elements that settle out of solution when a sample is left standing.

25. Blood is also considered a colloid because it contains numerous proteins and a solution because of its numerous dissolved solutes, such as ions and sugars.

26. The concentration of a solution may be expressed as either the mass of solute/volume of solution, percent of mass of solute in 100 milliliters of solution, moles of solute/liter of solution (molarity), or the moles of solute/kilogram of solvent (molality).

27. Biological molecules typically contain carbon (C), hydrogen (H), and oxygen (O) and in some cases may also contain nitrogen (N), phosphorus (P), and sulfur (S). Of these, hydrogen is the only one capable of forming a common biological ion.

28. Carboxylic acids and phosphates are capable of acting as acids.

29. A polymer is composed of repeating monomer subunits. Proteins are composed of amino acids, carbohydrates are composed of simple sugars, and nucleic acids are composed nucleotides.

30. Lipids are hydrophobic molecules and do not typically dissolve in water.

31. Phospholipids contain both a hydrophilic head group and a pair of hydrophobic fatty acid tails, making them ideally suited for forming cellular membranes.

32. Glycogen can be found within the liver and muscle tissue of animals and is composed of repeating glucose subunits.

33. Fructose, glucose, and galactose are monosaccharides. Sucrose, maltose, and galactose are disaccharides. Glycogen and starch are polysaccharides.

34. Nucleic acids store and transfer genetic information within cells.

35. RNA molecules contain a ribose sugar rather than the deoxyribose sugar of DNA. The nucleotide thymine is present in DNA. In its place, RNA contains the nucleotide uracil.

36. Amino acids are the monomers of a protein and are held together by peptide bonds.

37. A dipeptide consists of 2 amino acids, an oligopeptide contains 3 to 20 amino acids, a polypeptide contains 21 to 199 amino acids, and a protein consists of 200 or more amino acids. The term *protein* is generally used to refer to any of these molecules.

38. The R group of leucine is a short nonpolar hydrocarbon, making it a nonpolar amino acid.

39. The tertiary structure of a protein is its three-dimensional shape. The quaternary structure describes the interaction of two or more polypeptide chains within a functional protein.

40. Denaturing a protein changes its conformation and often affects its activity. Exposure of a protein to hydrogen ions can denature a protein by disrupting electrostatic interactions such as ionic bonds within the molecule.

Answers to "Do You Know the Basics?"

1. C
Feedback: *Isotopes* are atoms of the same element that differ in the number of neutrons.

2. A
Feedback: *Lipids* are hydrophobic molecules and are not soluble in water.

3. C
Feedback: Water has a high *specific heat*, allowing it to absorb energy without changing temperature. Conversely, the high *heat of vaporization* for water allows it to dissipate a large amount of energy during evaporative cooling of the skin.

4. D
Feedback: A pH less than 7.0 is acidic and a pH greater than 7.0 is basic.

5. D
Feedback: The formed elements of blood act as a suspension. Dissolved proteins in the plasma act as a colloid. The numerous dissolved solutes also make it a solution.

6. A
Feedback: *Triglycerides* are not considered polymers because they are not composed of repeating monomer subunits.

7. C
Feedback: Glucose is stored in animal tissues as *glycogen*.

8. B
Feedback: Although phosphates which contain phosphorus are common ions in the body, phosphorus itself is not a common ion.

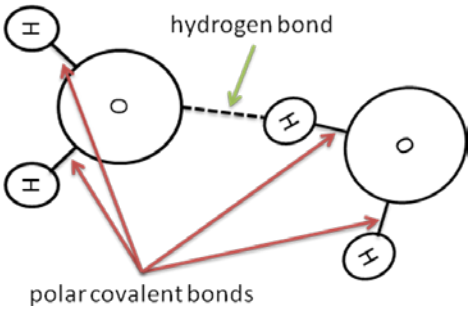
9. B
Feedback: A *hydrogen bond* is an intermolecular attraction between a slightly positive hydrogen atom and another slightly negative atom.

10. B
Feedback: *Denaturing* a protein changes its conformation. Excessive denaturation can permanently affect protein structure and possibly its function as well.

11. Common cations of the human body include sodium ions (Na^+), potassium ions (K^+), calcium ions (Ca^{2+}), magnesium ions (Mg^{2+}), and hydrogen ions (H^+). Common anions include chloride ions (Cl^-), bicarbonate ions (HCO_3^-), and phosphate ions (PO_4^{3-}).

12. A polar molecule such as water results from an unequal distribution of electrons between covalently bonded atoms. Oxygen, the more electronegative of the atoms, will have a stronger pull on the electrons and will thus have a slightly more negative charge around it. The hydrogen atom will be relatively more positive (or less negative). Two water molecules can form a hydrogen bond between their opposite poles, whereby relatively positive hydrogen will be attracted to relatively negative oxygen on the other molecule.

13.



14. Covalently bonded compounds such as glucose will not dissociate when dissolved in water; however, they will remain in solution after the mixture is no longer agitated. Ionic compounds such as sodium chloride (NaCl) will disassociate in water. The polar water molecules will disrupt the electrostatic interactions between sodium and chloride ions, thereby separating them.

15. An acid contributes hydrogen ions to a solution, making it more acidic; a base absorbs hydrogen ions from a solution, making it more basic. pH is the measure of hydrogen ions in a solution. A buffer is a solution capable of absorbing either hydrogen or hydroxyl ions, thereby maintaining its pH when acids or bases are added.

16. The concentration of a solution may be expressed as either the ratio of the mass of solute compared to the volume of the solution, as the percent of mass of solute in 100 milliliters of solution, as the number of moles of solute per liter of solution (molarity), or the number of moles of solute per kilogram of solvent (molality).

17. Proteins are composed of amino acids; carbohydrates are composed of simple sugars; nucleic acids are composed of nucleotides; and lipids consist of fatty acids.

18. The catabolism of either the nitrogenous bases present in nucleotides or the amine groups of amino acids may result in nitrogenous waste that must be removed from the body by the kidneys.

19. In an aqueous environment, amphipathic molecules such as phospholipids will orient themselves so that their hydrophobic domains face each other while the hydrophilic domains are exposed to water. This is the basis behind the arrangement of phospholipids within a phospholipid bilayer.

20. Denaturing a protein changes its conformation and often affects its activity. Exposure of a protein to a pH outside of its norm or an increase in temperature can denature a protein by disrupting electrostatic interactions such as ionic bonds within the molecule.

Answers to "Can You Apply What You've Learned?"

1. C
Feedback: Surfactant is a detergent that prevents hydrostatic interactions between water molecules, thereby preventing the lungs from collapsing. Premature babies often lack the ability to produce surfactant and are at risk for respiratory problems.

2. B
Feedback: Electrolytes such as sodium chloride (NaCl) dissociate into constituent ions in an aqueous environment, forming a solution capable of conducting electricity. Nonelectrolytic molecules such as *glucose* do not dissociate in water.

3. B
Feedback: Isotopes are atoms of the same element that differ in their number of neutrons. In a *radioisotope* the extra neutrons will decay and be released as radiation, which may be measured or visualized during a diagnostic test.

4. D
Feedback: Calcium ions are an important structural component of bone tissue.

5. C
Feedback: *Proteins* consist of covalently bonded amino acids held together by peptide bond.

Answers to "Can You Synthesize What You've Learned?"

1. High-energy radiation can affect bonds within nucleotides, thereby damaging DNA.

2. Acidosis is an increase in the number of hydrogen ions in the blood, resulting in a lower pH. The increasing number of hydrogen ions may start to damage the hydrostatic interactions holding proteins together, destroying tertiary structure and denaturing the proteins.

3. The drug would regulate the levels of the monosaccharide glucose within the blood.