


JOHN P. J. PINEL



BIOPSYCHOLOGY

4TH
EDITION

Biopsychology



Fourth Edition

John P. J. Pinel

UNIVERSITY OF BRITISH COLUMBIA

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Preface

The fourth edition of *Biopsychology* is a clear, engaging introduction to current biopsychological theory and research. It is intended for use as a primary text in one- or two-semester courses in biopsychology—variously entitled *Biopsychology*, *Physiological Psychology*, *Brain and Behavior*, *Psychobiology*, *Behavioral Neuroscience*, or *Behavioral Neurobiology*.

The defining feature of *Biopsychology* is its unique combination of biopsychological science and personal, reader-oriented discourse. It is a textbook that is “un-textbooklike.” Rather than introducing biopsychology in the usual textbook fashion, it weaves the fundamentals of biopsychology together with clinical case studies, social issues, personal implications, and humorous anecdotes. It tries to be a friendly mentor who speaks directly to the reader and enthusiastically relates recent advances in biopsychological science.

My intention was that the personality of *Biopsychology* would be more than mere window dressing. I hope that *Biopsychology*’s engaging pedagogical approach facilitates the acquisition and retention of information, so that it delivers more biopsychology and more enjoyment for less effort.

Writing this preface is the final step in my preparation of this edition. It marks the end of a year in which I have dedicated myself to further strengthening *Biopsychology*’s strong points, dealing with areas needing improvement, and keeping it abreast of important advances in the field. The following sections of this preface describe the major features of this edition.

Features That Have Carried Over from Previous Editions

The following are features of the first three editions of *Biopsychology* that have been maintained and strengthened in this edition.

- **AN EMPHASIS ON BEHAVIOR** In some biopsychological textbooks, the coverage of neurophysiology, neurochemistry, and neuroanatomy subverts the coverage of behavioral research. *Biopsychology* gives top billing to behavior: It stresses that neuroscience is a team effort and that the unique contribution made by biopsychologists to this team effort is their behavioral expertise.

- **A BROAD DEFINITION OF BIOPSYCHOLOGY** *Biopsychology* is the study of the biology of behavior. *Biopsychology* focuses on the neural mechanisms of behavior, but also emphasizes the evolution, genetics, and adaptiveness of behavioral processes.

- **EXTENSIVE COVERAGE OF CLINICAL AND HUMAN RESEARCH** *Biopsychology* provides more than the customary coverage of clinical case studies and research on human subjects. One of *Biopsychology*’s dominant themes is that diversity is an important feature of biopsychological research: that major advances in biopsychological science often result from the convergence of pure and applied research and from the convergence of research involving human and nonhuman subjects.

- **A FOCUS ON THE SCIENTIFIC METHOD** *Biopsychology* emphasizes important, but frequently misunderstood, points about the scientific method. The following are three of them: (1) The scientific method is a means of answering questions that is as applicable to daily life as it is to the laboratory. (2) The scientific method is fun—it is basically the same method that is used by detectives to solve crimes. (3) Widely accepted scientific theories are current best estimates, not statements of absolute fact.

- **AN INTEGRATIVE APPROACH** *Biopsychology* has not taken the modular approach, dispensing biopsychology as a series of brief independent subject modules. *Biopsychology*’s approach is integrative. It creates a strong fabric of research findings and ideas by weaving together related subject areas and research findings into chapters of intermediate length.

- **AN EMPHASIS ON PERSONAL AND SOCIAL RELEVANCE** Several chapters of *Biopsychology*—particularly those on eating, sleeping, sex, and drug addiction—carry strong personal and social messages. In these chapters, students are encouraged to consider the relevance of biopsychological research to their lives outside the classroom.

- **WIT AND ENTHUSIASM** In my experience, biopsychology laboratories are places of enthusiasm, dedication, and good humor. *Biopsychology* communicates these important aspects of “biopsychological life.”

■ **ILLUSTRATIONS** The illustrations in *Biopsychology* are special. This is because each illustration was conceptualized and designed by a scientist–artist team who were uniquely qualified to create illustrations to clarify and reinforce the text. This uniquely qualified team was my wife, Maggie, with occasional suggestions from me.

Changes to This Edition

Biopsychology is one of the most rapidly progressing fields of science. This edition of *Biopsychology* has kept abreast of recent developments; it contains approximately 430 references to articles that have been published since the last edition. Indeed, these additions have dictated changes to many parts of this text. The following is a list of some of the topics that receive more or better coverage in this edition than in the last:

- cognitive neuroscience
- thinking about evolution
- mitochondrial DNA
- the human genome project
- functions of the autonomic nervous system
- metabotropic and ionotropic receptors
- ligands and ligand-gated channels
- human brain scanning
- approaches to neuropsychological testing
- genetic engineering
- transgenic animal models
- necrosis and apoptosis
- ischemic brain damage
- search for a Parkinson's gene
- two streams of visual cortical analysis
- secondary auditory cortex
- anterior cingulate cortex and pain
- conscious awareness
- selective attention
- change blindness
- secondary motor cortex
- somatotopic organization of the motor cortex
- cerebellum and learning
- ob/ob mice
- leptin
- calorie restriction and health
- neuroanatomy of osmoreceptors
- update on the notorious case of ablatio penis

- sexual attraction
- genetics of circadian rhythms
- polyphasic sleep and sleep reduction
- melatonin and sleep
- theories of hippocampal function
- functional brain imaging and memory
- memory and the striatum
- theories of drug conditioning
- methamphetamine and ecstasy
- stem cells
- human studies of neuroplasticity
- genetic treatments of brain disorders
- dyslexia
- functional brain imaging and language
- lateralization of memory
- diathesis-stress model
- ulcers, infection, and stress
- culture and depression
- beneficial effects of sleep deprivation on depression

Learning Aids

Biopsychology has four features that are expressly designed to help students learn and remember the material:

- **boldfaced key terms** and their **marginal definitions**—additional key terms of less importance appear in italics;
- **study exercises** that occur in the chapters at key transition points, where students can benefit most from pausing to consolidate preceding material before continuing;
- **food-for-thought discussion questions** at the end of each chapter;
- **appendices**, which serve as convenient sources of important information that is too detailed for some students of biopsychology.

Ancillary Materials Available with Biopsychology

- **TEST BANK** The test bank for this edition of *Biopsychology* comprises more than 2000 multiple-choice questions. The difficulty of each item is rated—easy, moderate, or difficult—to assist instructors with their test construction. The test bank is prepared by John Pinel.

■ **INSTRUCTOR'S MANUAL** The instructor's manual, skillfully prepared by Mike Mana for *Biopsychology*, includes a set of lecture notes. The instructor's manual is available on disk.

■ **STUDY GUIDE** Each chapter of the study guide prepared by Michael Mana of Western Washington University includes three sections. Section I is composed of "jeopardy" study items—named after the popular television quiz show. The jeopardy study items are arranged in two columns: questions on the left and answers on the right. Sometimes there is nothing in the space to the right of a question, and the student's task is to write the correct answer. Sometimes there is nothing in the space to the left of an answer, and the student's task is to write in the correct question. Once the jeopardy study items are completed, the student has a list of questions and answers that summarize the main points of the chapter, conveniently arranged for bidirectional studying.

Section II of each chapter is composed of essay study questions. Spaces are provided for the student to write outlines of the correct answers to each question. The essay study questions encourage students to consider general issues.

Section III of each chapter is a practice examination. Students are advised to use their results on the practice examination to guide the final stages of their preparation for in-class examinations.

In addition, Allyn and Bacon's Digital Image Archive for Physiological Psychology is available to adopters of the book. This Instructor's Resource, available on CD-ROM from your local A&B sales representative, provides over 250 full color images from the text and from other sources. Finally, we are happy to provide a new resource for both students and instructors at <http://www.abacon.com/pinel>. Students will find multiple-choice questions that will allow them to "practice" taking exams on line, as well as web links and activities. Instructors will find helpful information about integrating technology in the classroom as well as up-to-date web links and updates about the newest research in biopsychology and the other neurosciences.

■ **BIOPSYCHOLOGY VIDEO** Instructors who adopt *Biopsychology* can obtain a new 60-minute biopsychology videotape. Based on the *Films for the Humanities* series, this video provides students with glimpses of important biopsychological phenomena such as sleep recording, growing axons, memory testing in monkeys, the formation of synapses, gender differences in brain structure, human amnesic patients, rewarding brain stimulation, and brain scans.

Additional ancillary materials are also available to instructors. Please consult your local Allyn and Bacon representative for details.

Acknowledgments

I wrote *Biopsychology*, but Maggie Edwards made important contributions to all other aspects of the manuscript preparation. Her role in the preparation of the art warrants special acknowledgment. Users of this book will come to recognize that its illustrations are special: The illustrations are so finely attuned to the writing that it appears as if the author must be a talented designer who designed them himself—but I'm not, and I didn't. The illustrations were all designed by Maggie after discussion, debate, and, in some cases, argument with me. You see, Maggie is a professional artist with an extensive background in psychology who also happens to be my partner in life. Maggie took a year from her own successful career to help me achieve a level of illustration that is normally out of reach of writers who are not lucky enough to share their lives with such a talented and dedicated person. I thank her on behalf of the many students who will benefit from her contribution.

Allyn and Bacon did a remarkable job of producing this book. They shared my dream of a textbook that meets the highest standards of pedagogy but is still personal, attractive, and enjoyable. Thank you to Bill Barke, Carolyn Merrill, and the other executives at Allyn and Bacon for having faith in *Biopsychology* and providing the financial and personal support necessary for it to stay at the forefront of its field. A special thank you goes to Elaine Ober and Margaret Pinette for coordinating the entire production effort—an excruciatingly difficult and often thankless job.

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To the Student

In the 1960s, I was, in the parlance of the times, “turned on” by an undergraduate course in biopsychology. I could not imagine anything more interesting than a field of science dedicated to studying the relation between psychological processes and the brain. My initial fascination led to a long career as a student, researcher, and teacher of biopsychological science. *Biopsychology* is my attempt to share this fascination with you.

I have tried to make *Biopsychology* a different kind of textbook, a textbook that includes clear, concise, and well-organized explanations of the key points but is still interesting to read—a book from which you might suggest a suitable chapter to an interested friend or relative. To accomplish this goal, I thought about what kind of textbook I would have liked when I was a student, and I decided immediately to avoid the stern formality and ponderous style of conventional textbook writing.

I wanted *Biopsychology* to have a relaxed and personal style. In order to accomplish this, I imagined that you and I were chatting as I wrote, and that I was telling you—usually over a glass of something—about the interesting things that go on in the field of biopsychology. Imagining these chats kept my writing from drifting back into conventional “textbookese,” and it never let me forget that I was writing this book for you, the student.

I hope that *Biopsychology* teaches you much, and that reading it generates in you the same personal feeling that writing it did in me. If you are so inclined, I welcome your comments and suggestions. You can contact me at the Department of Psychology, University of British Columbia, Vancouver, B.C., Canada, V6T 1Z4 or at the following e-mail address:

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Brief Contents

CHAPTER 1	Biopsychology as a Neuroscience	1	CHAPTER 9	The Sensorimotor System	221
CHAPTER 2	Evolution, Genetics, and Experience: Asking the Right Questions about the Biology of Behavior	20	CHAPTER 10	The Biopsychology of Eating and Drinking	248
CHAPTER 3	The Anatomy of the Nervous System	51	CHAPTER 11	Hormones and Sex	284
CHAPTER 4	Neural Conduction and Synaptic Transmission	80	CHAPTER 12	Sleep, Dreaming, and Circadian Rhythms	311
CHAPTER 5	What Biopsychologists Do: The Research Methods of Biopsychology	106	CHAPTER 13	Drug Addiction and Reward Circuits in the Brain	342
CHAPTER 6	Human Brain Damage and Animal Models	137	CHAPTER 14	Memory and Amnesia	371
CHAPTER 7	The Visual System: From Eye to Cortex	159	CHAPTER 15	Neuroplasticity: Development, Learning, and Recovery from Brain Damage	401
CHAPTER 8	Mechanisms of Perception, Conscious Awareness, and Attention	188	CHAPTER 16	Lateralization, Language, and the Split Brain	434
			CHAPTER 17	Biopsychology of Stress and Illness	465

Contents

Preface	xvi	Key Terms	18
To the Student	xxi	Additional Reading	18
<hr/>		<hr/>	
1	BIOPSYCHOLOGY AS A NEUROSCIENCE	2	EVOLUTION, GENETICS, AND EXPERIENCE: ASKING THE RIGHT QUESTIONS ABOUT THE BIOLOGY OF BEHAVIOR
1.1	What Is Biopsychology?		20
1.2	What Is the Relation between Biopsychology and the Other Disciplines of Neuroscience?	2.1	Thinking about the Biology of Behavior: From Dichotomies to Relations and Interactions
1.3	What Types of Research Characterize the Biopsychological Approach?		21
	Human and Nonhuman Subjects		Is It Physiological, or Is It Psychological?
	Experiments and Nonexperiments		Is It Inherited, or Is It Learned?
	Pure and Applied Research		Problems with Thinking about the Biology of Behavior in Terms of Traditional Dichotomies
1.4	What Are the Divisions of Biopsychology?	2.2	Human Evolution
	Physiological Psychology		Evolution and Behavior
	Psychopharmacology		Course of Human Evolution
	Neuropsychology		Thinking about Human Evolution
	Psychophysiology		Evolution of the Human Brain
	Cognitive Neuroscience		Conclusion
	Comparative Psychology	2.3	Fundamental Genetics
1.5	Converging Operations: How Do Biopsychologists Work Together?		Mendelian Genetics
1.6	Scientific Inference: How Do Biopsychologists Study the Unobservable Workings of the Brain?		Chromosomes, Reproduction, and Linkage
1.7	What Is Bad Science, and How Do You Spot It?		Sex Chromosomes and Sex-Linked Traits
	Conclusion		Chromosome Structure and Replication
	Food for Thought		The Genetic Code and Gene Expression
			Human Genome Project
			Mitochondrial DNA
		2.4	Behavioral Development: The Interaction of Genetic Factors and Experience
			Selective Breeding of "Maze-Bright" and "Maze-Dull" Rats

Phenylketonuria: A Single-Gene Metabolic Disorder	44	Food for Thought	78
Development of Birdsong	45	Key Terms	79
		Additional Reading	79

2.5 The Genetics of Human Psychological Differences	47
Development of the Individual versus Development of Differences among Individuals	47
Minnesota Study of Twins Reared Apart	48
Conclusion	49
Food for Thought	50
Key Terms	50
Additional Reading	50

3 THE ANATOMY OF THE NERVOUS SYSTEM 51

3.1 General Layout of the Nervous System	52
Divisions of the Nervous System	52
Meninges, Ventricles, and Cerebrospinal Fluid	53
Blood–Brain Barrier	55
3.2 Cells of the Nervous System	56
Anatomy of Neurons	56
Supportive Cells of the Nervous System: Glial Cells and Satellite Cells	56
3.3 Neuroanatomical Techniques and Directions	61
Neuroanatomical Techniques	61
Directions in the Vertebrate Nervous System	63
3.4 Spinal Cord	65
3.5 The Five Major Divisions of the Brain	66
3.6 Major Structures of the Brain	67
Myelencephalon	68
Metencephalon	68
Mesencephalon	69
Diencephalon	70
Telencephalon	71
Conclusion	77

4 NEURAL CONDUCTION AND SYNAPTIC TRANSMISSION 80

4.1 The Neuron's Resting Membrane Potential	81
Recording the Membrane Potential	81
Resting Membrane Potential	83
The Ionic Basis of the Resting Potential	83
4.2 Generation and Conduction of Postsynaptic Potentials	85
4.3 Integration of Postsynaptic Potentials and Generation of Action Potentials	86
4.4 Conduction of Action Potentials	89
Ionic Basis of Action Potentials	89
Refractory Periods	89
Conduction of Action Potentials	90
Conduction in Myelinated Axons	90
The Velocity of Axonal Conduction	91
Conduction in Neurons without Axons	91
4.5 Synaptic Transmission: Chemical Transmission of Signals from One Neuron to Another	91
Structure of Synapses	91
Synthesis, Packaging, and Transport of Neurotransmitter Molecules	92
Release of Neurotransmitter Molecules	94
The Activation of Receptors by Neurotransmitter Molecules	94
Reuptake, Enzymatic Degradation, and Recycling	97
4.6 The Neurotransmitters	98
Amino Acid Neurotransmitters	98
Monoamine Neurotransmitters	98
Soluble-Gas Neurotransmitters	99
Acetylcholine	99
Neuropeptides	100

4.7	Pharmacology of Synaptic Transmission	101	5.5	Genetic Engineering	125
	How Drugs Influence Synaptic Transmission	101		Gene Knockout Techniques	125
	Psychoactive Drugs: Four Examples	101		Gene Replacement Techniques	125
	Conclusion	104		PART 2: The Behavioral Research Methods of Biopsychology	126
	Food for Thought	104	5.6	Neuropsychological Testing	127
	Key Terms	105		Modern Approach to Neuropsychological Testing	127
	Additional Reading	105		Tests of the Common Neuropsychological Test Battery	128
				Tests of Specific Neuropsychological Function	129
5	WHAT BIOPSYCHOLOGISTS DO: THE RESEARCH METHODS OF BIOPSYCHOLOGY	106	5.7	Behavioral Methods of Cognitive Neuroscience	131
	PART 1: Methods of Studying the Nervous System	107	5.8	Biopsychological Paradigms of Animal Behavior	132
5.1	Methods of Visualizing the Living Human Brain	107		Paradigms for Assessment of Species-Common Behaviors	132
	Contrast X-Rays	107		Traditional Conditioning Paradigms	133
	X-Ray Computed Tomography	107		Seminal Animal Learning Paradigms	133
	Magnetic Resonance Imaging	108		Conclusion	135
	Positron Emission Tomography	109		Food for Thought	136
	Functional MRI	110		Key Terms	136
5.2	Recording Human Psychophysiological Activity	112		Additional Reading	136
	Scalp Electroencephalography	112			
	Muscle Tension	114	6	HUMAN BRAIN DAMAGE AND ANIMAL MODELS	137
	Eye Movement	115			
	Skin Conductance	116	6.1	Causes of Brain Damage	139
	Cardiovascular Activity	116		Brain Tumors	139
5.3	Invasive Physiological Research Methods	117		Cerebrovascular Disorders	140
	Stereotaxic Surgery	117		Closed-Head Injuries	141
	Lesion Methods	118		Infections of the Brain	143
	Electrical Stimulation	120		Neurotoxins	144
	Invasive Electrophysiological Recording Methods	120		Genetic Factors	144
5.4	Pharmacological Research Methods	121		Programmed Cell Death	145
	Routes of Drug Administration	121	6.2	Neuropsychological Diseases	146
	Selective Chemical Lesions	122		Epilepsy	146
	Measuring Chemical Activity of the Brain	122		Parkinson's Disease	148
	Locating Neurotransmitters and Receptors in the Brain	123		Huntington's Disease	149

Multiple Sclerosis	151	Color Constancy and the Retinex Theory	183
Alzheimer's Disease	151	Conclusion	186
6.3 Animal Models of Human Neuropsychological Diseases	154	Food for Thought	187
Kindling Model of Epilepsy	154	Key Terms	187
Transgenic Mouse Model of Alzheimer's Disease	155	Additional Reading	187
MPTP Model of Parkinson's Disease	156		
Conclusion	156		
Food for Thought	157		
Key Terms	157		
Additional Reading	158		
7 THE VISUAL SYSTEM: FROM EYE TO CORTEX	159	8 MECHANISMS OF PERCEPTION, CONSCIOUS AWARENESS, AND ATTENTION	188
7.1 Light Enters the Eye and Reaches the Retina	160	8.1 Principles of Sensory System Organization	189
7.2 The Retina and Translation of Light into Neural Signals	163	Hierarchical Organization	189
Cone and Rod Vision	164	Functional Segregation	190
Eye Movement	168	Parallel Processing	191
Visual Transduction: The Conversion of Light to Neural Signals	168	The Current Model of Sensory System Organization	191
7.3 From Retina to Primary Visual Cortex	170	8.2 Cortical Mechanisms of Vision	192
Retinotopic Organization	172	Scotomas: Completion	192
The M and P Pathways	172	Scotomas: Blindsight	193
7.4 Seeing Edges	173	Perception of Subjective Contours	194
Lateral Inhibition and Contrast Enhancement	173	Functional Areas of Secondary and Association Visual Cortex	194
Receptive Fields of Visual Neurons	175	Dorsal and Ventral Streams	196
Receptive Fields: Neurons of the Retina-Geniculate-Striate Pathway	175	Prosopagnosia	197
Receptive Fields: Simple Cortical Cells	176	Interim Conclusion	198
Receptive Fields: Complex Cortical Cells	177	8.3 Audition	199
Columnar Organization of Primary Visual Cortex	178	The Ear	200
Spatial-Frequency Theory	179	From the Ear to the Primary Auditory Cortex	201
7.5 Seeing Color	181	Primary Auditory Cortex	202
Component and Opponent Processing	182	Sound Localization	202
		Effects of Auditory Cortex Damage	203
		8.4 Somatosensation: Touch and Pain	204
		Cutaneous Receptors	204
		Dermatomes	204
		The Two Major Ascending Somatosensory Pathways	205
		Cortical Areas of Somatosensation	208
		Effects of Damage to the Primary Somatosensory Cortex	209

Somatosensory Agnosias	209	Ventromedial Corticospinal Tract	
The Paradoxes of Pain	210	and Ventromedial Cortico–	
Phantom Limbs	212	Brainstem–Spinal Tract	233
8.5 The Chemical Senses:		The Two Dorsolateral Motor Pathways	
Smell and Taste	213	and the Two Ventromedial Motor	
Olfactory System	214	Pathways Compared	233
Gustatory System	215	9.7 Sensorimotor Spinal Circuits	236
Brain Damage and the Chemical Senses	216	Muscles	236
8.6 Selective Attention	217	Receptor Organs of Tendons and Muscles	237
Conclusion	219	Stretch Reflex	238
Food for Thought	219	Withdrawal Reflex	239
Key Terms	220	Reciprocal Innervation	239
Additional Reading	220	Recurrent Collateral Inhibition	240
		Walking: A Complex Sensorimotor Reflex	243
9 THE SENSORIMOTOR SYSTEM	221	9.8 Central Sensorimotor Programs	243
9.1 Three Principles of		Central Motor Programs Can	
Sensorimotor Function	222	Develop without Practice	243
The Sensorimotor System Is		Practice Creates Central Motor Programs	244
Hierarchically Organized	222	Conclusion	246
Motor Output Is Guided by		Food for Thought	246
Sensory Input	223	Key Terms	246
Learning Changes the Nature		Additional Reading	247
and Locus of Sensorimotor Control	223		
A General Model of Sensorimotor		10 THE BIOPSYCHOLOGY OF	
System Function	223	EATING AND DRINKING	248
9.2 Sensorimotor Association Cortex	224		
Posterior Parietal Association Cortex	224	PART 1: Hunger, Eating,	
Dorsolateral Prefrontal		and Body Weight Regulation	249
Association Cortex	226	10.1 Digestion and Energy Flow	249
9.3 Secondary Motor Cortex	227	10.2 Theories of Hunger and Eating: Set	
9.4 Primary Motor Cortex	229	Points Versus Positive Incentives	252
9.5 Cerebellum and Basal Ganglia	231	Set-Point Assumption	252
Cerebellum	231	Glucostatic and Lipostatic Set-Point	
Basal Ganglia	231	Theories of Hunger and Eating	253
9.6 Descending Motor Pathways	232	Problems with Set-Point Theories	
Dorsolateral Corticospinal Tract and		of Hunger and Eating	254
Dorsolateral Corticorubrospinal Tract	232	Positive-Incentive Theory	254
		10.3 Factors That Determine	
		What, When, and How	
		Much We Eat	255

Puberty: Hormones and the Development of Secondary Sex Characteristics	296	12.2 REM Sleep and Dreaming	315
Three Cases of Exceptional Human Sexual Development	298	Testing Common Beliefs about Dreaming	315
11.3 Effects of Gonadal Hormones on Adults	301	The Interpretation of Dreams	316
Male Reproduction-Related Behavior and Testosterone	301	Lucid Dreams	316
Female Reproduction-Related Behavior and Gonadal Hormones	303	12.3 Why Do We Sleep?	317
Anabolic Steroid Abuse	303	Recuperation and Circadian Theories	317
11.4 The Hypothalamus and Sexual Behavior	304	12.4 Circadian Sleep Cycles	318
Structural Differences between the Male Hypothalamus and the Female Hypothalamus	304	Free-Running Circadian Sleep-Wake Cycles	319
The Hypothalamus and Male Sexual Behavior	306	Jet Lag and Shift Work	320
The Hypothalamus and Female Sexual Behavior	306	12.5 Effects of Sleep Deprivation	321
11.5 Sexual Orientation, Hormones, and the Brain	307	Two Classic Sleep-Deprivation Studies	322
Sexual Orientation, Genes, and Hormones	307	Experimental Studies of Sleep Deprivation in Humans	322
Sexual Orientation and Early Hormones	308	Sleep-Deprivation Studies in Laboratory Animals	323
What Triggers the Development of Sexual Attraction?	308	REM-Sleep Deprivation	324
Is There a Difference in the Brains of Homosexuals and Heterosexuals?	308	Interpreting the Effects of Sleep Deprivation: A Special Recuperative Function for Slow-Wave Sleep	325
Conclusion	309	Increase in Sleep Efficiency	325
Food for Thought	309	12.6 Recuperation and Circadian Theories of Sleep Combined	326
Key Terms	310	12.7 Neural Mechanisms of Sleep	327
Additional Reading	310	Reticular Activating System Theory of Sleep	328
		Three Important Discoveries about the Neural Basis of Sleep	329
		Brain Areas That Have Been Implicated in Controlling Sleep and Dreaming	329
		12.8 The Circadian Clock: Neural and Molecular Mechanisms	332
		Location of the Circadian Clock in the Suprachiasmatic Nuclei	332
		Genetics of Circadian Rhythms	333
		Mechanisms of Entrainment	333
		12.9 Drugs That Affect Sleep	334
		Hypnotic Drugs	334
		Antihypnotic Drugs	335
		Melatonin	335
		12.10 Sleep Disorders	336
		Insomnia	336
		Hypersomnia	337
		REM-Sleep-Related Disorders	337

12

SLEEP, DREAMING, AND CIRCADIAN RHYTHMS 311

12.1 The Physiological and Behavioral Correlates of Sleep	312
The Three Standard Psychophysiological Measures of Sleep	313
Four Stages of Sleep EEG	313

12.2 REM Sleep and Dreaming	315
Testing Common Beliefs about Dreaming	315
The Interpretation of Dreams	316
Lucid Dreams	316
12.3 Why Do We Sleep?	317
Recuperation and Circadian Theories	317
12.4 Circadian Sleep Cycles	318
Free-Running Circadian Sleep-Wake Cycles	319
Jet Lag and Shift Work	320
12.5 Effects of Sleep Deprivation	321
Two Classic Sleep-Deprivation Studies	322
Experimental Studies of Sleep Deprivation in Humans	322
Sleep-Deprivation Studies in Laboratory Animals	323
REM-Sleep Deprivation	324
Interpreting the Effects of Sleep Deprivation: A Special Recuperative Function for Slow-Wave Sleep	325
Increase in Sleep Efficiency	325
12.6 Recuperation and Circadian Theories of Sleep Combined	326
12.7 Neural Mechanisms of Sleep	327
Reticular Activating System Theory of Sleep	328
Three Important Discoveries about the Neural Basis of Sleep	329
Brain Areas That Have Been Implicated in Controlling Sleep and Dreaming	329
12.8 The Circadian Clock: Neural and Molecular Mechanisms	332
Location of the Circadian Clock in the Suprachiasmatic Nuclei	332
Genetics of Circadian Rhythms	333
Mechanisms of Entrainment	333
12.9 Drugs That Affect Sleep	334
Hypnotic Drugs	334
Antihypnotic Drugs	335
Melatonin	335
12.10 Sleep Disorders	336
Insomnia	336
Hypersomnia	337
REM-Sleep-Related Disorders	337