

NEW TO THIS EDITION

Global Changes

- Every piece of art updated to make it more vibrant, three-dimensional, and instructional.
- New digital authors created a seamless relationship between textbook and ancillaries/digital products in clever and engaging ways.
- Connect Question Bank has the same new art as the text and many new questions. Each Connect Question Bank chapter also includes an integrated question (a multi-step integration of chapter concepts).
- Career Corners, new to each chapter, introduce students to interesting career options.
- Each chapter ends with a list of online tools that students may use to study and master the concepts presented.

Specific Changes At-a-Glance

Chapter	Topic	Change
1	Scientific method	Chapter 1 introduces and Appendix B expands coverage
1	A&P updates	Rewritten with new examples
1	Body fluid compartments	New figure (1.4)
1	Homeostasis	Figure 1.8 (previously 1.4) simplified
1	Systems	More detailed introduction
1	Positional terms	Figure 1.14 redone with model
1	Body sections	Figure 1.15 sections now match sectional planes
1	Body regions	Use of terms “lateral,” “inguinal,” and “pubic”
1	Anatomical Plates	Redrawn for accuracy
2	Proteins	Levels of protein structure section rewritten
2	Atomic structure	Figures 2.4, 2.5, 2.7, now show corresponding IUPAC color of the element and number of protons, neutrons, and electrons
2	Polar molecules	Description reworded
2	Protein structure	Figure 2.18 better shows relationships among structural levels of a protein
3	Cell structure	Figure 3.2 added depth and vertical perspective; organelles more realistic
3	Mitochondria	New box on mitochondrial inheritance
3	Cilia	New box on cilia subtypes and related ciliopathies
3	Intracellular membranes	Figures 3.4, 3.5, 3.6, 3.10 have enlargement boxes that show phospholipid bilayers in membrane bounded organelles
3	Ion channels	Figure 3.14 now includes an ion channel
3	Phagocytosis	Figure 3.19 now has five steps
3	Cellular differentiation	Figure 3.23 simplified to better illustrate the roles of stem cells and progenitor cells
4	Metabolic reactions	New text art overview of metabolism
4	Metabolic pathways	New figure 4.8 shows a general metabolic pathway as a cycle, to lead into the specific example of citric acid cycle; reordered text to facilitate understanding
4	DNA structure	Figures 4.11 and 4.12 better depict relationship between bases and sugar-phosphate backbone
4	DNA versus RNA	Table 4.2 replaces figure 4.12 comparing DNA and RNA complementary base pairing
4	Complementary base pairing	Art for base pairs moved into figure 4.13, in context of transcription and translation
4	Transcription and translation	Figure 4.13 now shows translation beginning at the start codon
4	Translation	Figure 4.14 now shows translation beginning at the start codon and depicts correspondence between specific amino acids and specific codons
5	Tissue structure	All figures show more 3D idealized structure alongside a micrograph
5	Thin sections	Figure 5.1 is new and presents examples of how different cut sections would appear on a microscope slide

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NEW TO THIS EDITION

Specific Changes At-a-Glance —Continued

Chapter	Topic	Change
5	Connective tissues	Material added regarding blood supply
5	Micrographs	New micrographs for figures 5.2, 5.3, 5.4, 5.11, 5.12, 5.14, 5.19, 5.22, 5.23, 5.24, and 5.25
6	Skin functions	Material added to section on Vitamin D
6	Skin structure	Figure 6.1 adds hair bulge and new micrograph
6	Hair follicles	Material on the hair bulge added to text
6	Fingernails	Figure 6.4 redrawn and a new second view (orientation) added
6	Hair follicle	Figure 6.5 redrawn to include hair bulge, apocrine sweat gland and merocrine sweat gland
6	Sweat glands	Text describes merocrine (eccrine) and apocrine sweat glands
6	Wound healing	Figure 6.8 is new and shows the stages in healing of skin wounds
7	Bone marrow transplants	Rewritten box
7	Bone figures	Figures of the skeleton and of individual bones redrawn throughout
7	Skeletal structures	Table 7.2 “sulcus” added
7	Levers and movement	Figure 7.7 redrawn
7	Skull	Figures 7.10–7.16 have new coloring to clearly identify individual skull bones
7	Cleft palate	Rewritten box
7	Vertebrae	Wording added to section on the atlas
7	Vertebrae	Figures 7.18 and 7.19 redrawn
7	Atlas and axis	Figure 7.19 orientation arrows added
7	Scapula	Figure 7.22 redrawn to better correspond to location icon
7	Skeleton	Figures 7.23, 7.24, 7.25, 7.26, and 7.27, location icons added
7	Male and female skeletons	Table 7.3 rewritten
7	Hip bone	Figure 7.28 redrawn
7	Synovial joint	Figure 7.36 redrawn
7	Synovial joints	Rewritten text on joint capsule
7	Movements	Paragraphs added to clarify movement terms in context of anatomical position. Lateral flexion added
7	Movements	Figure 7.38 lateral flexion added
8	Muscle structure	Figure 8.1 redrawn to better show the relationship among epimysium, perimysium, and endomysium
8	Muscle fiber structure	Figure 8.4 redrawn to better show transverse tubules and to better illustrate relationship between thick and thin filaments
8	Neuromuscular junction	Section reorganized
8	Role of actin and myosin	Myosin heads distinguished from cross-bridges formed with actin
9	Contraction cycle	Figure redrawn to better separate continued contraction from relaxation
8	Mechanism of contraction	Figure redrawn to show pulling from both ends of sarcomere. Enlargement boxes added
8	Creatine phosphate	Figure 8.9 redrawn
8	Oxygen supply	Role of myoglobin rewritten
8	Oxygen debt and muscle fatigue	Formation of lactic acid, fate of lactate, and their roles in muscle fatigue rewritten
8	Motor units	Figure 8.13 redrawn to better isolate motor units
8	Agonists	Description of different muscle roles, such as agonist and antagonist, rewritten. New box on difference between agonist and prime mover
8	Muscle actions	Paragraphs added to clarify movement terms in context of anatomical position; paragraph added on multiple actions of certain muscles
8	Scalene muscles	Figures 8.17 and 8.19 now include scalenes
8	Muscles that move the head	Table 8.6 now includes scalenes and alternate role of muscles that aid in forceful inhalation
8	Muscles that move the arm	Paragraph added to clarify movements of flexion and extension of the shoulder
8	Muscle actions	Anatomical terms from chapter 1 are used throughout
8	Muscle illustrations	Figures redrawn throughout
8	Muscles of the pelvic floor	Text and figure 8.24 now include the central tendon
9	“Nerve impulse” and “Nerve cell”	New box clarifying usage
9	Synapse	New paragraph on the synapse added to introduction

Specific Changes At-a-Glance —Continued

Chapter	Topic	Change
9	Action potential, impulse conduction, and synaptic transmission	Rewritten to clearly distinguish among these terms
9	Classification of neurons	Figure 9.7 now more diagrammatic
9	Facilitation	Explanation rewritten
9	Synapses	Figure 9.8 has a new part to show the schematic style of presenting neurons and synapses used throughout the chapter
9	Action potential	Figure 9.13 and the action potential introduction appear earlier in the chapter
9	Threshold	Figure 9.14 now includes a graph illustrating sub-threshold and threshold depolarization
9	Withdrawal reflex	Portions of this section rewritten
9	Brain	New brain figure
9	Brainstem	Figure 9.33 redrawn and locator icons added for anterior and posterior views
9	Cranial nerves	Figure 9.35 now has a (b) part illustrating the relationship of the nasal cavity, the olfactory nerve, and the olfactory bulb
10	Pain	Section now includes a reference to inhibition of pain pathways
10	Olfactory pathways	Limbic system added to discussion
10	Spiral organ	Figure 10.9 has improved drawings of innervation
10	Equilibrium	Figures 10.12 and 10.13 have improved location icons
10	Eye	Figures 10.14 and 10.17 now have location icons
10	Eye	Figure 10.17 macula lutea added
10	Retina	Figure 10.22 new micrograph
10	Retinal neurons	Figures 10.21, 10.25, and 10.26 present same style for synapses as in chapter 9
11	Target cells	Figure 11.1 redrawn to emphasize that hormones reach all cells, but only target cells respond
11	Pituitary gland	New text on intermediate lobe added to box
11	Pituitary hormones	New discussion of neurons that secrete pituitary hormones
11	Pituitary blood vessels	Redrawn presentation of hypophyseal portal system and associated vessels
11	Adrenal gland	Figure 11.13 redrawn to better show different zones and adrenal medulla
11	Effects of epinephrine and norepinephrine	Table 11.5 rewritten
11	Pancreas	Reworked description of the exocrine pancreas
11	Melatonin	Rewritten box
12	Blood cell counts	New box on variations in counts from different sources
12	Red blood cells	Figure 12.3 now shows cell membrane in section
12	Red blood cell life cycle	Figure 12.6 redrawn and legend brought up into text in numbered steps
12	White blood cell counts	Text and Table 12.1 include new values
12	Blood groups and transfusions	Substantial text rewrite
12	Rh incompatibility	Figure 12.19 redone
13	Overview of circulation	Figure 13.1 is new
13	Blood oxygenation	New terms used are “oxygen-rich” and “oxygen-poor” blood
13	Pericardial membranes	New figure with an enlargement box
13	Heart valves	Figure 13.6 adjusted for better orientation
13	Blood flow through the heart	Figure 13.7 modeled after 13.1 with only certain areas highlighted
13	Coronary vessels	Figure 13.9 redrawn
13	Cardiac cycle	Substantial rewrite
13	Cardiac muscle fibers	Detail added on intercalated discs
13	Electrocardiogram	Substantial rewrite, figure 13.14 has new art
13	Blood pressure	Figure 13.24 shows pulsatile pressure ending at capillaries
13	Arteries	Figures 13.27, 13.28, 13.29, 13.30, and 13.31 were redrawn for accuracy and consistency
13	Veins	Figures 13.32, 13.33, and 13.35 redrawn; figure 13.34, labels added
14	Overview of lymphatic system	Figure 14.1 is new and modeled after 13.1 for consistency
14	Lymphatic structures	Section 14.5, Lymph Nodes, is expanded to include MALT and titled Lymphatic Tissues and Lymphatic Organs

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Specific Changes At-a-Glance —Continued

Chapter	Topic	Change
14	Spleen	Figure 14.6 redrawn to better illustrate sinuses and red pulp
14	Lymphocytes and fetal development	Figure 14.13 redrawn to more accurately represent a fetal bone
14	Body defenses	Figure 14.11 is a new summary table
14	T and B cell activation	Figure 14.14 redrawn to include phagolysosome
14	Primary and secondary responses	Figure 14.17 redrawn with peak levels corresponding to text description
14	Allergic reactions	Section rewritten and expanded, and box on anaphylaxis made part of text
15	Mesentery	Figure 15.3 redrawn to better show mesentery
15	Movements through alimentary canal	Figure 15.4 redrawn to better show mucosa
15	Pancreas	Box on pancreatitis rewritten
15	Appendix	Update regarding role in maintaining gut microbiome
15	Duodenum	Figures 15.15 and 15.19 redrawn to show duodenum in its normal position
15	Liver	Figure 15.17 redrawn and combined with a new micrograph that corresponds better to art
15	Mesentery	Figure 15.21 has a new enlargement box detailing mesentery structure
15	Villus	Figure 15.24 redrawn to be consistent with figure 15.3
15	Nutrition	Figure 15.33 now shows ChooseMyPlate.gov
15	Nutrients	Definition of nutrients added
15	Proteins	Wording added regarding protein digestion, absorption, and utilization
15	Vitamins	Table 15.9 has designations B7 and B9 added to vitamin names already listed
16	Organs of the respiratory system	Figure 16.1 and others redrawn, including lung anatomy
16	Pleural membranes	Figures 16.6, 16.7, and 16.11 redrawn, including color-coded representations
16	Inspiration	Scalenes added to text and figure 16.13
16	Expiration	Figure 16.14 now includes elastic recoil of the lungs
16	Respiratory volumes and capacities	Table 16.2 reworded
16	Control of breathing	Figure 16.18 representation of cranial nerves redrawn
16	Diffusion across the respiratory membrane	Added to explanation of how partial pressures and diffusional gradients are related
16	Gas transport	Added a sentence explaining oxygen-binding capacity of hemoglobin
16	Gas transport	Added a paragraph explaining drop on PO ₂ due to mixing with bronchial venous blood
16	Gas transport	Figures 16.20, 16.21, 16.22, and 16.23 redrawn with similar presentations
17	Location of the kidneys	Figure 17.1 redrawn, vertebrae labeled as markers
17	Kidney structure	Rewritten section on renal cortex and renal medulla
17	Nephrons	Explanation of functional units
17	Blood Supply of a nephron	Clarification regarding pressure in the peritubular capillaries
17	Structure of a nephron	Figure 17.6 has new part showing functional relationships
17	Overview of urinary system	Figure 17.7 is a new flow chart summarizing the urinary system
17	Filtration pressure and filtration rate	Sections rewritten
17	Urine formation	Figures 17.9, 17.13, 17.14, and 17.15 redrawn in same style to highlight relationships among processes in urine formation
17	Renin-angiotensin system	Figure 17.12 redrawn to better show the primary source of angiotensin converting enzyme
18	Body Fluids	Figure 18.1 redrawn with new schematic presentation
18	Transcellular fluid	Reworded description
18	Fluid movements	Figure 18.3 redrawn and legend elements labeled in figure
18	Balance	Significant rewording
18	Hydrogen ion concentration	Reworded to ensure that changes in pH are reinforced in terms of changes in hydrogen ion concentration
18	Respiratory alkalosis	Figure 18.13 redrawn to parallel related figures
18	Metabolic alkalosis	Figure 18.14 redrawn with new material
19	Semen	Expanded description of seminal fluid and prostate secretions
19	Sperm count	Table 19A values updated
19	Hormonal effects in males	Figure 19.6 relabeled to be consistent with figure 19.13 on hormonal effects in the female

Specific Changes At-a-Glance —Continued

Chapter	Topic	Change
19	Female reproductive anatomy	Figure redrawn for accuracy
19	Oogenesis	Text rewritten to describe year-long maturation of a follicle
19	Ovarian cycle	Figure 19.9 redrawn to show stages of oogenesis as a timeline rather than cycle
19	Hormones of the ovarian cycle	Figure 19.14 redrawn to show more accurate hormone levels and only stages of follicle development in ovarian cycle
19	Menopause	Text reordered and rewritten for clarity
19	Contraceptives	Significant rewrite and additions
20	Fertilization	Section 20.2 retitled “Fertilization” and material on pregnancy moved to later section
20	Steps in fertilization	Text rewritten and figure 20.2 redrawn to more accurately show involvement of sperm cell membrane and enzymes
20	Pregnancy	Section 20.3 retitled “Pregnancy and the Prenatal Period” with text material added
20	Cleavage	Figure 20.3 redrawn for accuracy and consistency
20	Embryonic stage	Significantly reworked text with new material
20	Placenta	Figures 20.7, 20.8, 20.9, and 20.10 redrawn for consistency
20	Embryo	Figure 20.11 size expressed in millimeters
20	Prolactin	Material added to text
20	Fetal circulation	Terms “oxygen-poor blood” and “oxygen-rich blood” added to text and art