Online Appendix E

ANSWERS TO EVEN-NUMBERED PREDICT QUESTIONS

Chapter 1

2. This question is about the hierarchical levels of organization in the body. The question tells us that an organ, the pancreas, is the source of the health disorder. Next, the question explains that particular groups of cells (tissue) in this organ are responsible for the normal functioning of the body. Finally, the question tells us that the individual cells release the chemical insulin, which, in this case, is not being produced, as it should. It is the lack of this chemical that is disrupting the health of the individual. Considering the hierarchy of organization, chemical → cell → tissue → organ, an adjustment at any of these levels could theoretically solve the issue.

   Currently, the chemical level is where diabetes is most commonly corrected. Purified insulin is injected into the blood at certain times. However, there are also drugs that stimulate the pancreatic cells to increase insulin production or to make other cells more responsive to insulin. Next, the tissue level is an important area of research to determine whether groups of insulin-producing pancreatic cells (pancreatic islets; see chapter 18 opening photo and caption) can be isolated and implanted into the patient. Finally, the next higher level, the organ level, could be a level of correction by transplanting a new pancreas into a diabetes patient.
4. To answer this question, you must first realize that regulation of our body's environment is due to homeostatic mechanisms. These mechanisms work to keep variables near their set point. In this chapter, you learned that in order to keep body temperature near its set point, the control center (the hypothalamus) receives input from thermoreceptors in the skin. The hypothalamus would then instruct the effectors (the sweat glands) to produce sweat if body temperature had risen too high. So, for this question, you can predict that swimming in cool water would prevent the hypothalamus from stimulating the sweat glands to produce sweat. The next part of the question asks what would happen if this mechanism was not sufficient to maintain normal body temperature. In other words, if you were swimming in cool water, the thermoreceptors would cause the hypothalamus to initiate shivering. Simply preventing sweating was insufficient to keep body temperature from dropping out of its normal range. If shivering continued to be ineffective, the body would conserve heat through loss of consciousness and severe hypothermia could set in.
6. The use of the anatomical directional terms can be compared to using the cartographic direction terms N, S, E, and W. As long as we know the reference points, and the corresponding terms, we can reference any part of the body. However, there are some terms for four-legged animals that are different from those for upright, two-legged humans, yet others are the same in both species. For example, in both humans and cats, *cephalic* means toward the head. But because the head of the cat points in the direction the cat walks, *anterior* also refers to the head, whereas in humans, *anterior* refers to the front of the body (e.g., face, stomach). In both humans and cats, *dorsal* means toward the back. But in cats, *superior* also means toward the back, whereas in humans, *superior* refers to the head. In humans, *posterior* is the other term for the rear (e.g., back of head, back).

Organism	Head	Back	Front of body
Cat	Cephalic/ anterior	Dorsal/ superior	Ventral/ inferior
Human	Cephalic/ superior	Dorsal/ posterior	Ventral/ anterior

8. The first step is to define the abdominopelvic and peritoneal cavities. The abdominopelvic cavity is located inferiorly to the diaphragm and superiorly to the symphysis pubis. The peritoneal cavity is located between the visceral peritoneum, which covers organs in the abdominopelvic cavity, and the parietal peritoneum, which lines the wall of the abdominopelvic cavity. Thus, notice the bright white area in figure 1.16*c*. This is the peritoneal cavity containing only peritoneal fluid. Although the peritoneal cavity is around these organs, they are not within the peritoneal cavity. Second, looking at the right side of figure 1.16*c* again, notice there are organs behind the parietal peritoneum, but inside the abdominopelvic cavity. These organs are also not within the peritoneal cavity and are considered retroperitoneal (e.g., the kidneys).

Chapter 2

2. The question asks us to predict the atomic structure of potassium. By definition, the atomic number (19) is the number of protons. Therefore, there are 19 protons in potassium. Because the number of electrons in an atom is the same as the number of protons, there are 19 electrons. To find the number of neutrons of any element, subtract the atomic number (19) from the mass number (39): $39 - 19 = 20$. Thus, there are 20 neutrons.
4. To answer this question, it may be helpful to write out the formulas of the reactants and the products. Hydrogen gas is represented by H_2, whereas O_2 represents oxygen gas; the product, water, is represented by H_2O. The oxygen atom is more electronegative than hydrogen, and each hydrogen forms a polar covalent bond with the oxygen. Recall that a polar covalent bond occurs when the more electronegative atom can pull the electrons more strongly and the electrons associate with the oxygen more than they do the hydrogens. In a way, the oxygen has gained some negativity and its charge has been lowered. Thus, we say that the oxygen is reduced. On the other hand, the hydrogen atoms have partially lost their units of negativity, their electrons, and are more positive than they were before. In this case, we say the hydrogens are oxidized. The term *oxidized* is used because oxygen is an effective electron acceptor. A useful mnemonic device to remember these terms is OIL RIG (oxidation is loss [of electrons]; reduction is gain [of electrons]).
6. Recall that the definition of an acid is a proton donor. Thus, by losing an H^+, dihydrogen phosphate ion ($H_2PO_4^-$) is functioning as the conjugate acid. When the H^+ is lost, monohydrogen phosphate ion (HPO_4^-) is formed and is the conjugate base. The definition of a base is a proton acceptor. Thus, if H^+ is added to the solution, it combines with HPO_4^- and forms $H_2PO_4^-$.

Online Appendix F

ANSWERS TO EVEN-NUMBERED CONCEPT CHECK QUESTIONS

Chapter 1

2. b; 4. c; 6. a; 8. c; 10. c
12. Answer *e* is correct. Positive-feedback mechanisms continuously stimulate a response until the initial stimulus is removed. They are sometimes harmful. The continually decreasing blood pressure is an example of a harmful positive-feedback mechanism. Negative-feedback mechanisms result in a return to homeostasis. The elevated heart rate is a negative-feedback mechanism that attempts to return blood pressure to a normal value. In this case, the negative-feedback mechanism is inadequate to restore homeostasis, and medical intervention (a transfusion) is necessary.
14. a; 16. b; 18. a; 20. b; 22. e
24. After the pole passes through the abdominal wall, it pierces the parietal peritoneum. In passing through the stomach, it penetrates the visceral peritoneum, the stomach itself, and the visceral peritoneum on the other side of the stomach. Because the diaphragm is lined inferiorly by parietal peritoneum and superiorly by parietal pleura, these are the next two membranes pierced. The pole then passes through the pleural space and visceral pleura to enter the lung.

Chapter 2

2. b; 4. b; 6. d; 8. e
10. The formation of free fatty acids and glycerol from a triglyceride is a decomposition reaction because a larger molecule breaks down into smaller molecules. All of the decomposition reactions in the body are collectively referred to as catabolism. This reaction can also be classified as a hydrolysis reaction because, as part of the reaction, a water molecule is split into hydrogen, which becomes part of the glycerol molecule, and hydroxide, which becomes part of a fatty acid molecule. Yes, the reverse anabolic reaction generates water.
12. c
14. The slight amount of heat functions as activation energy and starts a chemical reaction. The reaction releases a large amount of heat, causing the solution to become hot.
16. b
18. As A and B are added to the solution, the enzyme E catalyzes the formation of C. However, when C binds to the active site of E, the ability of E to catalyze the formation of C is blocked. As more and more C is produced, the rate of formation of C is slowed. Because the reaction of C with E is reversible, there will always be some E that has a functional (not blocked) active site, and some A will therefore always combine with B.
20. c; 22. c; 24. e
26. Rapid respiration before diving into the water causes blood levels of carbon dioxide to decrease. As a result, there is a slight increase in blood pH. Recall that carbon dioxide molecules react with water to produce carbonic acid, and some of the carbonic acid molecules dissociate to form hydrogen ions and bicarbonate ions. These reactions are reversible. As Ned hyperventilates, the blood carbon dioxide levels decrease, which causes some hydrogen ions to react with bicarbonate ions to produce carbonic acid. The carbonic acid then dissociates to form water and carbon dioxide, so there is a net loss of protons. While holding his breath under water, carbon dioxide levels increase in Ned's blood. The carbon dioxide molecules react with water to form carbonic acid, which then dissociates to form hydrogen ions and bicarbonate ions. As a result, there is a slight decrease in blood pH. However, the pH of the blood does not change dramatically, in part because of buffers in the blood.
28. d; 30. c
32. Heating the substances might help because proteins can be denatured and can coagulate (as in frying an egg). Another possibility is to try dissolving the substances in water. Most lipids are insoluble in water, whereas many proteins either are soluble in water or form colloids with water.
34. e

Chapter 3

2. e; 4. c; 6. c; 8. a
10. Water moves by osmosis from solution B into solution A. Because solution A is hyperosmotic to solution B, solution A has more solutes and less water than does solution B. Water therefore moves from solution B (with more water) to solution A (with less water).
12. e
14. d
16. Answer *b* is correct. At point A on the graph, the extracellular concentration is equal to the intracellular concentration. If movement were by simple diffusion or by facilitated diffusion, at this point the rate of movement would be zero. Because it is not zero, it is reasonable to conclude that the mechanism involved is active transport.
18. c; 20. c; 22. e; 24. c
26. Because the drug inhibits mRNA synthesis, protein synthesis is stopped. If the cell releases proteins as they are synthesized, the rate of protein secretion dramatically decreases following the administration of the drug. On the other hand, if the cell releases stored proteins, the rate of secretion at first is normal and then gradually declines.
28. c

Chapter 4

2. e; 4. b; 6. c; 8. b
10. In general, epithelial cells undergo cell division (mitosis) in response to injury, and the newly produced cells replace the damaged cells. However, if the basement membrane is destroyed, nothing is present to provide scaffolding for the newly formed epithelial cells. Without the basement membrane, there is no effective way for the newly formed epithelial cells to repair a structure, such as a kidney tubule. Because the basement membranes appear mostly intact, the person is likely to survive, and the kidney will regain most of its ability to function.
12. a; 14. e; 16. d; 18. a; 20. b; 22. d;
24. e; 26. c; 28. b
30. Histamine is one of the mediators of inflammation released in response to tissue damage. However, several other chemical mediators are also released. Antihistamines might reduce the inflammatory response somewhat, but they are not likely to have a major effect because of the other chemical mediators released at the same time. In certain types of inflammatory responses, such as allergic responses, histamines are released in large amounts. Under these conditions, antihistamines do reduce the inflammatory response.
32. d

Interactive Case Studies and the Human Body (1-10)

The Female Body

Case Study 1

Hematology

AIDS

Answers:

1. This individual has Acquired Immunodeficiency Syndrome (AIDS) caused by the Human Immunodeficiency Virus (HIV).
2. The hematocrit abnormality is caused by the dehydration.
3. Some current treatments include: AZT (Zidovudine) and ddI (Didanosine), both antiretroviral agents which slow the replication of the virus, prevent occurrence or recurrence of opportunistic infections, and boost the immune system.
4. The individual is experiencing hypokalemia prior to treatment.
5. This abnormal potassium level could cause cardiac arrhythmias due to the hyperpolarization of the resting membrane potential.

Interactive Case Studies and the Human Body (11-20)

The Male Body

Case Study 11

Hematology

Polycythemia

Answers:

1. The disorder of this individual is polycythemia.
2. The arterial O_2 saturation and erythropoietin levels are important in confirming that the increased hematocrit is not due to hypoxemia or an abnormally elevated erythropoietin level. The O_2 saturation level would indicate if there is a physiologic stimulus for the increased erythrocyte production.
3. Phlebotomy is the letting of blood for transfusion pheresis, diagnostic testing, or experimental procedures.
4. Phlebotomy (removal of the whole blood) removes both blood cells and plasma. The plasma volume is replaced within days, whereas the erythrocytes take several weeks to be replaced.
5. Myelosuppressive therapy is therapy for the suppression of the bone marrow's production of blood cells and platelets.
6. Myelosuppressive therapy may be needed to suppress the erythrocyte production in the myeloid tissue if the hematocrit continues to rise after the phlebotomies.

Saladin/Nolan
Clinical Applications Manual

ANSWERS TO CASE STUDY QUESTIONS

Chapter 1

1. Legionnaires disease and Pontiac fever were initially considered idiopathic in that no cause was initially found. Of course, after the condition was attributed to the Legionella bacteria, it was no longer idiopathic.
2. The infectious disease physician is the best doctor to treat this disease. Infectious disease medicine is a subspecialty of internal medicine.
3. This disease is caused (etiology) by an infection of the Legionella bacteria.
4. Pontiac fever is an acute disease; it lasts less than 3 months. Legionnaires disease can be considered chronic in that survivors of the disease can have sequela for months to years.
5. The disease is more common in the middle to late age groups. Chronic smokers, patients with respiratory conditions, and immunocompromised patients have a higher incidence of infection.
6. When the patient presents to the clinician with signs and symptoms of the disease, a history and physical exam is performed. The results of the history and physical exam lead the clinician to a tentative diagnosis, based upon his/her clinical knowledge. In order to confirm the diagnosis, lab tests are performed. It is at this point throat swabs and samples of respiratory secretions are obtained. These samples are tested using microbiological procedures. If these findings are positive for the Legionella bacteria, this states that the patient has been exposed and infected. To further diagnose the actual disease, histopathological studies are performed to look for diagnostic changes in the patient's lung tissue.
7. Some signs of this disease are cough, fever, diarrhea, vomiting, and loss of coordination. Some symptoms are muscle aches, headaches, tiredness, and loss of appetite.
8. It appears that there is no person-to-person transfer of the bacteria.
9. In a small population of individuals, the incidence (new cases) was high. However, keep in mind this was a limited, small population of individuals; it was mainly among those that attended the convention. If we study it in terms of the larger U.S. population and/or global population, it would be quite small.
10. For this answer, look at morbidity rates of infectious diseases such as SARS, COVID-19, AIDS and compare their numbers. For this condition, assume that the morbidity rate is 182 individuals out of 2,000 individuals that attended the convention. Assume the mortality rate is 29 individuals out of 182 that got ill from the condition.

Chapter 1: The Human Organism

Student Learning Outcomes

After reading this chapter, students should be able to:

1.1A Define *anatomy.*
1.1B Describe the levels at which anatomy can be studied.
1.1C Define *physiology.*
1.1D Describe the levels at which physiology can be studied.
1.1E Explain the importance of the relationship between structure and function.
1.2A Explain why it is important to study other organisms along with humans.
1.3A Name the six levels of organization of the body.
1.3B Describe the major characteristics of the six levels of organization.
1.3C List the 11 organ systems and identify their components.
1.3D Describe the major functions of each system.
1.4A List and define the six characteristics of life.
1.5A Define *homeostasis.*
1.5B Explain why homeostasis is important for proper body function.
1.5C Describe a negative-feedback mechanism and give an example.
1.5D Describe a positive-feedback mechanism and give an example.
1.6A Describe a person in the anatomical position.
1.6B Define the directional terms for the human body and use them to locate specific body structures.
1.6C Know the terms for the parts and regions of the body.
1.6D Name and describe the three major planes of the body.
1.6E Name and describe the three major ways to cut an organ.
1.6F Describe the major trunk cavities and their divisions.
1.6G Locate organs in their specific cavity, abdominal quadrant, or region.
1.6H Describe the serous membranes, their locations, and their functions.

Chapter Outline

1.1 Anatomy and Physiology

1. Anatomy is the study of the body's structures.
    - Developmental anatomy considers anatomical changes from conception to adulthood. Embryology focuses on the first 8 weeks of development.
    - Cytology examines cells, and histology examines tissues.
    - Gross anatomy studies organs from either a systemic or a regional perspective.
2. Surface anatomy uses superficial structures to locate deeper structures, and anatomical imaging is a noninvasive technique for identifying deep structures.
3. Physiology is the study of the body's functions. It can be approached from a cellular or a systems point of view.

4. Pathology deals with all aspects of disease. Exercise physiology examines changes caused by exercise.

1.2 Biomedical Research

Much of our knowledge about humans is derived from research on other organisms.

1.3 Structural and Functional Organization of the Human Body

1. Basic chemical characteristics are responsible for the structure and functions of life.
2. Cells are the basic structural and functional units of all living organisms. Organelles are small structures within cells that perform specific functions.
3. Tissues are composed of groups of cells of similar structure and function and the materials surrounding them. The four primary tissue types are epithelial, connective, muscle, and nervous tissues.
4. Organs are structures composed of two or more tissues that perform specific functions.
5. Organs are arranged into the 11 organ systems of the human body (see Figure 1.3).
6. Organ systems interact to form a whole, functioning organism.

1.4 Characteristics of Life

Humans share many characteristics with other organisms, such as organization, metabolism, responsiveness, growth, development, and reproduction.

1.5 Homeostasis

Homeostasis is the condition in which body functions, body fluids, and other factors of the internal environment are maintained at levels suitable to support life.

Feedback Loops

1. Feedback loops allow for processes to be regulated by the end result.

Negative Feedback

1. Negative-feedback mechanisms maintain homeostasis.
2. Many negative-feedback mechanisms consist of a receptor, a control center, and an effector.

Positive Feedback

1. Positive-feedback mechanisms usually increase deviations from normal.
2. Although a few positive-feedback mechanisms normally exist in the body, some positive-feedback mechanisms are harmful.
3. Normal positive-feedback mechanisms include blood clotting and childbirth labor. Harmful positive-feedback examples include decreased blood flow to the heart.

1.6 Terminology and the Body Plan

Body Positions

1. A human standing erect with the face directed forward, the arms hanging to the sides, and the palms facing forward is in the anatomical position.
2. A person lying face upward is supine; a person lying face downward is prone.

Directional Terms

Directional terms always refer to the anatomical position, no matter what the actual position of the body (see Table 1.2).

Body Parts and Regions

1. The body can be divided into a central region, consisting of the head, neck, and trunk, and the upper limbs and lower limbs.

2. Superficially, the abdomen can be divided into quadrants or into nine regions. These divisions are useful for locating internal organs or describing the location of a pain or a tumor.

Planes

1. Planes of the Body
   - A sagittal plane divides the body into right and left parts. A median plane divides the body into equal right and left halves.
   - A transverse (horizontal) plane divides the body into superior and inferior portions.
   - A frontal (coronal) plane divides the body into anterior and posterior parts.
2. Sections of an Organ
   - A longitudinal section of an organ divides it along the length of the organ.
   - A transverse (cross) section cuts at a right angle to the length of the organ.
   - An oblique section cuts across the length of the organ at an angle other than a right angle.

Body Cavities

The body contains two types of internal cavities: the dorsal and ventral body cavities.

1. The dorsal body cavity contains the cranial cavity and the vertebral canal.
2. The ventral body cavity houses the thoracic cavity and the abdominopelvic cavity. The mediastinum subdivides the thoracic cavity.
3. The diaphragm separates the thoracic and abdominal cavities.
4. Pelvic bones surround the pelvic cavity.
5. Serous membranes line the trunk cavities. The parietal portion of a serous membrane lines the wall of the cavity, and the visceral portion is in contact with the internal organs.
   - The serous membranes secrete fluid, which fills the space between the visceral and parietal membranes. The serous membranes protect organs from friction.
   - The pericardial cavity surrounds the heart, the pleural cavities surround the lungs, and the peritoneal cavity surrounds certain abdominal and pelvic organs.
6. Mesenteries are parts of the visceral peritoneum that hold the abdominal organs in place and provide a passageway for blood vessels and nerves to the organs.
7. Retroperitoneal organs are located “behind” the parietal peritoneum.

Topics Related to the Study of Anatomy and Physiology

The use of animals in research is relevant, and the students may have strong opinions about the ethical issues involved. Discuss pros and cons (including financial considerations) for alternatives to animal experimentation, such as tissue culture and computer simulation.

Anatomical anomalies can be used for discussion concerning the concept of normal. Anatomy and physiology are replete with references to normal and abnormal structures and values. Students will benefit from the clarification of the meaning of the word “normal” as it will be used within the context of the course.

Newspaper, magazine, or internet sources related to the new imaging technologies can help students appreciate the amount of knowledge of anatomy and physiology a diagnostician must possess in order to interpret those potentially meaningless images. Use Table 1.1, Anatomical Imaging, as the starting point for a homework assignment to find out more information.

There are excellent photographs throughout the text that illustrate technological advances in imaging techniques. The advents of the electron microscope, patch clamping, microelectrodes, and radioimmunoassay have increased our ability to investigate cell structures and cell membrane transport. The newest scanning tunneling electron microscopes have taken resolution down to the level of individual molecules. Class discussion could focus on the intriguing area of cellular research.

Themes in Chapter 1
Structure and Function
Medical Terminology "When in Rome . . ." is a concept that could be applied to knowing and using anatomical and medical terminology. Students must use their language in order to communicate with other scientists and health-care professionals. Students need to learn that there is value in the precision of anatomical terminology. The notion that the body is a collection of interlocking parts is a concept foreign to many students, who view the body as a singular and solid entity. Students may not realize there is a connection between the words that are used in class and their own bodies. Point out the valuable list of prefixes, suffixes, and combining forms on the back cover of the book and the Glossary (Pages G-1 to G-3) that will help them gain a mastery of this "new" language. Also useful is Table 1.2, Directional Terms for Humans.
Homeostasis
Feedback Spend time on the concepts of positive and negative feedback to ensure student understanding. Provide examples in addition to those provided in the text. Ask students to think about and then discuss examples of events that push the body out of homeostasis and how the body returns to homeostasis. Discuss ways the body can be helped to return to homeostasis in emergencies. Be sure students understand how to interpret the Process Figure 1.6 Negative- and Positive-Feedback Mechanisms as well as Homeostasis Figure 1.7 Negative-Feedback Control of Body Temperature because this format is used throughout the book and can be an invaluable tool in understanding complex body processes.
Cell Theory and Biochemistry
Students must assimilate this foundational knowledge before they can grasp more complex physiological processes like cell membrane transport and cell-to-cell communication. Stress the pivotal position of cells and biochemistry in understanding higher levels of organization.
Changes Through Time
Students must grasp the difference between structures/parts and functions/processes. Introduce the element of time and the possibility of change through time (moment to moment, over the life span, and evolutionarily) in both structures and functions.

Learning Outcomes Correlation With Predict Question Types

Question Type	Question #	Bloom's level	Learning Outcome
Learn to Predict		Apply	1.5A, 1.5B
Predict	1	Apply	1.5A, 1.5B
Predict	2	Understand	1.5A
Predict	3	Apply	1.5A, 1.5B
Predict	4	Understand	1.5B
Predict	5	Understand	1.5B, 1.5C
Predict	6	Understand	1.6A, 1.6B
Predict	7	Understand	1.6B
Predict	8	Understand	1.6F–1.6H