



ARIZONA STATE UNIVERSITY
GENERAL STUDIES COURSE PROPOSAL COVER FORM

Course information:

Copy and paste **current** course information from *Class Search/Course Catalog*.

| | | | |
|-----------------------------------|--|------------|--|
| Academic Unit | <u>Human Systems Engineering</u> | Department | <u>The Polytechnic School</u> |
| Subject | <u>EGR</u> | Number | <u>223</u> |
| | | Title | <u>Biology of Human Systems</u> |
| | | | <u>(to be HSE 223 when new prefix is approved)</u> |
| Units: | | | <u>3</u> |
| Is this a cross-listed course? | (Choose one) | | |
| If yes, please identify course(s) | <u>No</u> | | |
| Is this a shared course? | (choose one) If so, list all academic units offering this course | | <u>No</u> |
| Course description: | | | |

Requested designation: (Choose One)

Note- a separate proposal is required for each designation requested

Eligibility:

Permanent numbered courses must have completed the university's review and approval process.
 For the rules governing approval of omnibus courses, contact Phyllis.Lucie@asu.edu or Lauren.Leo@asu.edu.

Submission deadlines dates are as follow:

For Fall 2015 Effective Date: October 9, 2014

For Spring 2016 Effective Date: March 19, 2015

Area(s) proposed course will serve:

A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study.

Checklists for general studies designations:

Complete and attach the appropriate checklist

- [Literacy and Critical Inquiry core courses \(L\)](#)
- [Mathematics core courses \(MA\)](#)
- [Computer/statistics/quantitative applications core courses \(CS\)](#)
- [Humanities, Arts and Design core courses \(HU\)](#)
- [Social-Behavioral Sciences core courses \(SB\)](#)
- [Natural Sciences core courses \(SQ/SG\)](#)
- [Cultural Diversity in the United States courses \(C\)](#)
- [Global Awareness courses \(G\)](#)
- [Historical Awareness courses \(H\)](#)

A complete proposal should include:

- Signed General Studies Program Course Proposal Cover Form
- Criteria Checklist for the area
- Course Catalog description
- Course Syllabus
- Copy of Table of Contents from the textbook and list of required readings/books

Respectfully request that proposals are submitted electronically with all files compiled into one PDF. If necessary, a hard copy of the proposal will be accepted.

Contact information:

| | | | |
|-----------|-----------------------|---------|-----------------------|
| Name | <u>Nancy J. Cooke</u> | Phone | <u>480-727-5158</u> |
| Mail code | <u>2880</u> | E-mail: | <u>ncooke@asu.edu</u> |

Department Chair/Director approval: (Required)

| | | | |
|------------------------------|--------------------|-------|-----------------|
| Chair/Director name (Typed): | <u>Ann McKenna</u> | Date: | <u>12/30/14</u> |
| Chair/Director (Signature): | | | |

Arizona State University Criteria Checklist for
SOCIAL-BEHAVIORAL SCIENCES [SB]

Rationale and Objectives

Social-behavioral sciences use distinctive scientific methods of inquiry and generate empirical knowledge about human behavior, within society and across cultural groups. Courses in this area address the challenge of understanding the diverse natures of individuals and cultural groups who live together in a complex and evolving world.

In both private and public sectors, people rely on social scientific findings to consider and assess the social consequences of both large-scale and group economic, technological, scientific, political, ecological and cultural change. Social scientists' observations about human interactions with the broader society and their unique perspectives on human events make an important contribution to civic dialogue.

Courses proposed for a General Studies designation in the Social-Behavioral Sciences area must demonstrate emphases on: (1) social scientific theories, perspectives and principles, (2) the use of social-behavioral methods to acquire knowledge about cultural or social events and processes, and (3) the impact of social scientific understanding on the world.

Revised April 2014

Proposer: Please complete the following section and attach appropriate documentation.

| ASU--[SB] CRITERIA | | | | | |
|--|-----------------------------|--|--|-----------------------------|---|
| A SOCIAL-BEHAVIORAL SCIENCES [SB] course should meet all of the following criteria. If not, a rationale for exclusion should be provided. | | | | | |
| YES | NO | | Identify Documentation Submitted | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 1. Course is designed to advance basic understanding and knowledge about human interaction. | Course description, syllabus, & table of Contents from the textbook | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 2. Course content emphasizes the study of social behavior such as that found in: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; vertical-align: top;"> <ul style="list-style-type: none"> • ANTHROPOLOGY • ECONOMICS • CULTURAL GEOGRAPHY • HISTORY </td> <td style="width: 50%; vertical-align: top;"> Psychology Sociology </td> </tr> </table> | <ul style="list-style-type: none"> • ANTHROPOLOGY • ECONOMICS • CULTURAL GEOGRAPHY • HISTORY | Psychology Sociology | Course description, syllabus, & table of Contents from the textbook |
| <ul style="list-style-type: none"> • ANTHROPOLOGY • ECONOMICS • CULTURAL GEOGRAPHY • HISTORY | Psychology Sociology | | | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 3. Course emphasizes: <ul style="list-style-type: none"> a. the distinct knowledge base of the social and behavioral sciences (e.g., sociological anthropological). <li style="text-align: center;">OR b. the distinct methods of inquiry of the social and behavioral sciences (e.g., ethnography, historical analysis). | Course description, syllabus, & table of Contents from the textbook | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4. Course illustrates use of social and behavioral science perspectives and data. | Course description, syllabus, & table of Contents from the textbook | | |
| | | THE FOLLOWING TYPES OF COURSES ARE EXCLUDED FROM THE [SB] AREA EVEN THOUGH THEY MIGHT GIVE SOME CONSIDERATION TO SOCIAL AND BEHAVIORAL SCIENCE CONCERNS: | | | |
| | | • Courses with primarily arts, humanities, literary or philosophical content. | | | |
| | | • Courses with primarily natural or physical science content. | | | |
| | | • Courses with predominantly applied orientation for professional skills or training purposes. | | | |
| | | • Courses emphasizing primarily oral, quantitative, or written skills. | | | |

| Course Prefix | Number | Title | General Studies Designation |
|---------------|--------|--------------------------|-----------------------------|
| HSE | 223 | Biology of Human Systems | SB |

Explain in detail which student activities correspond to the **specific** designation criteria. Please use the following organizer to explain how the criteria are being met.

| Criteria (from checklist) | How course meets spirit (contextualize specific examples in next column) | Please provide detailed evidence of how course meets criteria (i.e., where in syllabus) |
|---------------------------|--|--|
| 1 | The goal of this introductory course is to provide students with an understanding of the biological basis of human individual and social behavior. Topics specifically include emotion & affective disorders (Chap 11, 16), human communication (Chap 14), learning (Chap 13), anxiety disorders (Chap 17), autistic disorders (Chap 17), and drug abuse (Chap 18). | See the classes from Oct. 20 through Oct. 27 and from Nov. 19 through Dec.1 in the syllabus. |
| 2 | The course provides a wealth of information that will be particularly beneficial for students in neuroscience, psychology, anthropology, and sociology. The covered topics include (but are not limited to) sexual behavior, emotional responses, perceptual and cognitive functions, learning, communication, mental illness, anxiety/stress disorders, autistic disorders, and drug abuse. | See the table of content from the textbook. Chapters 11, 16, 17, & 18 emphasize specifically the study of social behavior such as emotional interactions, affective disorders, stress-related disorders, and drug abuse, which are also covered extensively in psychology and sociology. |

| | | |
|---|--|--|
| 3 | The course teaches students a wealth of knowledge about the biological basis of human behavior. It also introduces students to a wide range of techniques and methods used to investigate human behavior (Chap 5). | Throughout this course, students will learn the biological basis of human individual and social behaviors such as eating (Chap 12), sleeping(Chap 9), sexual behavior(Chap 10), emotional responses(Chap 11), sensory perception (Chaps 6,7,9), learning and memory(Chap 13), language and cognitive functions(Chap 14), mental illness(Chaps 15,16,17), and drug abuse(Chap 18). Chapter 5 is devoted specifically to research methods. |
| 4 | This course uses a lot of social and behavioral studies to illustrate how our behavior is shaped and sometimes changed by the underlying biological or pathological processes. An emphasis is placed on applying the knowledge to some real-world problems like treatment of schizophrenia, affective disorders, stress-related problems, autistic disorders, drug abuse, etc. | See the classes from Nov. 17 through Dec.1 in the syllabus. |

Course Catalog Description

HSE 223: Biology of Human Systems

Introduction to the biological processes involved in many aspects of our behavior such as eating, sleeping, sexual behavior, emotional responses, sensory perception, learning, language, memory, cognitive functions, mental illness, and drug abuse. A foundational Social/Behavioral Science course to prepare students for advanced courses in psychology, anthropology, sociology, neuroscience, or related fields.

HSE-223: Biology of Human Systems

Arizona State University

Fall semester 2015

Course line # 12345

Instructor Information:

Dates of classes: Tues & Thurs, Aug. 20 - Dec. 3
Instructor: Bing Wu, Ph.D.
Human System Engineering Program
Email: Bing.Wu@asu.edu (*preferred contact method*)
Work Phone: 480-727-3716 (O)
Office Hours: Tues & Thurs, 4:30 – 5:30 or by appointments through email
Office Location: 150E, Santa Catalina Hall, Polytechnic campus

Course Information:

Pre-requisites: HSE 101, PSY 101, or EGR 103

Course Format: Lectures. The class will meet on **Tuesdays and Thursdays from 3:00 to 4:15 pm at Room 120, Peralta Hall.**

Course description: Introduction to the biological processes involved in many aspects of our behavior such as eating, sleeping, sexual behavior, emotional responses, sensory perception, learning, language, memory, cognitive functions, mental illness, and drug abuse. A foundational Social/Behavioral Science course to prepare students for advanced courses in psychology, anthropology, sociology, neuroscience, or related fields.

Required Course Texts, Materials and Resources:

The required textbook is as follows:

Carlson, Neil R. (2012). *Physiology of Behavior* (11th Edition). Boston, MA: Pearson Education, Inc.

Course materials like Powerpoint presentations and study guides for the exams will be available on the Blackboard (<http://myasucourses.asu.edu>).

Student Learning Outcomes

After successfully completing this course, students should be able to:

- Describe the methods used to study the biological basis of behavior;
- Explain the structure & functions of the nervous system;
- Discuss the role of the brain and nervous system in health and disease;
- Summarize the basic principles of psychopharmacology;
- Indicate the effects of the major neurotransmitters on behavior;
- Apply the principles of biopsychology to real-world human behavior and problems;

Tentative Course Calendar

| <i>Date</i> | <i>Class Topic & Required Reading</i> |
|-------------|--|
| 08/20/2015 | <i>Syllabus & class introduction</i> |
| 08/25/2015 | <i>Introduction to human biological systems</i> Reading: Chapter 1 (pp. 1 - 26) |
| 08/27/2015 | <i>Structure & Function of Cells of the Nervous System</i> Reading: Chapter 2 (pp. 27 - 65) |
| 09/01/2015 | <i>Structure of the Nervous System</i> Reading: Chapter 3 (pp. 66 - 98) |
| 09/03/2015 | <i>Psycho-pharmacology</i> Reading: Chapter 4 (pp. 99 - 129) |
| 09/08/2015 | <i>Methods & Strategies of Research</i> Reading: Chapter 5 (pp. 130 - 163) |
| 09/10/2015 | <i>Review (1)</i> |
| 09/15/2015 | Exam 1 |
| 09/17/2015 | <i>Vision (1): Coding of Visual Information</i> Reading: Chapter 6 (pp. 164 - 186) |
| 09/22/2015 | <i>Vision (2): Analysis of Visual Information</i> Reading: Chapter 6 (pp. 187 - 206) |
| 09/24/2015 | <i>Audition & Vestibular System</i> Reading: Chapter 7 (pp. 207 - 230) |
| 09/29/2015 | <i>The Body Senses & Pain</i> Reading: Chapter 7 (pp. 231 - 243) |
| 10/01/2015 | <i>The Chemical Senses</i> Reading: Chapter 7 (pp. 244 - 254) |
| 10/06/2015 | <i>Review (2)</i> |
| 10/08/2015 | Exam 2 |
| 10/13/2015 | Fall Break – Classes Excused |
| 10/15/2015 | <i>Control of Movement</i> Reading: Chapter 8 (pp. 255 - 287) |
| 10/20/2015 | <i>Learning and Memory</i> Reading: Chapter 13 (pp. 434 - 478) |
| 10/22/2015 | <i>Human Communications</i> Reading: Chapter 14 (pp. 479 - 515) |
| 10/27/2015 | <i>Emotion</i> Reading: Chapter 11 (pp. 359 - 392) |
| 10/29/2015 | <i>Ingestive Behavior</i> Reading: Chapter 12 (pp. 393 - 433) |
| 11/03/2015 | <i>Sleep & Biological Rhythms</i> Reading: Chapter 9 (pp. 288 - 322) |
| 11/05/2015 | <i>Review (3)</i> |
| 11/10/2015 | Exam 3 |
| 11/13/2015 | <i>Reproductive Behavior</i> Reading: Chapter 10 (pp. 323 - 358) |
| 11/17/2015 | <i>Neurological Disorders</i> Reading: Chapter 15 (pp. 516 - 551) |

| | |
|------------|---|
| 11/19/2015 | <i>Schizophrenia and the Affective Disorders</i> Reading: Chapter 16 (pp. 552 - 583) |
| 11/24/2015 | <i>Anxiety Disorders, Autistic Disorder, ADHD and Stress</i> Reading: Chapter 17 (pp. 584 - 613) |
| 11/26/2015 | <i>Thanksgiving – Classes Excused</i> |
| 12/01/2015 | <i>Drug Abuse</i> Reading: Chapter 18 (pp. 614 - 643) |
| 12/03/2015 | <i>Review (4)</i> |
| 12/08/2015 | <i>Exam 4</i> |

WARNING: Please always remember that the purpose of this course is to study the biological basis of human behavior. Some content like the biological basis of sexuality may be deemed offensive by some students. If that was the case, please let me know and feel free to discuss it with me.

Course Assignments

For each topic, there will be lectures and assigned readings. The course requirements are (1) participation in class, (2) quizzes, and (3) four exams.

Readings: Students need to read the assigned book chapters before class.

Quizzes: Quizzes will be given at the beginning of each class (excluding the review and exam days). They are designed to test your understanding of the reading assignment and ensure that you come prepared. Each quiz will account for 1% of the total grade. The quizzes also serve as an attendance record. NO make-up quizzes will be given. If a student misses a quiz, he or she will receive NO point for that quiz.

Exams: There will be four exams based on the materials covered in the classroom. The exams will be closed-book, closed-notes, closed-homework, and taken in class. The format is a combination of multiple-choice, short answer, and short essay. There will be NO make-up exam unless there is a documented emergency. Anyone missing an exam without a ASU sanctioned excuse will receive a zero score.

The course grade will be based as follows:

| | |
|---------|---------|
| Exam 1 | 20 pts |
| Exam 2 | 20 pts |
| Exam 3 | 20 pts |
| Exam 4 | 20 pts |
| Quizzes | 20 pts |
| TOTAL | 100 pts |

Grading Scale

Final grades will be assigned as follows:

| | | | | | |
|----|------------------------------------|---|--------|----|--------|
| A+ | >=96% | A | 93-95% | A- | 90-92% |
| B+ | 86-89% | B | 83-85% | B- | 80-82% |
| C+ | 76-79% | C | 70-75% | D | 60-69% |
| E | <60% | | | | |
| XE | Failure due to academic dishonesty | | | | |

NO incomplete grades will be given except in cases of serious medical emergencies as evidenced by a documented report.

Grade Appeals

ASU has formal and informal channels to appeal a grade. If you wish to appeal any grading decisions, please see <http://catalog.asu.edu/appeal>.

Classroom behavior:

- **Attendance and Participation**

Your presence for the entire class period is mandatory and critical to academic success. The following penalties will be imposed for missing class without a valid and verifiable excuse: Every unexcused absence causes a deduction of 5 points from the final grade. Absences will be excused ONLY if the student has a ASU sanctioned excuse. The excused absences include those resulting from: (1) illness, death in the family or other emergency, or other reasons beyond the student's control; (2) a student's religious beliefs, observances, and practices that are in accord with ACD 304-04 (<http://www.asu.edu/aad/manuals/acd/acd304-04.html>), "Accommodation for Religious Practices", and (3) those university sanctioned events/activities that are in accord with ACD 304-02 (<http://www.asu.edu/aad/manuals/acd/acd304-02.html>), "Missed Classes Due to University-Sanctioned Activities".

- **Late and Missing Assignments**

Make-up exams will NOT be given unless the student provides documentation of the illness or emergency. Anyone missing an exam without a university sanctioned excuse will receive a zero score.

- **Cell Phone and Recording Devices**

Always turn off your cellular phone before you enter our classroom. You are not allowed to receive and make phone calls during class meetings. Other communication devices and recording devices are also strictly prohibited from the classroom.

- **Electronic Communication**

Acceptable use of university computers, internet and electronic communications can be found in the Student Code of Conduct (<http://www.asu.edu/aad/manuals/usi/usi104-01.html>) and in the University's Computer, Internet, and Electronic Communications Policy (<http://www.asu.edu/aad/manuals/acd/acd125.html>).

University policies:

- **Academic Integrity**

All students at ASU are expected to follow the Student Code of Conduct. Each student must act with honesty and integrity, and must respect the rights of others in carrying out all academic assignments. Plagiarism, and any other form of academic dishonesty that is in violation with the Student Code of Conduct, will not be tolerated. All necessary and appropriate sanctions will be issued to all parties involved with plagiarizing any and all course work. For more information, please see the ASU Student Academic Integrity Policy: <http://provost.asu.edu/academicintegrity>.

- **Nondiscrimination, Anti-Harassment, and Nonretaliation**

Arizona State University is committed to providing the university community, including students, faculty, staff, and guests, with an environment that is free of harassment, discrimination, or retaliation. ASU expressly prohibits harassment, discrimination, and retaliation by employees, students, contractors, or agents of the university based on protected status, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, and gender identity. If you believe that you have been subjected to any discrimination, harassment, or retaliation in violation of this policy, or you believe that this policy has been violated, you should report the matter immediately to the Office of Equity and Inclusion (<https://cfo.asu.edu/hr-equityandinclusion>; Phone: (480) 965-5057; Fax: (480) 237-7998; Email: EqualityandInclusion@mainex1.asu.edu).

- **Policy against Threatening Behavior**

Any kind of abusive, disruptive, threatening, or violent behaviour will NOT be tolerated. Students are expected to comply with the ASU policy against threatening behavior, per the *Student Services Manual*, SSM 104–02 (<http://www.asu.edu/aad/manuals/ssm/ssm104-02.html>), “Handling Disruptive, Threatening, or Violent Individuals on Campus”. Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students.

- **Disability Accommodations**

To request academic accommodations due to a disability, please contact the ASU Disability Resource Center (<https://eoss.asu.edu/drc>; Phone: (480) 965-1234; Fax: (480) 965-0441; Email: DRC@asu.edu). This is a very important step as accommodations may be difficult to make retroactively. If you have a letter from their office indicating that you have a disability which requires academic accommodations, in order to assure that you receive your accommodations in a timely manner, please present this documentation to me no later than the end of the first week of the semester so that your needs can be addressed effectively.

- **Religious Accommodations**

Students will not be penalized for missing class due to religious obligations, holidays, observances, and practices that are in accord with ACD 304–04 (<http://www.asu.edu/aad/manuals/acd/acd304-04.html>). Students who need to be absent from class due to the observance of a religious holiday or participate in

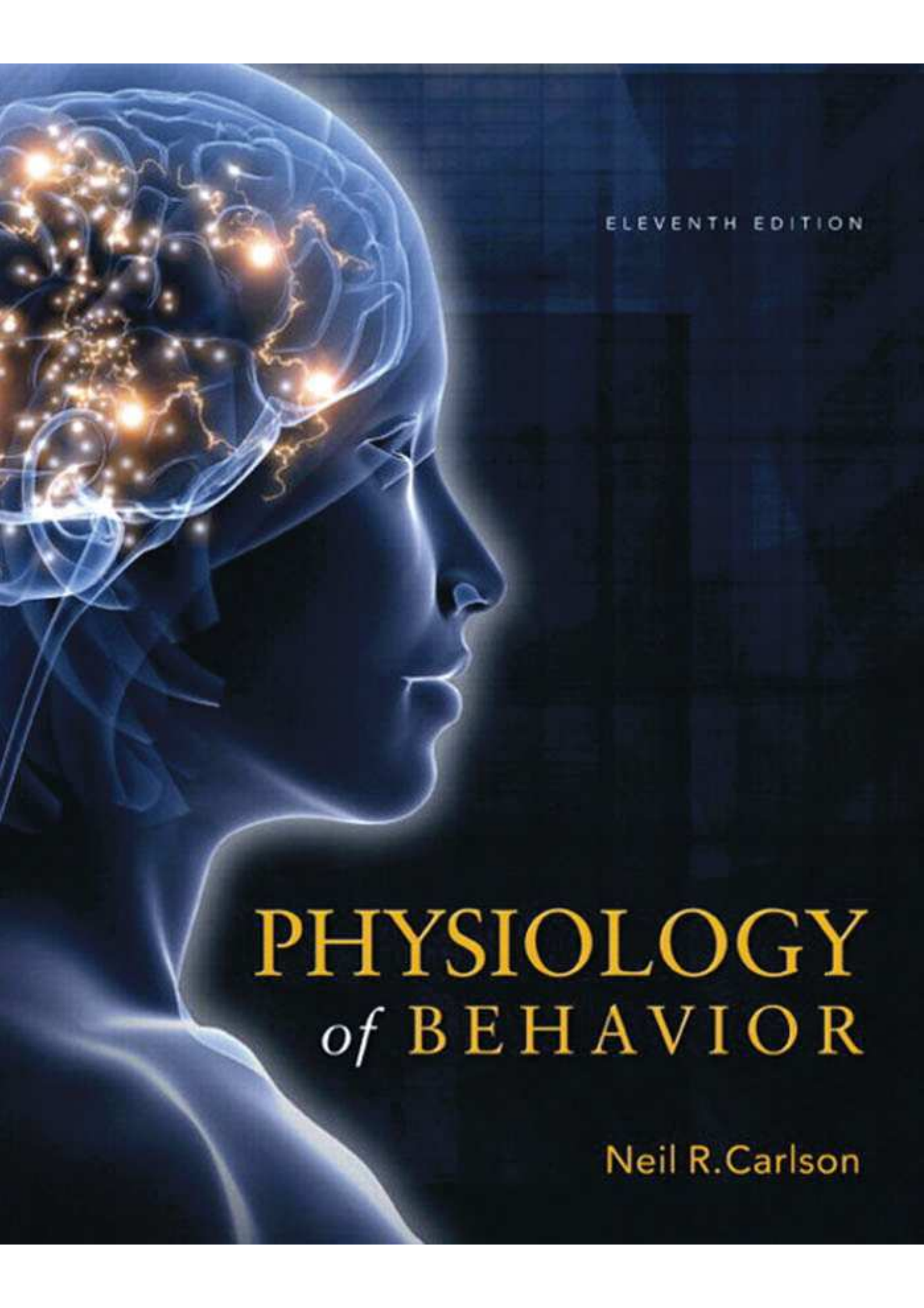
required religious functions must notify me in writing as far in advance of the holiday/obligation as possible. Students will need to identify the specific holiday or obligatory function to me. The student should contact me to make arrangements for making up tests/assignments within a reasonable time.

- **Military Personnel Statement**

A student who is a member of the National Guard, Reserve, or other U.S. Armed Forces branch and is unable to complete classes because of military activation may request complete or partial administrative unrestricted withdrawals or incompletes depending on the timing of the activation. For information, please see <http://www.asu.edu/aad/manuals/usi/usi201-18.html>.

Syllabus disclaimer:

This syllabus is intended to give the student guidance in what may be covered during the semester. Efforts will be made to follow the syllabus as outlined above, but the possibility exists that unforeseen events will make syllabus changes necessary. The instructor reserves the right to make changes to this syllabus and/or course schedule. If changes are made, students will be notified in a timely manner by e-mail or by an announcement in class.



ELEVENTH EDITION

PHYSIOLOGY
of **BEHAVIOR**

Neil R. Carlson

Brief Contents

- Chapter 1** Introduction 1
- Chapter 2** Structure and Functions of Cells of the Nervous System 27
- Chapter 3** Structure of the Nervous System 66
- Chapter 4** Psychopharmacology 99
- Chapter 5** Methods and Strategies of Research 130
- Chapter 6** Vision 164
- Chapter 7** Audition, the Body Senses, and the Chemical Senses 207
- Chapter 8** Control of Movement 255
- Chapter 9** Sleep and Biological Rhythms 288
- Chapter 10** Reproductive Behavior 323
- Chapter 11** Emotion 359
- Chapter 12** Ingestive Behavior 393
- Chapter 13** Learning and Memory 434
- Chapter 14** Human Communication 479
- Chapter 15** Neurological Disorders 516
- Chapter 16** Schizophrenia and the Affective Disorders 552
- Chapter 17** Anxiety Disorders, Autistic Disorder,
Attention-Deficit/Hyperactivity Disorder,
and Stress Disorders 584
- Chapter 18** Drug Abuse 614

Contents



1 Introduction 1

Understanding Human Consciousness: A Physiological Approach 3

- Blindsight 4
- Split Brains 4
- Unilateral Neglect 7
- Perception of Self 8
- SECTION SUMMARY 8

The Nature of Behavioral Neuroscience 9

- The Goals of Research 10
- Biological Roots of Behavioral Neuroscience 10
- SECTION SUMMARY 14

Natural Selection and Evolution 14

- Functionalism and the Inheritance
of Traits 14

Evolution of the Human Species 16

Evolution of Large Brains 19

■ SECTION SUMMARY 21

Ethical Issues in Research with Animals 22

Careers in Neuroscience 26

■ SECTION SUMMARY 24

Strategies for Learning 25

Review Questions 26

Explore the Virtual Brain in MyPsychLab 26



2 Structure and Functions of Cells of the Nervous System 27

Cells of the Nervous System 29

- Neurons 29
- Supporting Cells 36
- The Blood–Brain Barrier 39
- SECTION SUMMARY 40

Communication Within a Neuron 41

- Neural Communication: An Overview 41
- Measuring Electrical Potentials of Axons 43
- The Membrane Potential: Balance
of Two Forces 45
- The Action Potential 46
- Conduction of the Action Potential 49
- SECTION SUMMARY 50

Communication Between Neurons 51

- Structure of Synapses 52
- Release of Neurotransmitter 54

Activation of Receptors 56

Postsynaptic Potentials 57

Termination of Postsynaptic Potentials 58

Effects of Postsynaptic Potentials:
Neural Integration 60

Autoreceptors 60

Other Types of Synapses 61

Nonsynaptic Chemical Communication 62

■ SECTION SUMMARY 63

Review Questions 65

Explore the Virtual Brain in MyPsychLab 65



3

Structure of the Nervous System 66

Basic Features of the Nervous System 67

- An Overview 70
- Meninges 70
- The Ventricular System and Production of CSF 71
- SECTION SUMMARY 74

The Central Nervous System 74

- Development of the Central Nervous System 74
- The Forebrain 80
- The Midbrain 88
- The Hindbrain 89
- The Spinal Cord 91
- SECTION SUMMARY 92

The Peripheral Nervous System 93

- Spinal Nerves 93
- Cranial Nerves 93
- The Autonomic Nervous System 94
- SECTION SUMMARY 98

Review Questions 98

Exploring the Virtual Brain in MyPsychLab 98



4

Psychopharmacology 99

Principles of Psychopharmacology 101

- Pharmacokinetics 101
- Drug Effectiveness 103
- Effects of Repeated Administration 104
- Placebo Effects 105
- SECTION SUMMARY 106

Sites of Drug Action 106

- Effects on Production of Neurotransmitters 107
- Effects on Storage and Release of Neurotransmitters 108
- Effects on Receptors 108
- Effects on Reuptake or Destruction of Neurotransmitters 110
- SECTION SUMMARY 110

Neurotransmitters and Neuromodulators 111

- Acetylcholine 111
- The Monoamines 114
- Amino Acids 121
- Peptides 123
- Lipids 124
- Nucleosides 125
- Soluble Gases 126
- SECTION SUMMARY 127

Review Questions 129

Explore the Virtual Brain in MyPsychLab 129



5

Methods and Strategies of Research 130

Experimental Ablation 132

- Evaluating the Behavioral Effects of Brain Damage 132
- Producing Brain Lesions 132
- Stereotaxic Surgery 134
- Histological Methods 135
- Tracing Neural Connections 139
- Studying the Structure of the Living Human Brain 142

■ SECTION SUMMARY 144

Recording and Stimulating Neural Activity 146

- Recording Neural Activity 146
- Recording the Brain's Metabolic and Synaptic Activity 149
- Stimulating Neural Activity 151

■ SECTION SUMMARY 154

Neurochemical Methods 156

- Finding Neurons That Produce Particular Neurochemicals 156
- Localizing Particular Receptors 157
- Measuring Chemicals Secreted in the Brain 158

■ SECTION SUMMARY 159

Genetic Methods 160

- Twin Studies 160
- Adoption Studies 161
- Genomic Studies 161
- Targeted Mutations 161
- Antisense Oligonucleotides 162

■ SECTION SUMMARY 162

Review Questions 163



6

Vision 164

The Stimulus 166

Anatomy of the Visual System 167

- The Eyes 167
- Photoreceptors 169
- Connections Between Eye and Brain 171

■ SECTION SUMMARY 173

Coding of Visual Information in the Retina 174

- Coding of Light and Dark 174
- Coding of Color 176

■ SECTION SUMMARY 180

Analysis of Visual Information: Role of the Striate Cortex 181

- Anatomy of the Striate Cortex 181
- Orientation and Movement 181
- Spatial Frequency 182

Retinal Disparity 184

Color 184

Modular Organization of the Striate Cortex 185

■ SECTION SUMMARY 186

Analysis of Visual Information: Role of the Visual Association Cortex 187

Two Streams of Visual Analysis 187

Perception of Color 190

Perception of Form 191

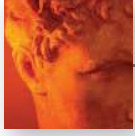
Perception of Movement 198

Perception of Spatial Location 201

■ SECTION SUMMARY 204

Review Questions 206

Exploring the Virtual Brain in MyPsychLab 206



7

Audition, the Body Senses, and the Chemical Senses 207

Audition 208

- The Stimulus 208
- Anatomy of the Ear 209
- Auditory Hair Cells and the Transduction of Auditory Information 211
- The Auditory Pathway 213
- Perception of Pitch 216
- Perception of Loudness 218
- Perception of Timbre 218
- Perception of Spatial Location 219
- Perception of Complex Sounds 223
- SECTION SUMMARY 226

Vestibular System 227

- Anatomy of the Vestibular Apparatus 228
- The Receptor Cells 229
- The Vestibular Pathway 229
- SECTION SUMMARY 230

Somatosenses 231

- The Stimuli 231
- Anatomy of the Skin and Its Receptive Organs 231

- Perception of Cutaneous Stimulation 232
- The Somatosensory Pathways 235
- Perception of Pain 237
- SECTION SUMMARY 242

Gustation 243

- The Stimuli 243
- Anatomy of the Taste Buds and Gustatory Cells 244
- Perception of Gustatory Information 244
- The Gustatory Pathway 246
- SECTION SUMMARY 247

Olfaction 248

- The Stimulus 248
- Anatomy of the Olfactory Apparatus 248
- Transduction of Olfactory Information 250
- Perception of Specific Odors 250
- SECTION SUMMARY 253

Review Questions 254

Exploring the Virtual Brain in MyPsychLab 254



8

Control of Movement 255

Skeletal Muscle 256

- Anatomy 257
- The Physical Basis of Muscular Contraction 258
- Sensory Feedback from Muscles 258
- SECTION SUMMARY 260

Reflexive Control of Movement 261

- The Monosynaptic Stretch Reflex 261
- The Gamma Motor System 261
- Polysynaptic Reflexes 263
- SECTION SUMMARY 264

Control of Movement by the Brain 264

- Organization of the Motor Cortex 265
- Cortical Control of Movement: The Descending Pathways 266

- Planning and Initiating Movements:
 - Role of the Motor Association Cortex 268
- Imitating and Comprehending Movements:
 - Role of the Mirror Neuron System 273
- Control of Reaching and Grasping 275
- Deficits of Skilled Movements:
 - The Apraxias 276
 - The Basal Ganglia 277
 - The Cerebellum 282
 - The Reticular Formation 285
- SECTION SUMMARY 286

Review Questions 287

Exploring the Virtual Brain in MyPsychLab 287



9

Sleep and Biological Rhythms 288

A Physiological and Behavioral Description of Sleep 289

- Stages of Sleep 290
- Mental Activity During Sleep 293
- SECTION SUMMARY 294

Disorders of Sleep 294

- Insomnia 294
- Narcolepsy 295
- REM Sleep Behavior Disorder 297
- Problems Associated with Slow-Wave Sleep 297
- SECTION SUMMARY 298

Why Do We Sleep? 299

- Functions of Slow-Wave Sleep 299
- Functions of REM Sleep 301
- Sleep and Learning 302
- SECTION SUMMARY 303

Physiological Mechanisms of Sleep and Waking 304

- Chemical Control of Sleep 304
- Neural Control of Arousal 305
- Neural Control of Slow-Wave Sleep 308
- Neural Control of REM Sleep 311
- SECTION SUMMARY 314

Biological Clocks 315

- Circadian Rhythms and Zeitgebers 315
- The Suprachiasmatic Nucleus 316
- Control of Seasonal Rhythms: The Pineal Gland and Melatonin 319
- Changes in Circadian Rhythms: Shift Work and Jet Lag 320
- SECTION SUMMARY 321

Review Questions 322

Exploring the Virtual Brain in MyPsychLab 322



10

Reproductive Behavior 323

Sexual Development 324

- Production of Gametes and Fertilization 324
- Development of the Sex Organs 325
- Sexual Maturation 328
- SECTION SUMMARY 331

Hormonal Control of Sexual Behavior 331

- Hormonal Control of Female Reproductive Cycles 331
- Hormonal Control of Sexual Behavior of Laboratory Animals 332
- Organizational Effects of Androgens on Behavior: Masculinization and Defeminization 334
- Effects of Pheromones 334
- Human Sexual Behavior 338
- Sexual Orientation 340
- SECTION SUMMARY 345

Neural Control of Sexual Behavior 346

- Males 346
- Females 348
- Formation of Pair Bonds 350
- SECTION SUMMARY 351

Parental Behavior 352

- Maternal Behavior of Rodents 352
- Hormonal Control of Maternal Behavior 353
- Neural Control of Maternal Behavior 354
- Neural Control of Paternal Behavior 356
- SECTION SUMMARY 357

Review Questions 358

Exploring the Virtual Brain in MyPsychLab 358



11 Emotion 359

Emotions as Response Patterns 360

- Fear 361
- Anger, Aggression, and Impulse Control 365
- Hormonal Control of Aggressive Behavior 371
- SECTION SUMMARY 375

Communication of Emotions 376

- Facial Expression of Emotions:
 - Innate Responses 377
- Neural Basis of the Communication of Emotions:
 - Recognition 378
- Neural Basis of the Communication of Emotions:
 - Expression 384
- SECTION SUMMARY 387



12 Ingestive Behavior 393

Physiological Regulatory Mechanisms 394

Drinking 396

- Some Facts About Fluid Balance 396
- Two Types of Thirst 397
- Neural Mechanisms of Thirst 401
- SECTION SUMMARY 402

Eating: Some Facts About Metabolism 403

- SECTION SUMMARY 406

What Starts a Meal? 406

- Signals from the Environment 406
- Signals from the Stomach 407
- Metabolic Signals 408
- SECTION SUMMARY 409

What Stops a Meal? 410

- Head Factors 410
- Gastric Factors 410
- Intestinal Factors 410
- Liver Factors 411

Feelings of Emotions 388

- The James-Lange Theory 388
- Feedback from Emotional Expressions 390
- SECTION SUMMARY 391

Review Questions 392

Exploring the Virtual Brain in MyPsychLab 392

Insulin 412

Long-Term Satiety: Signals from Adipose Tissue 412

- SECTION SUMMARY 413

Brain Mechanisms 414

- Brain Stem 414
- Hypothalamus 414
- SECTION SUMMARY 420

Obesity 421

- Possible Causes 421
- Treatment 424
- SECTION SUMMARY 427

Anorexia Nervosa/Bulimia Nervosa 428

- Possible Causes 429
- Treatment 431
- SECTION SUMMARY 432

Review Questions 432

Exploring the Virtual Brain in MyPsychLab 433



13

Learning and Memory 434

The Nature of Learning 435

■ SECTION SUMMARY 438

Synaptic Plasticity: Long-Term Potentiation and Long-Term Depression 439

Induction of Long-Term Potentiation 439

Role of NMDA Receptors 441

Mechanisms of Synaptic Plasticity 443

Long-Term Depression 447

Other Forms of Long-Term Potentiation 448

■ SECTION SUMMARY 448

Perceptual Learning 449

Learning to Recognize Stimuli 449

Perceptual Short-Term Memory 451

■ SECTION SUMMARY 452

Classical Conditioning 452

■ SECTION SUMMARY 453

Instrumental Conditioning 454

Basal Ganglia 454

Reinforcement 455

■ SECTION SUMMARY 458

Relational Learning 459

Human Anterograde Amnesia 459

Spared Learning Abilities 461

Declarative and Nondeclarative Memories 462

Anatomy of Anterograde Amnesia 464

Role of the Hippocampal Formation in
Consolidation of Declarative Memories 466

Episodic and Semantic Memories 467

Spatial Memory 468

Relational Learning in Laboratory Animals 469

■ SECTION SUMMARY 476

Review Questions 478**Exploring the Virtual Brain in MyPsychLab 478**

14

Human Communication 479

Speech Production and Comprehension: Brain Mechanisms 480

Lateralization 480

Speech Production 481

Speech Comprehension 485

Aphasia in Deaf People 494

Prosody: Rhythm, Tone,
and Emphasis in Speech 496

Recognition of People's Voices 497

Stuttering 497

■ SECTION SUMMARY 499

Disorders of Reading and Writing 500

Relation to Aphasia 500

Pure Alexia 501

Toward an Understanding of Reading 503

Developmental Dyslexias 509

Toward an Understanding of Writing 511

■ SECTION SUMMARY 513

Review Questions 514**Exploring the Virtual Brain in MyPsychLab 515**



15 Neurological Disorders 516

Tumors 517

- Seizure Disorders 519
- Cerebrovascular Accidents 522
- Traumatic Brain Injury 526
- SECTION SUMMARY 527

Disorders of Development 528

- Toxic Chemicals 528
- Inherited Metabolic Disorders 529
- Down Syndrome 530
- SECTION SUMMARY 531

Degenerative Disorders 531

- Transmissible Spongiform Encephalopathies 531
- Parkinson's Disease 533

- Huntington's Disease 538
- Alzheimer's Disease 540
- Amyotrophic Lateral Sclerosis 545
- Multiple Sclerosis 546
- Korsakoff's Syndrome 547
- SECTION SUMMARY 547

Disorders Caused by Infectious Diseases 549

- SECTION SUMMARY 550

Review Questions 551

[Exploring the Virtual Brain in MyPsychLab](#) 551



16 Schizophrenia and the Affective Disorders 552

Schizophrenia 554

- Description 554
- Heritability 555
- Pharmacology of Schizophrenia:
 - The Dopamine Hypothesis 556
- Schizophrenia as a Neurological Disorder 559
- SECTION SUMMARY 568

- Biological Treatments 571
- The Monoamine Hypothesis 575
- Role of the 5-HT Transporter 575
- Role of the Frontal Cortex 576
- Role of Neurogenesis 577
- Role of Circadian Rhythms 578
- SECTION SUMMARY 582

Major Affective Disorders 570

- Description 570
- Heritability 571
- Season of Birth 571

Review Questions 583

[Exploring the Virtual Brain in MyPsychLab](#) 583



17

Anxiety Disorders, Autistic Disorder, Attention-Deficit/Hyperactivity Disorder, and Stress Disorders 584

Anxiety Disorders 586

Panic Disorder, Generalized Anxiety Disorder,
and Social Anxiety Disorder 586

Obsessive-Compulsive Disorder 588

■ SECTION SUMMARY 592

Autistic Disorder 593

Description 593

Possible Causes 594

■ SECTION SUMMARY 597

Attention-Deficit/Hyperactivity Disorder 598

Description 598

Possible Causes 599

■ SECTION SUMMARY 601

Stress Disorders 601

Physiology of the Stress Response 602

Health Effects of Long-Term Stress 603

Effects of Stress on the Brain 604

Posttraumatic Stress Disorder 606

Psychoneuroimmunology 609

■ SECTION SUMMARY 612

Review Questions 613

Exploring the Virtual Brain in MyPsychLab 613



18

Drug Abuse 614

Common Features of Addiction 615

A Little Background 615

Positive Reinforcement 616

Negative Reinforcement 620

Craving and Relapse 621

■ SECTION SUMMARY 624

Commonly Abused Drugs 624

Opiates 625

Stimulant Drugs: Cocaine and Amphetamine 626

Nicotine 627

Alcohol 631

Cannabis 633

■ SECTION SUMMARY 635

Heredity and Drug Abuse 636

■ SECTION SUMMARY 638

Therapy for Drug Abuse 638

■ SECTION SUMMARY 641

Review Questions 643

Exploring the Virtual Brain in MyPsychLab 643

REFERENCES 645

NAME INDEX 713

SUBJECT INDEX 723