Contents

Introduction to Physiology: The Cell and General Physiology		Membrane Physiology, Nerve, and Muscle		
CHAPTER 1		CHAPTER 4		
Functional Organization of the Human Body and Control of the "Internal		Transport of Substances Through Cell Membranes	47	
Environment"	3	The Cell Membrane Consists of a Lipid		
Cells Are the Living Units of the Body	3	Bilayer With Cell Membrane Transport	9АНД	
Extracellular Fluid—The "Internal		Proteins	47	
Environment"	3	Diffusion	47	
Homeostasis—Maintenance of a Nearly Constant Internal Environment	4	"Active Transport" of Substances Through Membranes	54	
Control Systems of the Body	6	The Rose Francisco and Endough		
Summary—Automaticity of the Body	10	CHAPTER 5		
windples of CPUBROOF PROBLEMENTS		Membrane Potentials and Action	9AHD	
CHAPTER 2		Potentials	61	
The Cell and Its Functions	11	Basic Physics of Membrane Potentials	61	
Organization of the Cell	9A 11	Measuring the Membrane Potential	62	
Physical Structure of the Cell	12	Resting Membrane Potential of Neurons	63	
Comparison of the Animal Cell With	10	Neuron Action Potential	65	
Precellular Forms of Life	18	Propagation of the Action Potential	69	
Functional Systems of the Cell	19 24	Re-establishing Sodium and Potassium Ionic Gradients After Action Potentials Are		
Locomotion of Cells	24	Completed—Importance of Energy		
CHAPTER 3		Metabolism	69	
Genetic Control of Protein Synthesis,		Plateau in Some Action Potentials	70	
Cell Function, and Cell Reproduction	27	Rhythmicity of Some Excitable		
Genes in the Cell Nucleus Control Protein	19172 7 6	Tissues—Repetitive Discharge	70	
Synthesis	27	Special Characteristics of Signal Transmission	74	
The DNA Code in the Cell Nucleus Is Transferred to RNA Code in the Cell		in Nerve Trunks	71 9AHO	
Cytoplasm—The Process of Transcription	30	CHAPTER 6		
Synthesis of Other Substances in the Cell	35	Contraction of Skeletal Muscle	75	
Control of Gene Function and Biochemical		Physiological Anatomy of Skeletal Muscle	75	
Activity in Cells	35	General Mechanism of Muscle Contraction	77	
The DNA–Genetic System Controls	27	Molecular Mechanism of Muscle	Elec	
Cell Reproduction	37	Contraction Infinite Met to stayland late	78	
Cell Differentiation	41 41	Energetics of Muscle Contraction	82	
Apoptosis—Programmed Cell Death	41	Characteristics of Whole Muscle Contraction	83	
Cancer Massive and	41	Contraction	03	

UNIT II

UNIT I

CHAPTER 7		Conditions That Cause Abnormal Voltages of	
Excitation of Skeletal Muscle:		the QRS Complex	147
Neuromuscular Transmission and		Prolonged and Bizarre Patterns of the QRS	HE CALL
Excitation-Contraction Coupling	89	Complex	148
Transmission of Impulses From Nerve		Current of Injury	148
Endings to Skeletal Muscle Fibers:	00	Abnormalities in the T Wave	152
The Neuromuscular Junction	89	CHAPTER 13	
Muscle Action Potential Excitation-Contraction Coupling	93 93	Cardiac Arrhythmias and Their	
excitation-contraction coupling	93	Electrocardiographic Interpretation	155
CHAPTER 8		Abnormal Sinus Rhythms	155
Excitation and Contraction of		Abnormal Rhythms That Result From Block	
Smooth Muscle	97	of Heart Signals Within the Intracardiac	156
Contraction of Smooth Muscle	97	Conduction Pathways Premature Contractions	158
Regulation of Contraction by Calcium Ions	99	Paroxysmal Tachycardia	160
Nervous and Hormonal Control of Smooth	TREE	Ventricular Fibrillation	161
Muscle Contraction	102	Atrial Fibrillation	164
PER A man authorited blanca desired blanca tor A 1379.		Atrial Flutter	165
UNIT III		Cardiac Arrest	165
The Heart			
Cell Memorane Consus of a Lipid	enti	UNIT IV	
CHAPTER 9		The Circulation	
Cardiac Muscle; The Heart as a Pump and		career in physiciony is medial lend in the little and in	
Function of the Heart Valves	109	CHAPTER 14	
Physiology of Cardiac Muscle	109	Overview of the Circulation; Biophysics	
Cardiac Cycle	113	of Pressure, Flow, and Resistance	169
Regulation of Heart Pumping	119	Physical Characteristics of the Circulation	169
CHAPTER 10 Rotton Action		Basic Principles of Circulatory Function	170
	122	Interrelationships of Pressure, Flow,	
Rhythmical Excitation of the Heart	123	and Resistance	171
Specialized Excitatory and Conductive System of the Heart	123	CHAPTER 15	
Control of Excitation and Conduction in	12993	Vascular Distensibility and Functions of	
the Heart	126	the Arterial and Venous Systems	179
ingation of the Action Patential		Vascular Distensibility	179
CHAPTER 11 mulicasto 9 bits mulbo2 printellidate	8-9%	Arterial Pressure Pulsations	180
The Normal Electrocardiogram	131	Veins and Their Functions	184
Characteristics of the Normal	121	CHAPTER 16	
Electrocardiogram	131	CHAPTER 10	
Flow of Current Around the Heart During the Cardiac Cycle	133	The Microcirculation and Lymphatic System: Capillary Fluid Exchange,	
Electrocardiographic Leads	134	Interstitial Fluid, and Lymph Flow	189
Methods for Recording Electrocardiograms	137	Structure of the Microcirculation and	Syr
(X)TUTE 9V (SV)		Capillary System	189
CHAPTER 12		Flow of Blood in the Capillaries—Vasomotion	190
Electrocardiographic Interpretation of		Exchange of Water, Nutrients, and Other	
Cardiac Muscle and Coronary Blood Flow Abnormalities: Vectorial Analysis	139	Substances Between the Blood and Interstitial Fluid	191
Principles of Vectorial Analysis of		Interstitium and Interstitial Fluid	192
	139	Fluid Filtration Across Capillaries Is	The L
Vectorial Analysis of the Normal		Determined by Hydrostatic and Colloid	Cel
Electrocardiogram	141	Osmotic Pressures and the Capillary	Cell D
Mean Electrical Axis of the Ventricular QRS and		Filtration Coefficient (a) Damman 2019—alzot	
Its Significance	144	Lymphatic System	198

CHAPTER 17 225 109 bloom 48 billions 16 3 to not to		CHAPTER 23	
Local and Humoral Control of Tissue		Heart Valves and Heart Sounds; Valvular	
Blood Flow	203	and Congenital Heart Defects	283
Local Control of Blood Flow in Response to		Heart Sounds	283
Tissue Needs	203	Abnormal Circulatory Dynamics in Valvular	
Mechanisms of Blood Flow Control	203	Heart Disease	286
Humoral Control of the Circulation	212	Abnormal Circulatory Dynamics in Congenital Heart Defects	288
Nance of Pressure Natriuresis and J.		Use of Extracorporeal Circulation During	200
CHAPTER 18		Cardiac Surgery	290
Nervous Regulation of the Circulation	200	Hypertrophy of the Heart in Valvular and	
and Rapid Control of Arterial Pressure	215	Congenital Heart Disease	290
Nervous Regulation of the Circulation	215	Their Control	
Special Features of Nervous Control of	224	CHAPTER 24	
Arterial Pressure	224	Circulatory Shock and Its Treatment	293
Red Blood Cell Learning		Physiological Causes of Shock	293
CHAPTER 19		Shock Caused by Hypovolemia—Hemorrhagic	Rena
Role of the Kidneys in Long-Term Control of Arterial Pressure and in Hypertension:		Shock Shall a salatematic to the	294
The Integrated System for Arterial		Neurogenic Shock—Increased Vascular	299
Pressure Regulation	227	Capacity	300
Renal-Body Fluid System for Arterial Pressure		Anaphylactic Shock and Histamine Shock	300
Control	227	Septic Shock	301
The Renin-Angiotensin System: Its Role in		Physiology of Treatment in Shock	302
Arterial Pressure Control	234	Circulatory Arrest	302
Summary of the Integrated, Multifaceted	241	ar Reabsorption Includes Poully and Foodbu	udul
System for Arterial Pressure Regulation	241	UNIT V	DA.
CHAPTER 20		The Body Fluids and Kidneys	
CHAPTER 20		Bloco I and a select the relation	Dog
Cardiac Output, Venous Return,	245	CHAPTER 25	
and Their Regulation	243		
Normal Values for Cardiac Output at Rest and During Activity	245	The Body Fluid Compartments: Extracellular and Intracellular Fluids;	
Control of Cardiac Output by Venous	Azadii.	Edema	305
Return—The Frank-Starling Mechanism		Fluid Intake and Output Are Balanced During	Urine
of the Heart	245		305
Pathologically High or Low Cardiac Outputs		Steady-State Conditions	303
Methods for Measuring Cardiac Output	248	Steady-State Conditions Body Fluid Compartments	7.14
Methods for Medsaring Caratac Output	248 256	Body Fluid Compartments	
Wethous for Weasaring Caratac Gatpar			
CHAPTER 21		Body Fluid Compartments Constituents of Extracellular and Intracellular	306
CHAPTER 21		Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The	306 307
CHAPTER 21 Muscle Blood Flow and Cardiac Output		Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle	306 307
CHAPTER 21		Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body	306 307 308
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease	256	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments	306 307
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation	256	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic	306 307 308
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease Blood Flow Regulation in Skeletal Muscle at	256 259	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic Equilibrium Between Intracellular and	306 307 308 309
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease Blood Flow Regulation in Skeletal Muscle at Rest and During Exercise	256 259 259	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic Equilibrium Between Intracellular and Extracellular Fluid	306 307 308
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease Blood Flow Regulation in Skeletal Muscle at Rest and During Exercise	256 259 259	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic Equilibrium Between Intracellular and Extracellular Fluid Volume and Osmolality of Extracellular and	306 307 308 309
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease Blood Flow Regulation in Skeletal Muscle at Rest and During Exercise Coronary Circulation	256 259 259	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic Equilibrium Between Intracellular and Extracellular Fluid Volume and Osmolality of Extracellular and Intracellular Fluids in Abnormal States	306 307 308 309
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease Blood Flow Regulation in Skeletal Muscle at Rest and During Exercise Coronary Circulation CHAPTER 22	259 259 262	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic Equilibrium Between Intracellular and Extracellular Fluid Volume and Osmolality of Extracellular and	306 307 308 309
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease Blood Flow Regulation in Skeletal Muscle at Rest and During Exercise Coronary Circulation CHAPTER 22 Cardiac Failure	259 259 262 271	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic Equilibrium Between Intracellular and Extracellular Fluid Volume and Osmolality of Extracellular and Intracellular Fluids in Abnormal States Glucose and Other Solutions Administered	306 307 308 309 310 312
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease Blood Flow Regulation in Skeletal Muscle at Rest and During Exercise Coronary Circulation CHAPTER 22 Cardiac Failure Circulatory Dynamics in Cardiac Failure Unilateral Left Heart Failure	259 259 262 271 271 275	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic Equilibrium Between Intracellular and Extracellular Fluid Volume and Osmolality of Extracellular and Intracellular Fluids in Abnormal States Glucose and Other Solutions Administered for Nutritive Purposes Clinical Abnormalities of Fluid Volume Regulation: Hyponatremia and	306 307 308 309 310 312 314
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease Blood Flow Regulation in Skeletal Muscle at Rest and During Exercise Coronary Circulation CHAPTER 22 Cardiac Failure Circulatory Dynamics in Cardiac Failure	259 259 262 271 271 275 275	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic Equilibrium Between Intracellular and Extracellular Fluid Volume and Osmolality of Extracellular and Intracellular Fluids in Abnormal States Glucose and Other Solutions Administered for Nutritive Purposes Clinical Abnormalities of Fluid Volume Regulation: Hyponatremia and Hypernatremia	306 307 308 309 310 312 314
CHAPTER 21 Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease Blood Flow Regulation in Skeletal Muscle at Rest and During Exercise Coronary Circulation CHAPTER 22 Cardiac Failure Circulatory Dynamics in Cardiac Failure Unilateral Left Heart Failure Low-Output Cardiac Failure—Cardiogenic	259 259 262 271 271 275	Body Fluid Compartments Constituents of Extracellular and Intracellular Fluids Measurement of Fluid Volumes in the Different Body Fluid Compartments—The Indicator-Dilution Principle Determination of Volumes of Specific Body Fluid Compartments Regulation of Fluid Exchange and Osmotic Equilibrium Between Intracellular and Extracellular Fluid Volume and Osmolality of Extracellular and Intracellular Fluids in Abnormal States Glucose and Other Solutions Administered for Nutritive Purposes Clinical Abnormalities of Fluid Volume Regulation: Hyponatremia and	306 307 308 309 310 312 314 314

CHAPTER 26		Regulation of Extracellular Fluid Potassium	389
The Urinary System: Functional Anatomy and Urine Formation by the Kidneys	323	Concentration and Potassium Excretion Control of Renal Calcium Excretion and	
Multiple Functions of the Kidneys	323	Extracellular Calcium Ion Concentration	396
Physiological Anatomy of the Kidneys	324	Control of Renal Magnesium Excretion and Extracellular Magnesium Ion Concentration	398
Micturition Urine Formation Results From Glomerular	327	Integration of Renal Mechanisms for Control	200
Filtration, Tubular Reabsorption, and	510,5	of Extracellular Fluid Importance of Pressure Natriuresis and	398
Tubular Secretion	331	Pressure Diuresis in Maintaining Body Sodium and Fluid Balance	399
CHAPTER 27		Distribution of Extracellular Fluid Between	bns
Glomerular Filtration, Renal Blood Flow, and Their Control	335	the Interstitial Spaces and Vascular System	401
Glomerular Filtration—The First Step in Urine	TAHO	Nervous and Hormonal Factors Increase the Effectiveness of Renal-Body Fluid	
Formation	335	Feedback Control	402
Determinants of the GFR	337	Integrated Responses to Changes in Sodium	
Renal Blood Flow	340	Intake *	405
Physiological Control of Glomerular Filtration		Conditions That Cause Large Increases	
and Renal Blood Flow	341	in Blood Volume and Extracellular	I adI
Autoregulation of GFR and Renal Blood Flow	342	Fluid Volume	405
CHAPTER 28		Conditions That Cause Large Increases in	
d Shock 308	247	Extracellular Fluid Volume but With Normal Blood Volume	406
Renal Tubular Reabsorption and Secretion	347	Hormal Blood Volume	A and
Tubular Reabsorption Is Quantitatively Large and Highly Selective	347	CHAPTER 31	
Tubular Reabsorption Includes Passive and	347	Acid-Base Regulation	409
Active Mechanisms	347	H ⁺ Concentration Is Precisely Regulated	409
Reabsorption and Secretion Along Different	0-17	Acids and Bases—Their Definitions and	162
Parts of the Nephron	353	Meanings	409
Regulation of Tubular Reabsorption	359	Defending Against Changes in H ⁺	410
Use of Clearance Methods to Quantify		Concentration: Buffers, Lungs, and Kidneys	410
Kidney Function	365	Buffering of H ⁺ in the Body Fluids Bicarbonate Buffer System	411
CHAPTER 29		Phosphate Buffer System	
		Proteins Are Important Intracellular Buffers	413
Urine Concentration and Dilution; Regulation of Extracellular Fluid		Respiratory Regulation of Acid-Base Balance	414
Osmolarity and Sodium Concentration	371	Renal Control of Acid-Base Balance	415
Kidneys Excrete Excess Water by Forming		Secretion of H ⁺ and Reabsorption of HCO ₃	Meth
Dilute Urine	371	by the Renal Tubules	416
Kidneys Conserve Water by Excreting	Meas	Combination of Excess H ⁺ With Phosphate	
Concentrated Urine	373	and Ammonia Buffers in the Tubule	Musc
Special Characteristics of the Loop of Henle		Generates "New" HCO ₃	418
That Cause Solutes to be Trapped in the Renal Medulla	374	Quantifying Renal Acid-Base Excretion	420
Control of Extracellular Fluid Osmolarity and	11374	Renal Correction of Acidosis—Increased Excretion of H ⁺ and Addition of HCO ₃ ⁻ to	
Sodium Concentration	381	the Extracellular Fluid	421
Osmoreceptor-ADH Feedback System		Renal Correction of Alkalosis—Decreased	
Importance of Thirst in Controlling		Tubular Secretion of H ⁺ and Increased	422
Extracellular Fluid Osmolarity and Sodium Concentration	384	Excretion of HCO ₃ Clinical Causes of Acid-Base Disorders	422
AVE	701		luggi
CHAPTER 30		CHAPTER 32	
Renal Regulation of Potassium, Calcium,		Diuretics, Kidney Diseases	427
Phosphate, and Magnesium; Integration		Didicties did Then medianisms	427
of Renal Mechanisms for Control of Blood		Kidney Diseases (163 mills) right afficiency of a	429
Volume and Extracellular Fluid Volume	389	Acute Kidney Injury	429

xiii

Chronic Kidney Disease Is Often Associated With Irreversible Loss of Functional Nephrons	432	in Humans Thromboembolic Conditions	490 491
Treatment of Renal Failure by	112111111111111111111111111111111111111	Anticoagulants for Clinical Use	492
Transplantation or by Dialysis With		Blood Coagulation Tests	493
an Artificial Kidney	440	Blood Coagulation lests	433
The Eyes L Oddangth of the Eyes Long	ac arrido	UNIT VII	
UNIT VI	635	Respiration	
Blood Cells, Immunity, and Blood Coagulation		en-Therapy seus a last sexplied bio Dans 19	Охуде
The District of the Control of the C	Sensory	CHAPTER 38	
CHAPTER 33		Pulmonary Ventilation	497
Red Blood Cells, Anemia,		Mechanics of Pulmonary Ventilation	497
and Polycythemia	445	Pulmonary Volumes and Capacities	501
Red Blood Cells (Erythrocytes)	445	Alveolar Ventilation	503
Anemias language and an amplitude and a sould be used	452	Functions of the Respiratory Passageways	504
Polycythemia	453	CHAPTER 39	
CHAPTER 34		Pulmonary Circulation, Pulmonary Edema,	
Resistance of the Body to Infection:		Pleural Fluid	509
I. Leukocytes, Granulocytes,		Physiological Anatomy of the Pulmonary Circulatory System	509
the Monocyte-Macrophage System,	CHAPTE	Pressures in the Pulmonary System	509
and Inflammation	455	Blood Volume of the Lungs	510
Leukocytes (White Blood Cells)	455	Blood Flow Through the Lungs and Its	CHAP
Neutrophils and Macrophages Defend Against Infections	457	Distribution assign has Abustil A ApiH ,no	510
Monocyte-Macrophage Cell System		Effect of Hydrostatic Pressure Gradients	
(Reticuloendothelial System)	458	in the Lungs on Regional Pulmonary Blood Flow	511
Inflammation: Role of Neutrophils	100196	Pulmonary Capillary Dynamics	513
and Macrophages	460	Fluid in the Pleural Cavity	515
Eosinophils	462 462	recroft 567	
Basophils	462	CHAPTER 40	
Leukopenia Leukemias	463	Principles of Gas Exchange; Diffusion of	
Designing Address [control seek to note	zimente i	Oxygen and Carbon Dioxide Through	E47
CHAPTER 35		the Respiratory Membrane	517
Resistance of the Body to Infection:		Physics of Gas Diffusion and Gas Partial Pressures	517
II. Immunity and Allergy	465	Compositions of Alveolar Air and	DEEL SEED
Acquired (Adaptive) Immunity	465	Atmospheric Air Are Different	519
Allergy and Hypersensitivity	475	Diffusion of Gases Through the Respiratory	
CHAPTER 36		Membrane	521
Blood Types; Transfusion; Tissue and		CHAPTER 41	
Organ Transplantation	477	Transport of Oxygen and Carbon Dioxide	
Antigenicity Causes Immune Reactions		in Blood and Tissue Fluids	527
of Blood	477	Transport of Oxygen From the Lungs to	
O-A-B Blood Types	477	the Body Tissues	527
Rh Blood Types	479	Transport of Carbon Dioxide in the Blood	534
Transplantation of Tissues and Organs	481	Respiratory Exchange Ratio	536
CHAPTER 37		CHAPTER 42	
Hemostasis and Blood Coagulation	483	Regulation of Respiration	539
Hemostasis Events	483	Respiratory Center	539
Mechanism of Blood Coagulation	485	Chemical Control of Respiration	541

Peripheral Chemoreceptor System for Control		General Design of the Nervous System	577
of Respiratory Activity—Role of Oxygen in Respiratory Control	542	Major Levels of Central Nervous System	2289
Regulation of Respiration During Exercise	545	Function Comparison of the Nervous System to 1999	579
Other Factors That Affect Respiration	546	Comparison of the Nervous System to a Computer	580
Other ractors mat / meet nespiration		Central Nervous System Synapses	580
CHAPTER 43		Some Special Characteristics of Synaptic	
Respiratory Insufficiency—		Transmission	592
Pathophysiology, Diagnosis,		Cells, Intercently, and Property on Sonshippens	
Oxygen Therapy	549	CHAPTER 47	
Useful Methods for Studying Respiratory	MAHO.	Sensory Receptors, Neuronal Circuits for	FOE
Abnormalities	549	Processing Information	595
Pathophysiology of Specific Pulmonary Abnormalities	551	Types of Sensory Receptors and the Stimuli They Detect	595
Hypoxia and Oxygen Therapy	554	Transduction of Sensory Stimuli Into Nerve	9 bas
Hypercapnia—Excess Carbon Dioxide in		lood Cells (Frythrocytes)	596
the Body Fluids	556	Transmission of Signals of Different Intensity	
Artificial Respiration	556	in Nerve Tracts—Spatial and Temporal	COC
		Summation Transmission and Processing of Signals in	600
UNIT VIII		Neuronal Pools	601
Aviation, Space, and Deep-Sea	Physic	Instability and Stability of Neuronal Circuits	605
Diving Physiology	347.	CHAPTER 48	
Voltille Verke Lings 2		Somatic Sensations: I. General	
CHAPTER 44		Organization, the Tactile and	
Aviation, High Altitude, and Space	1210	Position Senses	607
Physiology	561	Classification of Somatic Senses	607
Effects of Low Oxygen Pressure on the Body	561	Detection and Transmission of Tactile Sensations	607
in Aviation and Space Physiology	565	Sensory Pathways for Transmitting	607
"Artificial Climate" in the Sealed	biul3	Somatic Signals Into the Central	
Spacecraft	567	Nervous System	609
Weightlessness in Space	567	Transmission in the Dorsal Column–Medial Lemniscal System	609
CHAPTER 45		Transmission of Less Critical Sensory	eake.
Physiology of Deep-Sea Diving and Other		Signals in the Anterolateral Pathway	616
Hyperbaric Conditions	569	Some Special Aspects of Somatosensory	
Effect of High Partial Pressures of Individual	1979	Function vprellA bns vinun	618
Gases on the Body	569	CHAPTER 49 CHAPTER 49	
Self-Contained Underwater Breathing	1130		
Apparatus (SCUBA) Diving	573	Somatic Sensations: II. Pain, Headache, and Thermal Sensations	621
Special Physiological Problems in Submarines	574	Types of Pain and Their Qualities—Fast Pain	9AH
Hyperbaric Oxygen Therapy	574	and Slow Pain	621
about medas one napyro to mod	Trags	Pain Receptors and Their Stimulation	621
od and Tissue Fluidsched HOA notor will be	olg ni	Dual Pathways for Transmission of Pain	Ahrlige
UNIT IX		Signals Into the Central Nervous System	622
The Nervous System: A. General		Pain Suppression (Analgesia) System in	631
Principles and Sensory Physiology		the Brain and Spinal Cord Referred Pain (1989)	625
THADTES SO.	1000	Visceral Pain	626
CHAPTER 46		Some Clinical Abnormalities of Pain and	944
Organization of the Nervous System,		Other Somatic Sensations	628
Basic Functions of Synapses, and		Headache Seasis Events-	629
Neurotransmitters	577	Thermal Sensations	630

UNIT X	SAHD	Muscle Sensory Receptors—Muscle Spindles	
MANAGEMENT OF THE PARTY AND ADDRESS OF THE PARTY OF THE P	uciona	and Golgi Tendon Organs—and Their	607
The Nervous System:		Roles in Muscle Control	697
B. The Special Senses	-35A	Flexor Reflex and the Withdrawal Reflexes	702
parogen is Stored in the Light and in aroung		Crossed Extensor Reflex	703
CHAPTER 50		Reciprocal Inhibition and Reciprocal	703
The Eye: I. Optics of Vision	635	Innervation	704
Physical Principles of Optics	635	Reflexes of Posture and Locomotion	
Optics of the Eye	638	Scratch Reflex	705
Fluid System of the Eye—Intraocular Fluid	644	Spinal Cord Reflexes That Cause	705
The State of the S		Muscle Spasm	705
CHAPTER 51		Autonomic Reflexes in the Spinal Cord	705
The Eye: II. Receptor and Neural Function	Deact	Spinal Cord Transection and Spinal Shock	703
of the Retina	647	CHAPTER 56	
Anatomy and Function of the Structural	647	Cortical and Brain Stem Control of	
Elements of the Retina	647	Motor Function	707
Photochemistry of Vision	649	Motor Cortex and Corticospinal Tract	707
Color Vision	654	Control of Motor Functions by the	
Neural Function of the Retina	655	Brain Stem	713
CHARTER E2		Vestibular Sensations and Maintenance	
CHAPTER 52		of Equilibrium	714
The Eye: III. Central Neurophysiology	661	Functions of Brain Stem Nuclei in Controlling	
of Vision	661	Subconscious, Stereotyped Movements	719
Visual Pathways	661	tances by the Synoathetic and	
Organization and Function of the	CC2	CHAPTER 57	
Visual Cortex	662	Contributions of the Cerebellum and	
Neuronal Patterns of Stimulation During	664	Basal Ganglia to Overall Motor Control	721
Analysis of the Visual Image	666	The Cerebellum and Its Motor Functions	721
Eye Movements and Their Control	000	The Basal Ganglia and Their Motor Functions	730
Autonomic Control of Accommodation and	669	Integration of the Many Parts of the Total	
Pupillary Aperture	003	Motor Control System	735
CHAPTER 53			
The Sense of Hearing	673	CHAPTER 58	
Tympanic Membrane and the		Cerebral Cortex, Intellectual Functions of	
Ossicular System	673	the Brain, Learning, and Memory	737
Cochlea	674	Physiological Anatomy of the Cerebral Cortex	737
Central Auditory Mechanisms	679	Functions of Specific Cortical Areas	738
Hearing Abnormalities	682	Function of the Brain in	
Treating / Israelinances		Communication—Language Input	
CHAPTER 54		and Language Output	743
The Chemical Senses—Taste and Smell	685	Function of the Corpus Callosum and	
Sense of Taste	685	Anterior Commissure to Transfer	
Sense of Smell	688	Thoughts, Memories, Training, and Other Information Between the Two	
Serise of Sinen		Cerebral Hemispheres	745
Protein Metable 70		Thoughts, Consciousness, and Memory	745
UNIT XI		Thoughts, Consciousness, and Memory	OM
The Nervous System: C. Motor and		CHAPTER 59	
Integrative Neurophysiology		Behavioral and Motivational Mechanisms	
olism of Ca Johydrates and	Metabe	of the Brain—The Limbic System and	
CHAPTER 55		the Hypothalamus	751
CHAPTER 55		Activating—Driving Systems of the Brain	751
Motor Functions of the Spinal Cord;	COF		754
the Cord Reflexes	695	Limbic System The Hypothalamus, a Major Control	CESTLO
Organization of the Spinal Cord for	695	Headquarters for the Limbic System	755

Specific Functions of Other Parts of the	IMIUSCH	CHAPTER 64	
Limbic System The Company of the Com	759	Propulsion and Mixing of Food in the	
CHAPTER 60		Alimentary Tract	807
		Ingestion of Food	807
States of Brain Activity—Sleep, Brain Waves, Epilepsy, Psychoses, and Dementia	762	Motor Functions of the Stomach	809
Sleep	763 763	Movements of the Small Intestine	812
Brain Waves	766	Movements of the Colon	814
Seizures and Epilepsy	768	Other Autonomic Reflexes That Affect	046
Psychotic Behavior—Roles of Specific	anica	Bowel Activity	816
Neurotransmitter Systems	770	CHAPTER 65	
Alzheimer's Disease—Amyloid Plaques and		Secretory Functions of the Alimentary	
Depressed Memory	771	Tract	817
CHAPTER 61		General Principles of Alimentary Tract	017
The Autonomic Nervous System and		Secretion of Solive	817
the Adrenal Medulla	773	Secretion of Saliva	819
General Organization of the Autonomic		Esophageal Secretion Gastric Secretion	821
Nervous System	773	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	821 825
Basic Characteristics of Sympathetic and		Pancreatic Secretion Bile Secretion by the Liver	827
Parasympathetic Function	775	Secretions of the Small Intestine	830
Autonomic Reflexes	782	Secretion of Mucus by the Large Intestine	831
Stimulation of Discrete Organs in Some Instances and Mass Stimulation in Other		CONTENTS OF THE STATE OF THE ST	031
Instances by the Sympathetic and		CHAPTER 66	
Parasympathetic Systems	783	Digestion and Absorption in	
Pharmacology of the Autonomic Nervous	704	the Gastrointestinal Tract	833
System	784	Digestion of the Various Foods by Hydrolysis	833
CHAPTER 62		Basic Principles of Gastrointestinal Absorption	837
Cerebral Blood Flow, Cerebrospinal Fluid,	fritegr	Absorption in the Small Intestine Application of the Small Intertweether application of the Small Intertwe	837
and Brain Metabolism	787	Absorption in the Large Intestine: Formation	-
Cerebral Blood Flow	787	of Feces	841
Cerebrospinal Fluid System	790	CHAPTER 67	
Brain Metabolism	794		lympa
		Physiology of Gastrointestinal Disorders	843
UNIT XII	-	Disorders of Swallowing and the Esophagus	843
MARKET THE RESIDENCE OF THE PROPERTY OF THE PARTY OF THE	Functi	Disorders of the Stomach Disorders of the Small Intestine	843
Gastrointestinal Physiology	an 569		845
		Disorders of the Large Intestine General Disorders of the	846
CHAPTER 63		Gastrointestinal Tract	847
General Principles of Gastrointestinal			Sense
Function—Motility, Nervous Control,		San a Di Vain and their Qualities—Fast Pain	Sense
and Blood Circulation	797	UNIT XIII	
General Principles of Gastrointestinal Motility	797	Metabolism and Temperature Regulation	on
Neural Control of Gastrointestinal		Nervous System: C. Motor and	
Function—Enteric Nervous System	799	CHAPTER 68	
Hormonal Control of Gastrointestinal Motility	802	Metabolism of Carbohydrates and Formation of Adenosine Triphosphate	853
Functional Types of Movements in the	the H	Release of Energy From Foods and	MAHA
Gastrointestinal Tract	803	"Free Energy" Of Ishing and to another 1	853
Gastrointestinal Blood Flow—Splanchnic	Hamil	Adenosine Triphosphate Is the "Energy	
Circulation	804	Currency" of the Body	853

Central Role of Glucose in Carbohydrate		Dietary Balances	887
Metabolism	854	Regulation of Food Intake and Energy Storage	889
Transport of Glucose Through the Cell	Testo	Obesity Signation of to not specified	894
Membrane Function Palament	854	Inanition, Anorexia, and Cachexia	896
Glycogen Is Stored in the Liver and Muscle	855	Ological Functions of the Thyricilla Amountains	897
Release of Energy From Glucose by the Glycolytic Pathway	856	Vitamins	897
Formation of Large Quantities of ATP by Oxidation of Hydrogen—the Process of	19885	Mineral Metabolism	900
Oxidative Phosphorylation	858	CHAPTER 73	
Summary of ATP Formation During the Breakdown of Glucose	859	Energetics and Metabolic Rate Adenosine Triphosphate Functions as an	903
Anaerobic Release of Energy—Anaerobic	amer Develo	"Energy Currency" in Metabolism	903
Glycolysis	860	Control of Energy Release in the Cell	905
Release of Energy From Glucose by the Pentose Phosphate Pathway	861	Metabolic Rate Energy Metabolism—Factors That Influence	906
Formation of Carbohydrates From Proteins and Fats—Gluconeogenesis	861	Energy Output	907
Overlap Cycle; Function of the 1030 and of the		CHAPTER 74	
CHAPTER 69	Euper	Body Temperature Regulation and Fever	911
Lipid Metabolism	863	Normal Body Temperatures	911
Basic Chemical Structure of Triglycerides (Neutral Fat)	863	Body Temperature Is Controlled by Balancing Heat Production and Heat Loss	911
Transport of Lipids in the Body Fluids	863	Regulation of Body Temperature—Role of	
Fat Deposits	865	the Hypothalamus	915
Use of Triglycerides for Energy: Formation of Adenosine Triphosphate	866	Abnormalities of Body Temperature Regulation	919
Regulation of Energy Release From	869	tostatin Inhibits Glucagon and Insulin	
Triglycerides	870		
Phospholipids and Cholesterol Atherosclerosis	872	UNIT XIV	
Atheroscierosis	0/2	Endocrinology and Reproduction	
CHAPTER 70		PER 80	CHAP
Protein Metabolism	875	CHAPTER 75	
Basic Properties of Proteins	875	Introduction to Endocrinology	925
Transport and Storage of Amino Acids	875	Coordination of Body Functions by Chemical	
Functional Roles of the Plasma Proteins	877	Messengers standard bas muchal to wak	925
Hormonal Regulation of Protein Metabolism	880	Chemical Structure and Synthesis of Hormones	925
CHAPTER 71		Hormone Secretion, Transport, and	
The Liver as an Organ	881	Clearance From the Blood	929
Physiological Anatomy of the Liver	881	Mechanisms of Action of Hormones	930
Hepatic Vascular and Lymph Systems	881	Measurement of Hormone Concentrations	16169
Metabolic Functions of the Liver	883	Tin the Blood	936
Protein Metabolism	883		
Measurement of Bilirubin in the Bile as a		CHAPTER 76	
Clinical Diagnostic Tool	884	Pituitary Hormones and Their Control by the Hypothalamus	939
CHAPTER 72		Pituitary Gland and Its Relation to	
Dietary Balances; Regulation of Feeding;		the Hypothalamus	939
Obesity and Starvation; Vitamins and		Hypothalamus Controls Pituitary Secretion	940
Minerals	887	Physiological Functions of Growth Hormone	942
Energy Intake and Output Are Balanced Under Steady-State Conditions	887	Posterior Pituitary Gland and Its Relation to the Hypothalamus	948
hind and the transport and		TCD1	

CHAPTER 77		Spermatogenesis	1021
Thyroid Metabolic Hormones	951	Male Sexual Act	1026
Synthesis and Secretion of the Thyroid		Testosterone and Other Male Sex Hormones	1028
Metabolic Hormones	951	Abnormalities of Male Sexual Function	1033
Physiological Functions of the Thyroid		Erectile Dysfunction in the Male	1034
Hormones	954	The Function of the Pineal Gland in	
Regulation of Thyroid Hormone Secretion	958	Controlling Seasonal Fertility in	SYLE A
Diseases of the Thyroid	960	Some Animals	1034
CHAPTER 78		CHAPTER 82 nonstrioning of system	
THE REPORT OF THE PROPERTY OF THE PARTY OF T	965	Female Physiology Before Pregnancy and	
Adrenocortical Hormones	905	Female Hormones	1037
Corticosteroids: Mineralocorticoids, Glucocorticoids, and Androgens	965	Physiological Anatomy of the Female Sexual Organs	1037
Synthesis and Secretion of Adrenocortical	OCE	Oogenesis and Follicular Development in	
Hormones	965	the Ovaries	1037
Functions of the Mineralocorticoids—	968	Female Hormonal System	1039
Aldosterone Functions of Glucocorticoids	972	Monthly Ovarian Cycle; Function of the	
A C Mail	978	Gonadotropic Hormones	1039
Adrenal Androgens Abnormalities of Adrenocortical Secretion	979	Functions of the Ovarian Hormones— Estradiol and Progesterone	1042
		Regulation of the Female Monthly	
CHAPTER 79		Rhythm—Interplay Between the Ovarian	New 1
Insulin, Glucagon, and Diabetes Mellitus	983	and Hypothalamic-Pituitary Hormones	1047
Physiological Anatomy of the Pancreas	983	Abnormalities of Secretion by the Ovaries	1051
Insulin and Its Metabolic Effects	983	Female Sexual Act	1051
Glucagon and Its Functions	992	Female Fertility	1052
Somatostatin Inhibits Glucagon and Insulin Secretion	993	Hormonal Suppression of Fertility—	1053
Summary of Blood Glucose Regulation	993	Abnormal Conditions That Cause Female	
Diabetes Mellitus	994	Sterility 22201902	1053
crinology and freproductionsly nigra one.		Assorption in the cargo intestine. Formation	
CHAPTER 80		CHAPTER 83	4055
Parathyroid Hormone, Calcitonin, Calcium		Pregnancy and Lactation mailodateM	1055
and Phosphate Metabolism, Vitamin D,		Maturation and Fertilization of the Ovum	1055
Bone, and Teeth	1001	Early Nutrition of the Embryo	
Overview of Calcium and Phosphate		Anatomy and Function of the Placenta	
Regulation in the Extracellular Fluid	Chemin	Hormonal Factors in Pregnancy obslups 8 Isra	1059
and Plasma	1001	Response of the Mother's Body	1000
Bone and Its Relation to Extracellular	1003	to Pregnancy	1062
Calcium and Phosphate	1003	Parturition negro ne se se	1064
Vitamin D	1007	ogical Anatomy of the Liver and an original	1066
Parathyroid Hormone	1009	Vascular and Lymph Systems AS CETTANIS	
Calcitonin	1012	CHAPTER 84	4074
Summary of Control of Calcium Ion Concentration	1013	Fetal and Neonatal Physiology Growth and Functional Development of	1071
Pathophysiology of Parathyroid Hormone,	1444	the Fetus looT pistonpaid last	1071
Vitamin D, and Bone Disease	1014	Development of the Organ Systems	1071
Physiology of the Teeth	1016	Fetal Metabolism Adjustments of the Infant to	1072
CHAPTER 81		Extrauterine Life	1073
Reproductive and Hormonal Functions of		Special Functional Problems in	
the Male (and Function of the Pineal Gland	1) 1021	the Neonate	1076
Physiological Anatomy of the Male Sexual	Lio Filia	Special Problems of Prematurity	1079
Organs	1021	Growth and Development of the Child	1080

UNIT XV

Sports Physiology

CHAPTER 85

Sports Physiology	1085
Female and Male Athletes	1085
Muscles in Exercise	1085

Respiration in Exercise	1090
Cardiovascular System in Exercise	1092
Body Heat in Exercise	1094
Body Fluids and Salt in Exercise	1094
Drugs and Athletes	1095
Body Fitness Prolongs Life	1095
Index	1097