1	Fundamentals and Cell Physiology	2
	The Body: an Open System with an Internal Environment ··· 2 Control and Regulation ··· 4 The Cell ··· 8 Transport In, Through and Between Cells ··· 16 Passive Transport by Means of Diffusion ··· 20 Osmosis, Filtration and Convection ··· 24 Active Transport ··· 26 Cell Migration ··· 30 Electrical Membrane Potentials and Ion Channels ··· 32 Cilia as Motors, Sensors, and Developmental Aids ··· 36 Role of Ca²- in Cell Regulation ··· 38 Energy Turnover ··· 40 Aging ··· 44	
2	Nerve and Muscle, Physical Work	46
	Neuron Structure and Function ··· 46 Resting Membrane Potential ··· 48 Action Potential ··· 50 Propagation of Action Potentials in Nerve Fiber ··· 52 Artificial Stimulation of Nerve Cells ··· 54 Synaptic Transmission ··· 54 Motor End-plate ··· 60 Motility and Muscle Types ··· 62 Motor Unit of Skeletal Muscle ··· 62 Contractile Apparatus of Striated Muscle ··· 64 Contraction of Striated Muscle ··· 68 Mechanical Features of Skeletal and Cardiac Muscle ··· 70 Smooth Muscle ··· 74 Energy Supply for Muscle Contraction ··· 76 Physical Work ··· 78 Physical Fitness and Training ··· 80	
3	Autonomic Nervous System (ANS)	82
	Organization of the Autonomic Nervous System (ANS) ··· 82 Acetylcholine and Cholinergic Transmission ··· 86	

Catecholamines, Adrenergic Transmission and Adrenoceptors ··· 88

Non-cholinergic, Non-adrenergic Transmitters ... 90



Adrenal Medulla ··· 90

4	Blood	92
	Composition and Function of Blood ··· 92	
	Iron Metabolism and Erythropoiesis ··· 94	
	Flow Properties of Blood ··· 96	
	Plasma, Ion Distribution ··· 96	
	Immune System ··· 98	
	Hypersensitivity Reactions (Allergies) ··· 104	
	Blood Groups ··· 104	
	Hemostasis ··· 106	
	Fibrinolysis and Thromboprotection · · · 110	
5	Respiration	112
•		***
	Lung Function, Respiration · · · 112	
	Mechanics of Breathing · · · 114	
	Purification of Respiratory Air · · · 116	
	Artificial Respiration · · · 116	
	Pneumothorax ··· 116	
	Lung Volumes and their Measurement ··· 118	
	Dead Space, Residual Volume, Airway Resistance ··· 120	
	Pressure-Volume Curve of Lung and Thorax, Respiratory Work · · · 122	
	Surface Tension, Surfactant ··· 124	
	Dynamic Lung Function Tests ··· 124	
	Pulmonary Gas Exchange · · · 126	
	Pulmonary Blood Flow, Ventilation-Perfusion Ratio · · · 128	
	Alveolar-Arterial Oxygen Difference (AaDo <sub>2</sub> ) ··· 130	
	CO <sub>2</sub> Transport in Blood ··· 132	
	CO <sub>2</sub> Binding in Blood, CO <sub>2</sub> in CSF ··· 134	
	CO <sub>2</sub> in Cerebrospinal Fluid ··· 134	
	Binding and Transport of O <sub>2</sub> in Blood ··· 136	
	Internal (Tissue) Respiration, Hypoxia ··· 138	
	Respiratory Control and Stimulation · · · 140	
	Effects of Diving on Respiration · · · 142	
	Effects of High Altitude on Respiration · · · 144	
	Oxygen Toxicity ··· 144	
6	Acid-Base Homeostasis	146
	pH, pH Buffers, Acid-Base Balance ··· 146	
	Bicarbonate/Carbon Dioxide Buffer · · · 148	
	Acidosis and Alkalosis ··· 150	
	Assessment of Acid-Base Status ··· 154	
	ASSESSINENT OF ACID-DASE Status ··· 134	
7	Kidneys, Salt, and Water Balance	156
	Vidnou Structure and Europian 155	
	Kidney Structure and Function ··· 156	
	Renal Circulation · · · 158	
	Glomerular Filtration and Clearance ··· 160	
	Transport Processes at the Nephron · · · 162	

Reabsorption of Organic Substances · · · 164

Excretion of Organic Substances ··· 168 Reabsorption of Na* and Cl* ··· 170 Reabsorption of Water, Formation of Concentrated Urine ··· 172 Body Fluid Homeostasis ··· 176 Salt and Water Regulation ··· 178 Diuresis and Diuretics ··· 182 The Kidney and Acid-Base Balance ··· 184 Reabsorption and Excretion of Phosphate, Ca²* and Mg²* ··· 188 Potassium Balance ··· 192 Tubuloglomerular Feedback, Renin-Angiotensin System ··· 196	
Cardiovascular System	198
Overview ··· 198 Blood Vessels and Blood Flow ··· 200 Cardiac Cycle ··· 202 Cardiac Impulse Generation and Conduction ··· 204 Electrocardiogram (ECG) ··· 208 Excitation in Electrolyte Disturbances ··· 210 Cardiac Arrhythmias ··· 212 Ventricular Pressure-Volume Relationships ··· 214 Cardiac Work and Cardiac Power ··· 214 Regulation of Stroke Volume ··· 216 Venous Return ··· 216 Arterial Blood Pressure ··· 218 Endothelial Exchange Processes ··· 220 Myocardial Oxygen Supply ··· 222 Regulation of the Circulation ··· 224 Circulatory Shock ··· 230 Fetal and Neonatal Circulation ··· 232	
Thermal Balance and Thermoregulation	234
Thermal Balance ··· 234 Thermoregulation ··· 236	
Nutrition and Digestion	238
Nutrition ··· 238 Energy Metabolism and Calorimetry ··· 240 Energy Homeostasis and Body Weight ··· 242 Gastrointestinal (GI) Tract: Overview, Immune Defense, Blood Flow ··· 246 Neural and Hormonal Integration ··· 248 Saliva ··· 250 Deglutition ··· 252 Vomiting ··· 252 Stomach Structure and Motility ··· 254 Gastric Juice ··· 256 Small Intestinal Function ··· 258	

9

10

Pancreas ··· 260 Bile ··· 262

	Excretory Liver Function, Bilirubin ··· 264 Lipid Digestion ··· 266 Lipid Distribution and Storage ··· 268 Digestion and Absorption of Carbohydrates and Protein ··· 272 Vitamin Absorption ··· 274 Water and Mineral Absorption ··· 276 Large Intestine, Defecation, Feces ··· 278	
11	Hormones and Reproduction	280
	Integrative Systems of the Body ··· 280 Hormones ··· 282 Humoral Signals: Control and Effects ··· 286 Intracellular Transmission of Signals from Extracellular Messengers ··· 288 Hypothalamic-Pituitary System ··· 294 Carbohydrate Metabolism and Pancreatic Hormones ··· 296 Thyroid Hormones ··· 300 Calcium, Phosphate, and Magnesium Metabolism ··· 304 Biosynthesis of Steroid Hormones ··· 310 Adrenal Cortex and Glucocorticoids ··· 312 Oogenesis and the Menstrual Cycle ··· 314 Hormonal Control of the Menstrual Cycle ··· 316 Estrogens, Progesterone ··· 318 Hormonal Control of Pregnancy and Birth ··· 320 Prolactin and Oxytocin ··· 322 Androgens and Testicular Function ··· 324 Sexual Response, Intercourse and Fertilization ··· 326	
12	Central Nervous System and Senses	328
	Structure of the Central Nervous System ··· 328 Cerebrospinal Fluid ··· 328 Stimulus Reception and Processing ··· 330 Sensory Functions of the Skin ··· 332 Proprioception, Stretch Reflex ··· 334 Nociception and Pain ··· 336 Polysynaptic Reflexes ··· 338 Synaptic Inhibition ··· 338 Central Conduction of Sensory Input ··· 340 Movement ··· 342 Hypothalamus, Limbic System ··· 348 Cerebral Cortex, Electroencephalogram (EEG) ··· 350 Circadian Rhythms, Sleep-Wake Cycle ··· 352 Consciousness, Sleep ··· 354 Learning, Memory, Language ··· 356 Glia ··· 360 Sense of Taste ··· 360 Sense of Smell ··· 362 Sense of Balance ··· 364 Eye Structure, Tear Fluid, Aqueous Humor ··· 366	

	,
	394
;	
	413
,	
	415
_	