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Corret Answers are located at the end of each chapter.

TRUE/FALSE - Write 'T' if the statement is true and 'F' if the statement is false.

1) Histology is the study of structures that can be observed without a magnifying lens.
   - ◎ true
   - ◎ false

2) Feeling for swollen lymph nodes is an example of auscultation.
   - ◎ true
   - ◎ false

3) We can see through bones with magnetic resonance imaging (MRI).
   - ◎ true
   - ◎ false

4) Homeostasis and occupying space are both unique characteristics of living things.
   - ◎ true
   - ◎ false

5) Negative feedback is a self-amplifying chain of events that tend to produce rapid change in the body.
   - ◎ true
   - ◎ false

6) Positive feedback helps to restore normal function when one of the body's physiological variables gets out of balance.
   - ◎ true
   - ◎ false

7) Organs are made of tissues.
   - ◎ true
   - ◎ false

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8) A molecule of water is more complex than a mitochondrion (organelle).
   - ◎ true
   - ◎ false

9) In anatomical position, the palms face forward.
   - ◎ true
   - ◎ false

10) The frontal plane passes vertically through the body or an organ and divides it into equal right and left portions.
   - ◎ true
   - ◎ false

11) The cut of a guillotine is an example of a section done in the midsagittal plane.
   - ◎ true
   - ◎ false

12) The appendicular region consists of the head, neck, and trunk.
   - ◎ true
   - ◎ false

13) The appendix is typically found in the right lower quadrant.
   - ◎ true
   - ◎ false

14) The heart occupies a space called the pleural cavity.
   - ◎ true
   - ◎ false

15) The cranial cavity contains the brain.
   - ◎ true
   - ◎ false

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16) The liver is proximal to the diaphragm.
- ◎ true
- ◎ false

MULTIPLE CHOICE - Choose the one alternative that best completes the statement or answers the question.

17) During birth, the head of the baby pushes against the cervix and stimulates release of the hormone oxytocin. Oxytocin travels in the blood and stimulates the uterus to contract. Labor contractions become more and more intense until the baby is expelled. This is an example of _____.
- A) negative feedback
- B) positive feedback
- C) dynamic equilibrium
- D) integration control
- E) set point adjustment

18) A human body specimen used for dissection is called a_____.
- A) cadaver
- B) comparative specimen
- C) corpse
- D) dry specimen
- E) model

19) Feeling structures with your fingertips is called_____, whereas tapping on the body and listening for sounds of abnormalities is called_____.
- A) palpation; auscultation
- B) auscultation; percussion
- C) percussion; auscultation
- D) palpation; percussion
- E) percussion; palpation

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20) Which of these is the best imaging technique for routinely examining the anatomical development of a fetus?
A) Auscultation
B) PET scan
C) MRI
D) Sonography
E) Radiography

21) The fact that most of us have five lumbar vertebrae, but some people have six and some have four is an example of_____ variation among organisms.
A) cellular
B) holistic
C) physiological
D) anatomical
E) reductionist

22) When examining a patient, a nurse notices that their right kidney is not in its usual location. What does this most likely mean?
A) The patient definitely has a kidney disease.
B) The patient may simply have an anatomical variation.
C) The patient is faking an injury.
D) The patient's kidney was stolen by black market organ harvesters.
E) The nurse is not good at palpation.

23) Understanding the respiratory function of mice, helps us understand the respiratory function of humans. This is an example of_____.
A) neurophysiology
B) comparative physiology
C) endocrinology
D) physiopathology
E) histology

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24) Metabolism is the sum of _____.
A) inhalation and exhalation
B) growth and differentiation
C) anabolism and catabolism
D) positive and negative feedback
E) responsiveness and movement

25) The change in size of the bone marrow (where blood cells are produced) as an infant matures is an example of_____, whereas the transformation of blood stem cells into white blood cells is an example of_____.
A) development; differentiation
B) growth; development
C) growth; differentiation
D) differentiation; growth
E) differentiation; development

26) When you exercise you generate excess heat and your body temperature rises. Blood vessels dilate in the skin, warm blood flows closer to the body surface, and you lose heat. This is an example of _____.
A) negative feedback
B) positive feedback
C) dynamic equilibrium
D) integration control
E) set point adjustment

27) Blood glucose concentration rises after a meal and stimulates release of the hormone insulin. Insulin travels in the blood and stimulates body cells to uptake glucose from the bloodstream. This reduces blood glucose concentration. This is an example of _____.
A) negative feedback
B) positive feedback
C) dynamic equilibrium
D) integration control
E) set point adjustment

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28) Negative feedback loops are _____.
A) homeostatic
B) not homeostatic
C) associated with "vicious circles"
D) self-amplifying cycles
E) harmful

29) The ability to maintain internal stability is called _____.
A) homeostasis
B) thermodynamics
C) reproduction
D) development
E) evolution

30) During birth, the head of the baby pushes against the cervix and stimulates release of the hormone oxytocin. Oxytocin travels in the blood and stimulates the uterus to contract. Labor contractions become more and more intense until the baby is expelled. This is an example of _____.
A) negative feedback
B) positive feedback
C) dynamic equilibrium
D) integration control
E) set point adjustment

31) Which of the following is most likely to cause disease?
A) Positive feedback
B) Negative feedback
C) Homeostasis
D) Equilibrium
E) Irritability

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32) On average the resting heart rate of a healthy adult human is between 70 and 80 beats per minute (bpm). A marathon runner may have a resting heart rate of 55 bpm. This is an example of _____.

A) a normal anatomical variation
B) an exercise-induced physiological variation
C) a pathological physiological variation
D) an abnormality
E) a pathological anatomical variation

33) Which of the following is *least* likely to result in physiological variation?

A) Gender
B) Physical activity level
C) Age
D) Diet
E) Time of day

34) Which of the following is considered the simplest living body structure?

A) Organ system
B) Organ
C) Cell
D) Organelle
E) Molecule

35) An_____ is composed of two or more tissues types, whereas_____ are microscopic structures in a cell.

A) organ system; organs
B) organ system; organelles
C) organ; organelles
D) organ; molecules
E) organelle; molecules

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36) Which of the following lists the levels of human structure from the *most complex to the simplest*?

A) Organelle, cell, tissue, organ, organ system
B) Organ system, organ, cell, tissue, organelle
C) Organ system, organelle, tissue, cell, organ
D) Organ system, organ, tissue, cell, organelle
E) Organ, organ system, tissue, cell, organelle

37) Which of the following lists examples of body structures *from the simplest to the most complex*?

A) Mitochondrion, connective tissue, protein, stomach, adipocyte (fat cell)
B) Protein, mitochondrion, adipocyte (fat cell), connective tissue, stomach
C) Mitochondrion, connective tissue, stomach, protein, adipocyte (fat cell)
D) Protein, adipocyte (fat cell), stomach, connective tissue, mitochondrion
E) Protein, stomach, connective tissue, adipocyte (fat cell), mitochondrion

38) A/An_____ is a group of similar cells and their intercellular materials in a discrete region of an organ performing a specific function.

A) macromolecule
B) organ system
C) organelle
D) organism
E) tissue

39) Which one of the following is *not* in the correct anatomical position?

A) Arms at sides
B) Standing erect
C) Face and eyes facing forward
D) Feet flat on the floor
E) Palms facing posteriorly

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40) Which plane passes vertically through the body or an organ and divides it into anterior and posterior portions?
A) Sagittal
B) Frontal
C) Median
D) Transverse
E) Oblique

41) Which of the following body planes does not allow visualization of both kidneys in the same section?
A) Sagittal
B) Coronal
C) Frontal
D) Transverse

42) The image of a typical chest X-ray shows a_____ view of the thoracic region.
A) sagittal
B) frontal
C) transverse
D) oblique
E) lateral

43) The most superior segment of the upper limb is called the _____ region.
A) digital
B) manual
C) carpal
D) antebrachial
E) brachial

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44) The_____ region of the left lower limb is proximal to the_____ region of the same limb.

A) carpal; manual
B) femoral; crural
C) antebrachial; brachial
D) tarsal; crural
E) brachial; femoral

45) The interscapular region is_____ to the scapular region.

A) anterior
B) posterior
C) medial
D) lateral
E) superior

46) The stomach is located mainly in which quadrant of the abdomen?

A) Right upper quadrant (RUQ)
B) Right lower quadrant (RLQ)
C) Left upper quadrant (LUQ)
D) Left lower quadrant (LLQ)
E) Left middle quadrant (LMQ)

47) In the appendicular region, the wrist is called the_____ region, and the ankle is called the_____ region.

A) manual; pedal
B) brachial; crural
C) crural; antebrachial
D) carpal; tarsal
E) metacarpal; metatarsal

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48) The_____ cavity is inferior to the_____ cavity.
A) cranial; thoracic
B) thoracic; abdominopelvic
C) pericardial; pleural
D) thoracic; peritoneal
E) thoracic; cranial

49) The_____ wraps around the stomach, small intestine, and large intestine.
A) pleura
B) pericardium
C) meninges
D) visceral peritoneum
E) parietal peritoneum

50) The vertebral column encloses the _____.
A) thoracic cavity
B) abdominal cavity
C) pelvic cavity
D) vertebral canal
E) cranial cavity

51) The brain and the spinal cord are protected by _____.
A) a parietal layer
B) a visceral layer
C) mucous membranes
D) serous membranes
E) meninges

52) The thoracic cavity and abdominopelvic cavity are lined by _____.
A) an endothelium
B) the mediastinum
C) meninges
D) serous membranes
E) mucous membranes

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53) The thoracic cavity is divided into right, left, and medial portions by a region called the _____.

A) mediastinum
B) diaphragm
C) serous membrane
D) meninges
E) peritoneum

54) The_____ cavity contains the lungs, which are enfolded in the_____.

A) thoracic; pleurae
B) thoracic; pericardium
C) thoracic; peritoneum
D) abdominopelvic; peritoneum
E) abdominopelvic; pleurae

55) The heart is in the_____ cavity and is covered by the_____.

A) thoracic; pleura
B) thoracic; pericardium
C) pericardial; pleura
D) pericardial; peritoneum
E) cranial; meninges

56) The abdominopelvic cavity contains a moist serous membrane called the _____.

A) peritoneum
B) pleura
C) pericardium
D) mediastinum
E) meninges

57) Which of the following is *not* an organ system?

A) Skeletal
B) Endocrine
C) Epidermal
D) Reproductive
E) Lymphatic

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58) Which of the following is *not* an organ?
A) Tooth
B) Skin
C) Nail
D) Liver
E) Digestive system

59) The_____ is an organ directly associated with both the_____ systems.
A) stomach; digestive and reproductive
B) pancreas; digestive and endocrine
C) small intestine; digestive and integumentary
D) testis; male reproductive and urinary
E) ovary; female reproductive and lymphatic

60) Which system provides protection, water retention, thermoregulation, and vitamin D production?
A) Lymphatic system
B) Muscular system
C) Skeletal system
D) Integumentary system
E) Excretory system

61) Which system contains the thymus, spleen, and tonsils?
A) Endocrine system
B) Respiratory system
C) Lymphatic system
D) Circulatory system
E) Muscular system

62) Which two systems control and coordinate the 50 trillion cells that make up a human?
A) Muscular and nervous systems
B) Circulatory and lymphatic systems
C) Endocrine and nervous systems
D) Circulatory and endocrine systems
E) Muscular and skeletal systems

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63) Which system breaks down food and absorbs nutrients?
A) Digestive system
B) Urinary system
C) Reproductive system
D) Circulatory system
E) Lymphatic system

64) Which system regulates blood volume and pressure, stimulates red blood cell formation, and controls fluid, electrolyte, and acid-base balance?
A) Urinary system
B) Reproductive system
C) Digestive system
D) Muscular system
E) Circulatory system

65) While charting their observations, a doctor mistakenly misspells the intended word "ileum" as "ilium", asking a specialist to "examine the ilium further". What is the possible outcome of this mistake?
A) It's just a spelling error and it's obvious what the doctor meant.
B) The next practitioner may mistakenly examine the intestines when they should be examining the hip.
C) The next practitioner may mistakenly examine the hip when they should be examining the intestines.
D) The next practitioner may mistakenly examine the knee when they should be examining the lungs.
E) The practitioner may mistakenly examine the lungs when they should be examining the knee.

66) The prefix *hypo-* means_____, whereas *hyper-* means_____.
A) front; back
B) right; left
C) inside; outside
D) clear; dark
E) below; above

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67) What does the term "hypercalcemia" mean?

A) Elevated calcium levels
B) Lowered calcium levels
C) Elevated sodium levels
D) Elevated potassium levels
E) Lowered sodium levels

68) The plural of axilla (armpit) is_____ whereas the plural of appendix is_____.

A) axillae; appendices
B) axillides; appendages
C) axillies; appendi
D) axilli; appendices

69) The plural of villus (hair) is_____ whereas the plural of diagnosis is_____.

A) villuses; diagnosises
B) villi; diagnoses
C) villus; diagnosis
D) villi; diagnosis
E) villuses; diagnosis

70) The breastbone is_____ to the vertebral column.

A) anterior
B) posterior
C) superior
D) inferior
E) medial

71) The most_____ part of the small intestine is the part closest the stomach.

A) dorsal
B) ventral
C) proximal
D) distal
E) medial

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72) The right shoulder is_____ and_____ to the umbilical region.
A) superior; lateral
B) superior; medial
C) inferior; lateral
D) inferior; medial
E) posterior; lateral

73) The trachea is_____ to the esophagus.
A) superior
B) dorsal
C) anterior
D) posterior
E) inferior

74) In the cat, the head is_____ to the tail, whereas in the human the head is_____ to the gluteal region (buttock).
A) superior; superior
B) anterior; superior
C) posterior; dorsal
D) ventral; distal
E) anterior; posterior

75) The lumbar vertebrae are_____ to the thoracic vertebrae.
A) anterior
B) superior
C) cephalic
D) posterior
E) inferior

76) Which of the following is *least* likely to result in physiological variation?
A) Gender
B) Physical activity level
C) Age
D) Diet
E) Time of day

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77) What is the only plane that allows one to see both kidneys and the umbilicus at the same time?

A) Frontal
B) Midsagittal
C) Transverse
D) Parasagittal
E) Coronal

78) Which of the following lists examples of body structures *from the simplest to the most complex*?

A) Mitochondrion, connective tissue, protein, stomach, adipocyte (fat cell)
B) Protein, mitochondrion, adipocyte (fat cell), connective tissue, stomach
C) Mitochondrion, connective tissue, stomach, protein, adipocyte (fat cell)
D) Protein, adipocyte (fat cell), stomach, connective tissue, mitochondrion
E) Protein, stomach, connective tissue, adipocyte (fat cell), mitochondrion

79) Historically, the most accurate study of the body began with _____.

A) X-rays
B) dissection
C) palpation
D) MRI
E) a stethoscope

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Answer Key

Test name: Chapter 01

1) FALSE
2) FALSE
3) TRUE
4) FALSE
5) FALSE
6) FALSE
7) TRUE
8) FALSE
9) TRUE
10) FALSE
11) FALSE
12) FALSE
13) TRUE
14) FALSE
15) TRUE
16) FALSE
17) B
18) A
19) D
20) D
21) D
22) B
23) B
24) C
25) C
26) A
27) A
28) A
29) A
30) B
31) A
32) B
33) E
34) C
35) C
36) D
37) B

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38) E
39) E
40) B
41) A
42) B
43) E
44) B
45) C
46) C
47) D
48) E
49) D
50) D
51) E
52) D
53) A
54) A
55) B
56) A
57) C
58) E
59) B
60) D
61) C
62) C
63) A
64) A
65) C
66) E
67) A
68) A
69) B
70) A
71) C
72) A
73) C
74) B
75) E
76) E
77) E

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78) B
79) B

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CHAPTER 1: THE STUDY OF ANATOMY AND PHYSIOLOGY

Chapter Overview

Introduction

Chapter 1 explores the disciplines of anatomy and physiology and emphasizes key concepts. Some textbooks assert that anatomy is the study of structure whereas physiology is the study of function, but both disciplines share the central ideas that structure underlies function, and that structure and function are shaped by evolution. While the disciplines are closely intertwined, however, they differ in approach. The word *anatomy* means "cutting apart," and for millenia anatomists relied on dissection of both humans and other animals to understand the structures of the body and their functions. Updated imaging techniques offer alternative means of seeing inside the body without cutting; the chapter explains that dissection is still an important part of training health care professionals but that techniques ranging from radiography to PET scans offer new ways of visualizing the anatomy of living bodies.

Physiology emphasizes processes that take place in living bodies and sophisticated technology is often required to address physiological questions. Physiological research is closely tied to medicine, and is the basis for development of pharmaceuticals, for example.

Key Concepts

Core ideas in anatomy and physiology offer a powerful organizing framework for teaching and learning. The first chapter emphasizes the following key concepts, and offers examples of each. These concepts provide the foundation for all of the chapters that follow.

Structure/Function Relationship

Structure relates to function or "form follows function" is a common theme in anatomy and physiology. From the microscopic to the gross level, structure informs what the body is able to do. The shape of molecules such as proteins, DNA, and phospholipids determine their function as much as the bowl-like structure of the human pelvis underlies our ability to walk upright.

Levels of Human Structure

The chapter highlights the organizational hierarchy of the human body, and explains the levels of human structure from atoms, to molecules, cells, tissues, organs, and organ systems, to the organism itself. This concept of the structural levels helps students to make sense of each body system and provides a framework for understanding that diseases often involve changes at fundamental levels that impact the function of all of higher structural levels. For example, a mutation in DNA can have profound effects on cellular and tissue structure and function, which in turn may affect organ function, resulting in profound life-changing effects on the individual.

Homeostasis

The concept of homeostasis—the ability of the body to maintain internal stability-- is perhaps the most important idea in physiology. The mechanism by which the body regulates such homeostatically controlled variables as blood pressure, temperature, and pH is negative feedback. The chapter uses the example of changes in blood pressure to present a negative feedback loop, a tool that students will revisit in later chapters. The idea of positive feedback is also explained, using childbirth as an example.

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Other Key Concepts

Some other key concepts that students should understand after reading this chapter:

- Essential features of living organisms;
- Evolution and the value of comparative studies in anatomy and physiology; and
- Anatomical and physiological variation and the potential sources of variation among individuals.

After discussing the disciplines of anatomy and physiology and the central concepts that are key to understanding them, Chapter 1 introduces the basic body plan and specific terms that are essential for students to master, beginning with descriptions of the anatomical position and anatomical planes. Descriptions of body regions, including body cavities and membranes, are accompanied by vivid illustrations that will serve as a reference for students as they explore later chapters.

The 11 organ systems and their principal organs and functions are introduced.

- Integumentary system
- Skeletal system
- Muscular system
- Nervous system
- Endocrine system
- Circulatory system
- Lymphoid system
- Respiratory system
- Urinary system
- Digestive system
- Reproductive system

Finally, the chapter ends with a useful discussion of the language of medicine. Anatomical and physiological terms emerged over centuries, and some have obscure origins. The chapter provides tools for grappling with Greek and Latin that will help students feel less overwhelmed. The section demonstrates how students may identify roots, prefixes, suffixes, and singular and plural forms to both understand and effectively utilize anatomical and physiological vocabulary.

Keeping in mind that many students are interested in exploring medical professions, a “Career Spotlight” feature has been included in every chapter. Chapter 1 highlights aspects of what is entailed in pursuing a career as a radiological technologist.

Topics for Further Discussion

1. List some familiar examples of homeostasis in the body: body temperature, osmoregulation, body weight.
2. How can death be determined in humans? What do living things have in common with nonliving things? What makes them different?
3. Brainstorm with students about some of the ways that behavior and environment affect the body and what mechanisms does the body have to maintain stability? Changes in temperature, eating food and changes in blood sugar, and altitude may be suggested by students.
4. Fad diets, common conditions, and other current events are good ways to help students understand homeostasis. How does the Atkins diet affect blood sugar? How does Type II diabetes mellitus affect homeostasis?
5. How does structure dictate function? Show examples, such as the increased surface area of the intestinal mucosa and/or the opponens pollicis muscle and the first carpometacarpal joint.
6. What clinical benefits do we get from advanced imaging techniques such as MRI, X-ray, CT, PET scans and Sonography?
7. Make sure students understand the prefixes, root words, and suffixes associated with medical terminology. Give them terms they’ve never heard and see if they can figure them out by breaking

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them down into individual parts.

Learning Strategies

1. Emphasize the organizational hierarchy of the body (i.e., from subatomic particles to organ systems) as a framework for understanding health and disease. Exploring case studies helps students understand interactions between the hierarchical levels. Genetic disorders such as Cystic Fibrosis, Sickle Cell Disease, and Tay-Sachs drive home the idea that changes at the molecular level may have profound impacts on all other levels. DNA mutations that result in defective proteins may lead to abnormal cellular, tissue, and organ function, with potentially devastating consequences for the individual.
2. Have students work in pairs or small groups to use specific examples from class to explain how structure relates to function. If the class is face to face, students may use a blank piece of paper to both draw pictures and use sentences to complete the assignment. In online courses, discussions may be used to share ideas. Examples may range from molecular level structures such as the DNA double helix that facilitates transcription and replication to the shape of the pelvic girdle and vertebral column that underlie bipedal locomotion.
3. Have students draw negative feedback loops that explain mechanisms to maintain homeostasis. Examples of homeostatically regulated variables include blood pressure (the example given in chapter 1), body temperature, etc. Encourage students to use specific vocabulary (imbalance in homeostasis (stimulus), receptor, integrating center, effector, response).
4. Students may be intimidated by vocabulary such as *sarcoplasmic reticulum* or *hyponatremia*. The first chapter emphasizes strategies that enable them to break the long words into syllables. Each syllable comes from a Latin or Greek root with a specific meaning. Help students practice decoding the roots to make the meanings clear. Refer students to Appendix D in the textbook—Biomedical Word Roots, Prefixes, and Suffixes.
5. Try to implement some reflective writing exercises in your class. In a face-to-face class. Take the last few minutes of class and ask students to write down one concept/topic that challenged them and one thing that they learned. Ask them to comment on how they will apply what they learned in their own life. (If the class is on-line this can be either a discussion question or can be submitted as an assignment on an on-line learning platform such as Canvas or Blackboard).
6. Have students write a multiple choice exam question based on the lesson. Ask them to try to write a question that goes beyond recalling definitions and terms. Tell them you'll choose the two best and put them on the exam.
7. Create an inclusive environment that honors and respects diverse ethnicities, genders, abilities, ages, and academic experiences. Studies have shown that students who feel a sense of belonging and empowerment persist and succeed at higher rates than students who feel isolated and like they do not belong in a science course. Incorporate examples of research and discoveries by scientists from underrepresented groups. Have students display their names and pronouns (if they feel comfortable) by using name tags or having them create and bring a card with their name; try to learn and use their names and have them learn each other's names.

Related Teaching and Learning Resources

Professional Connections

1. Human Anatomy and Physiology Society (HAPS) https://www.hapsweb.org/
   The website has free teaching resources, and more resources for members. The society publishes a journal, the *HAPS Educator* that emphasizes innovative, research-based teaching strategies to reach A & P students.

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The society is a wonderful place to connect with other anatomy and physiology instructors. The HAPS list serve gives you the opportunity to ask your colleagues questions and receive authoritative answers within a few days; receive free copies of the American Association of Anatomists journals; and attend regional and annual general meetings with scientific update seminars and teaching workshops. HAPS educators have developed learning outcomes for anatomy and physiology that are available at the website.

Relevant Articles

Core Concepts

Michael, J., & McFarland, J. (2020). Another look at the core concepts of physiology: revisions and resources. *Advances in Physiology Education*, *44*(4), 752-762.

Michael, J., Modell, H., McFarland, J., & Cliff, W. (2009). The "core principles" of physiology: what should students understand?. *Advances in Physiology Education*, *33*(1), 10-16.

Culturally Responsive Pedagogy

Dewsbury, B. M., Swanson, H. J., Moseman-Valtierra, S., & Caulkins, J. (2022). Inclusive and active pedagogies reduce academic outcome gaps and improve long-term performance. *Plos one*, *17*(6), e0268620.

Massey, M. D. B., Arif, S., Embuldeniya, S., Nanglu, K., & Bielawski, J. (2022). Ten simple rules for succeeding as an underrepresented STEM undergraduate. *PLOS Computational Biology*, *18*(6), e1010101.

McGraw-Hill Connect Resources

APR Animation

Homeostasis: Thermoregulation

APR Module 1. Body Orientation

Gives students practice opportunities with topics such as Directional Terms, Body Regions, and Organ Systems.

Virtual Labs, available as part of Connect from McGraw Hill:

1st Lab – Virtual Labs Tutorial
Applying the Scientific Method – Pillbug Preferences
Evidence of Evolution – Fossils and Comparative Anatomy
Evidence of Evolution – Molecular Evidence

Testing Your Comprehension Questions and Answers

These questions can be found at the end of the Chapter 1 Student Study Guide.

1. *Question:* Identify which anatomical plane—sagittal, frontal, or transverse—is the only one that could *not* show (a) both the cerebrum and tongue, (b) both eyes, (c) both the hypogastric and gluteal regions, (d) both the sternum and vertebral column, and (e) both the heart and uterus.

   Answer: (a) transverse plane; (b) sagittal plane; (c) frontal plane; (d) frontal plane; (e) transverse plane

2. *Question:* Name one structure or anatomical feature that could be found in each of the following locations relative to the ribs: medial, lateral, superior, inferior, deep, superficial, posterior, and anterior. Try not to use the same example twice.

   *Answer:*Medial: sternum, vertebrae; Lateral: shoulder; Superior: clavicle, skull; Inferior: umbilicus, ilia; Deep: lungs, heart; Superficial: skin; Posterior: trapezius muscles; Anterior: pectoralis muscles.

3. *Question:* For each of the following nonbiological processes, state whether you think it is analogous to physiological positive feedback, negative feedback, or neither of these, and justify each answer: (a) a flushed toilet tank refilling to its original resting level; (b) a magnifying glass focusing the sun's rays and catching a piece of paper on fire; (c) a house fire in which heat from the flames ignites adjacent flammable material until, if unchecked, the whole house is consumed; (d) the increasingly loud howl of a loudspeaker as a band is setting up

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the sound stage for a concert and gets a microphone too close to the speaker.
Answer: (a) negative feedback. If the car dips below the set speed, it will accelerate. If the car goes above the set speed it will decelerate; (b) negative feedback. The bobber is set to allow a specific level of water to exist in the tank. If the water level decreases, the spigot engages and refills the tank to the set level; (c) neither. The energy of the light is concentrated on the paper and the stimulus must stay present to create the reaction; (d) positive feedback system. The reaction to the initial stimulus (heat on combustibles) further stimulates more reaction (more combustion); (e) positive feedback system. As the initial sound enters the microphone, the speaker amplifies it. The amplified sound enters the microphone and is re-amplified. The re-amplified sound then enters the microphone and is amplified yet again. This circle will continue until the microphone is moved away from the speaker.

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Apply What You Know Questions

1. *Question:* In a heart attack, the death of cardiac muscle reduces the heart's pumping effectiveness. Thus, blood flow throughout the body slows down. This leads to widespread blood clotting. Blood clots block the flow of blood to the cardiac muscle, so the muscle is less nourished and still more of it dies. Is this positive feedback, negative feedback, or both? Explain.
   Answer: Students might think this is negative because something very bad is happening, but the self-amplifying nature of this situation is, in fact, a positive feedback loop. The initial stimulus, the first set of dying cardiac muscle cells, causes a situation that results in further death of cardiac muscle cells, enhancing the situation the initial stimulus caused. This is an example of a positive feedback loop.

2. *Question:* A student means to write about part of the small intestine called the ileum, but misspells it ilium. In complaining about the points lost, the student says, "I was only one letter off!" The instructor says, "But you changed the entire meaning of the word." With the help of a dictionary, explain the instructor's reasoning.
   Answer: The hip bone is actually three bones that fuse in adulthood. The bones are the pubis, the ischium, and the ilum. Therefore, by misspelling ileum, the distal most region of the small intestine, with the term ilium, the student is actually giving an incorrect answer.

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