

McKinley/O'Loughlin/Bidle
Anatomy and Physiology: An Integrative Approach, 3/e
Instructor Answer Key to In-chapter and End-of-chapter Questions

Chapter 1
Answers to “What Did You Learn?”

1. A health care worker's knowledge of surface anatomy will allow the person to determine if the patient has a pulse (by knowing the locations of various pulse points) and be able to palpate the appropriate part of the chest to start CPR.
2. Anatomy is the study of structure and form. Physiology is the study of how the structures function.
3. Cardiovascular.
4. Anatomists focus on the form and structure of the small intestine. They examine the cells and tissues that form the small intestine, and describe the layers of the small intestinal wall. Physiologists focus on the function of the small intestine. They examine how the muscle of the smooth intestine propels food through the digestive tract and describe the process by which nutrients are broken down and absorbed. Both anatomists and physiologists know that form and function of the small intestine are interrelated.
5. When you study with a partner, you each can help the other identify gaps in your knowledge, keep study sessions focused and on track, and serve as a sounding board when explaining a concept.
6. 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.
7. 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 in turn are a function of the organization of their subunits. Therefore, each level of organization is dependent on the organization of all of the levels below.
8. The urinary system is responsible for filtering and removing waste products from the blood.
9. A transverse plane, also called a horizontal or cross-sectional plane, would divide the mouth into superior and inferior sections.
10. Proximal.
11. The term *antebrachial* refers to the forearm, the portion of the upper limb between the elbow and wrist.
12. The lungs are located within the thoracic cavity. The serous membranes surrounding them consist of the parietal pleura, lining the inside of the body wall, and the visceral pleura, lining the individual lungs.
13. Epigastric
14. 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.
15. 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.

16. 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.

17. 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 the parietal pleura, lining the internal walls of the thoracic cavity, and the *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. The anatomic position is the point of common reference used by anatomists and physiologists for accuracy and clarity. It provides an initial point of reference, from which all anatomic parts are described.

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 sweat 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.

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 O₂ saturation and erythropoietin levels are important in confirming that the increased hematocrit is not due to hypoxemia or an abnormally elevated erythropoietin level. The O₂ 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.
-

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.

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LearnSmart Labs: Blood

General Lab Outline

Total Time: 2 hr, 15 min

- I. Core Concepts: Blood (15 min)**
- II. Blood Smear and Differential White Cell Count (40 min)**
- III. Hematocrit (20 min)**
- IV. Hemoglobin Content (20 min)**
- V. Blood Typing Test (20 min)**
- VI. Final Summary Questions (10 min)**
- VII. Reports**

Assessed Learning Outcomes

- 1. Core Concepts: Blood
 - a. Recall that blood is composed of plasma and the formed elements
 - b. Structure and function of the formed elements
 - i. Recall the structure and function of red blood cells
 - ii. Recall the structure and function of white blood cells
 - iii. Recall the structure and function of platelets
 - iv. Compare the structure and function of the formed elements
 - c. Understand the basis of blood typing
 - i. Recall the red blood cells are covered in antigens, and plasma contain antibodies for foreign antigens
 - ii. Match blood types and antibodies
 - iii. Explain when transfusion reactions occur
 - d. Recall how to safely handle human blood
- 2. **Blood Smear and Differential White Cell Count**
 - a. Pre-lab Briefing
 - i. Recall the steps to perform a blood smear
 - ii. Recall how to perform a differential white blood cell count
 - b. Identify different white blood cells
 - i. Identify platelets in a blood smear slide
 - ii. Identify erythrocytes in a blood smear slide
 - iii. Identify neutrophils in a blood smear slide
 - iv. Identify lymphocytes in a blood smear slide
 - v. Identify monocytes in a blood smear slide
 - vi. Identify eosinophils in a blood smear slide
 - vii. Identify basophils in a blood smear slide

- c. Stimulation of Blood Smear and Differential White Cell Count
 - i. Prepare a blood smear
 1. Add a drop of blood
 2. Smear the blood drop
 3. Let blood smear dry in the air
 - ii. Stain the blood smear
 1. Add Wright's stain to blood smear
 2. Let Wright's stain react for a suitable time
 3. Add distilled water to the slide with stain
 4. Let the stain and water mixture react for a suitable time
 5. Rinse the stained blood smear
 6. Let the slide air dry
 - iii. Perform the correct procedure without guidance
 - iv. Dispose of materials contaminated with blood in biohazard container
 - v. Perform a different count on prepared microscope slide
 - vi. Differential cell count
 1. Count the correct number of neutrophils
 2. Count the correct number of lymphocytes
 3. Count the correct number of monocytes
 4. Count the correct number of eosinophils
 5. Count the correct number of basophils
 - vii. Infer the patient's health problem from the results of the differential white cell count
 - d. Post-lab probing
 - i. Explain the outcome if the stain acts for the wrong time
 - ii. Identify the normal values of a differential's white blood cell count
 - iii. Know the relationship between an abnormal differential white cell count and likely diseases
3. Hematocrit
- a. Pre-lab Briefing
 - i. Recall how to prepare a blood sample for a hematocrit test
 - b. Stimulation of Hematocrit Test
 - i. Fill a capillary tube with blood
 - ii. Seal capillary tubes
 - iii. Separate blood and plasma in the centrifuge
 - iv. Measure the hematocrit for one blood sample
 - v. Test all 5 blood samples
 - vi. Balance centrifuge
 - vii. Recall how to place the capillary tubes in centrifuge
 - viii. Infer whether test results indicate doping
 - ix. Use safe blood handling practices
 - x. Avoid cross-contamination samples

- c. Post-lab Probing
 - i. Explain the purpose of a hematocrit test
 - ii. Recall the normal hematocrit levels
- 4. Hemoglobin Content
 - a. Pre-lab Briefing
 - i. Recall how to prepare a blood sample for a hemoglobin test
 - b. Simulation of Hemoglobin Test
 - i. Test the three blood samples and positive and negative controls
 - ii. Stir until all hemoglobin is out of the red blood cells
 - iii. Measure the hemoglobin content
 - iv. Use safe blood handling practices
 - v. Avoid cross-contaminating samples
 - vi. Recall why hemolysis applicators are used
 - vii. Infer whether test results indicate doping
 - c. Post-lab Probing
 - i. Explain the purpose of hemoglobin test
 - ii. Recall the normal hemoglobin content
- 5. Blood Typing Test
 - a. Pre-lab Briefing
 - i. Recall how to determine the blood type
 - ii. Recall which transfusions lead to transfusion reactions
 - b. Simulation of Blood Typing Test
 - i. Test all blood samples
 - ii. Label the test slides
 - iii. Recall how the slides should be labeled
 - iv. Add blood from only one patient to each slide
 - v. Add the test serum to the labeled spot on the slide
 - vi. Determine the blood type
 - vii. Use safe blood handling practices
 - viii. Avoid cross-contaminating blood samples
 - ix. Recall why toothpicks are used in this experiment
 - x. Use your results to determine who can donate blood to whom
 - c. Post-lab Probing
 - i. Realize the need for type O packed cell transfusion when donor and recipient do not exactly match
- 6. Final Summary Questions
 - a. Differentiate between the purpose of the various blood tests

INSTRUCTOR NOTE: Safety requirements for blood handling may vary slightly from those used in this lab. Students may become frustrated if they begin to miss questions. Remind them that when missing a question they should remediate using the provided learning resource, most often a Slide, or the Library for that topic.

Student Instructions for Lab Experiments

Overview for All Experiments:

In the following exercises you will perform tests that allow you to examine the nature of blood and also let you evaluate different samples of blood.

These tests are useful diagnostic tools for physicians because blood composition reflects the status of many body functions and malfunctions.

Before getting started on the actual lab, I would like to go over some core concepts related to blood testing. Then you will proceed with the experiments.

Differential WBC Count:

In this experiment, you will prepare a microscope slide with a blood smear and perform a differential white blood cell count.

Before you start, I want to make sure that you have the necessary knowledge to execute the experiments.

Let's make sure you know how to prepare a blood smear microscope slide and how to perform a differential white blood cell count.

Important to Know About Blood Samples:

- What is a blood smear and how to make one
- How to stain a blood sample
- How to identify the different white blood cells
- What is a differential white blood cell count

Drag the labels from the right hand side to the correct locations on the slide. Select "Submit" when you are done.

Identify the different cells

Labels

- Monocyte
- Lymphocyte
- Erythrocytes
- Eosinophil
- Basophil
- Neutrophil
- Platelets

Give Feedback

Submit

INSTRUCTOR NOTE: Often the Coach will appear at the top right. Sometimes students think she is in the way of completing the exercise. However, if they are patient, she will disappear when she completes talking. Students can reactivate her and make her repeat instructions by clicking on her refresh icon.

Drag the labels from the right hand side to the correct locations on the slide. Select “Submit” when you are done.

- Microscope slides
- Wright's stain
- Staining rack
- Distilled water
- Pipettes
- Blood sample
- Microscope
- Blood smear
- Hazardous waste
- Filtered water

GIVE FEEDBACK

SUBMIT >

Simulator:

Click the Instructions button and follow the steps to make a blood smear.

Move the slide to the microscope to view it.

First, correctly focus the microscope slide. Move to the x40 objective to complete the count.

Hematocrit:

In this experiment, you will measure the hematocrit of blood samples.

Before we begin, I want to make sure you have the knowledge you need to execute the experiment and interpret your results.

Let's learn more about the hematocrit of a blood sample

Important to Know About Hematocrit Testing:

- What is the hematocrit value
- How is a hematocrit test performed

Drag the labels from the right hand side to the correct locations on the slide. Select “Submit” when you are done.

Identify the equipment in the lab

Micro Hematocrit Centrifuge

POWER
BRAKE
TIMER

A B C Pos Neg

Heparinized Micro-Hematocrit Capillary Tubes

CAUTION: Do not use if blood clots

Labels

- Centrifuge
- Alcohol swabs
- Capillary tubes
- Hematocrit chart
- Sharps container
- Blood samples
- Clay sealant

Give Feedback

Submit

Simulator:

Click the Instructions button and follow the steps to determine the hematocrit.

Compare the hematocrit to blood doping samples.

INSTRUCTOR NOTE: Students will see a number of possible combinations of doping results and hematocrit levels. If they repeat the experiment, they should expect different results. Each student should have different results.

Hemoglobin Content:

In this experiment, you will measure the hemoglobin content of blood samples.

Before we begin, I want to make sure you have the knowledge you need to execute the experiment and interpret your results.

Let's learn more about the hemoglobin content of blood and how to determine it.

Important to Know About Hemoglobin

- Hemoglobin in red blood cells
- How to measure the hemoglobin content of blood

Student labeling activity before entering lab simulation

Identify the equipment in the lab

Labels

- Alcohol wipes
- Hazardous waste
- Blood samples
- Hemolysis applicators
- Blood chamber
- Hemoglobinometer
- Pipettes

Give Feedback

Submit

Simulator:

Click the Instructions button and follow the steps to determine the hemoglobin content.

Compare the hemoglobin content to blood doping samples.

INSTRUCTOR NOTE: The two halves in the hemoglobinometer will not have a line between them when the correct reading is available. Students will see a number of possible combinations of doping results and hemoglobin concentrations. If they repeat the experiment, they should expect different results. Each student should have different results.

Blood Typing:

In this experiment, you will determine the blood type of some blood samples.

Before we begin, I want to make sure you have the knowledge you need to execute the experiment and interpret your results.

Let's learn more about the blood typing test.

Important to Know About Blood Typing

- How to determine the blood type
- Transfusion reactions

Student labeling activity before entering lab simulation

Identify the equipment in the lab

Labels

- Test serums
- Clean microscope slides
- Microscope slide
- Blood samples
- Wax pencil
- Toothpicks
- Pipettes
- Hazardous waste
- Test chart

Submit

Give Feedback

Simulator:

Click the Instructions button and follow the steps to determine the blood types.

Remember to label your slides with the sample and test types.

INSTRUCTOR NOTE: Students will see a number of possible combinations of blood types. If they repeat the experiment, they should expect different results. Each student should have different results.

Final Summary Questions

- a. Differentiate between the purpose of the various blood tests

INSTRUCTOR NOTE: These final summary questions are designed to assess students that have completed all components of the lab. If you only assign some of the exercises and have not instructed students on the other techniques in class, your students may struggle with some of these questions.

Type of Student Report

Students are provided the following types of reports at the conclusion of these lab experiments.

- I. Blood Smear and Differential White Cell Count – *Debriefing*
- II. Hematocrit – *Debriefing*
- III. Hemoglobin Content – *Debriefing*
- IV. Blood Typing Test – *Debriefing*