Evolution and Ecology 100 .................. 4
Neurobiology, Physiology, and Behavior 102 .......... 5
Approved electives .................................. 2
Other Biological Sciences or related science courses may be substituted with the prior approval of the major adviser.

Physics ........................................ 15
Physics 108 .................................. 3
Chemistry 107A ................................ 7
Geology 161, 162, 163 ............................. 9
Approved electives ................................ 2
Other Physics or related science courses may be substituted with the prior approval of the major adviser.

*Note: Students pursuing a concentration in earth science or physics may not have had the necessary prerequisites in organic chemistry.


Nature and Culture

(Formerly Entomology and Plant Pathology)

This major was discontinued effective June 30, 2011.

Courses in Nature and Culture (NAC)

Upper Division

192. Internship in Nature and Culture (1-12)

Internship—3-36 hours. Prerequisite: course 1. Internship in natural sciences, social sciences, or humanities on or off campus in which students use and improve their interdisciplinary skills and perspectives gained through the Nature and Culture curriculum. Supervised by a faculty member. May be repeated for credit. [F/P/NP grading only.

Nematology

Please see the department of Entomology and Nematology, on page 293, for further information.

(Formerly Entomology and Plant Pathology)

Michael Parrella, Ph.D., Chairperson of the Department
Edwin Lewis, Ph.D., Vice Chairperson of the Department
Department Office. 367 Briggs; 530-752-0300

Faculty

Edward P. Caswell-Chen, Ph.D., Professor
Howard Ferris, Ph.D., Professor
Edwin E. Lewis, Professor
Steven A. Nadler, Ph.D., Professor
Becky B. Werdahl, Ph.D., Professor
Emeriti Faculty

Bruce A. Jaffe, Ph.D., Professor Emeritus
Harry K. Kaya, Ph.D., Professor (Entomology)

Minor Program Requirements:

Nematology ........................................... 18-20
Nematology 100, 110, and Soil Science 100. ......................... 10
Two or three courses from one of the following areas: ................................. 8-10
(a) Plant Science: Microbiology 102; Entomology 100, 135, 153, 156, 156l; Evolution and Ecology 112; Plant Pathology 120, 148; Plant Biology 121; Soil Science 111, 112
(b) Entomology: One upper division Entomology course; Evolution and Ecology 112; Microbiology 102; Plant Biology 121; Plant Pathology 120, 148, Soil Science 102, 111, 112
Minor Adviser. S. Lawler

Graduate Study

Graduate degrees specializing in Nematology are offered through the Departments of Entomology and Plant Pathology, and through various Graduate Groups (Biochemistry, Ecology, Genetics, Plant Protection and Pest Management). Refer also to the Graduate Studies chapter of this catalog.

Courses in Nematology (NEM)

Related Courses. See Entomology and Nematology, on page 293.

10V. General Biology (4)

Web virtual lecture—3 hours; web electronic discussion—1 hour. Concepts and issues in biology. Emphasis on composition and structure of organisms; regulation and signaling; heredity, evolution and the interaction and interdependence among life forms and their environments. Significant writing is required. Designed for students not specializing in biology. Not open for credit to students who have completed course Biological Sciences 1A, 1B, 2A, 2B, 2C or 10. (Same course as Biological Sciences 10V) GE credit: SciEng, Wrt [SE, SL, WE.—Ill. (III.) Westerdahl]

Upper Division

100. General Plant Nematology (4)

Lecture—2 hours; laboratory—6 hours. Prerequisite: Biological Sciences 1B or 10. An introduction to the classification, morphology, biology, and control of the nematodes attacking cultivated crops. GE credit: SciEng | SE—[I.] Ferris

110. Introduction to Nematology (2)

Lecture—2 hours. Prerequisite: Biological Sciences 1B or the equivalent or consent of instructor. The relationship of nematodes to human environment. Classification, morphology, ecology, distribution, and importance of nematodes occurring in water and soil as parasites of plants and animals. GE credit: SciEng | SE—[II. (II.) Caswell-Chen, Nadler

199. Special Study for Advanced Undergraduates (1-5)

Prerequisite: consent of instructor. [F/P/NP grading only.

Graduate

201. Molecular and Physiological Plant Nematology (2)

Lecture—1 hour; discussion—1 hour. Prerequisite: Biological Sciences 101; Plant Pathology 120, course 100 or 110. Molecular biology and physiology of nematodes using Caenorhabditis elegans as a model, but with emphasis on plant-parasitic species. Plant responses to nematodes. Discussion of current literature emphasized. Offered in alternate years. —[II. Williams]

203. Ecology of Parasitic Nematodes (2)

Lecture—1 hour; discussion—1 hour. Prerequisite: course 100 or 110 or Entomology 156; Evolution and Ecology 101 or Plant Biology 117. Major concepts in population and community ecology of animal and plant-parasitic nematodes. Current advances in techniques, theory, and basic information about nematode host dynamics, and application to management of nematode disease. Offered in alternate years. —[III. Caswell-Chen

204. Management of Plant-Parasitic Nematodes (2)

Lecture—1 hour; laboratory—3 hours. Prerequisite: course 100 or 110. Theory, foundation, principles and practices of nematode management. Techniques and equipment used to manage nematodes and methods used to analyze their effectiveness. Offered in alternate years. —[II. Westerdahl

205. Insect Nematology and Biological Control (2)

Lecture—1 hour; discussion—1 hour. Prerequisite: courses 100 and 110, Entomology 100 or 110. The biology of insect-parasitic nematodes, their effect on the host, and their potential as biological control agents of insect and other invertebrate pests. Application of ecological theory in classical and augmentation biological control. Offered in alternate years. —[I.] Kaya, Lewis

206. Nematode Systematics and Evolution (2)

Lecture—1 hour; laboratory—3 hours. Prerequisite: course 100 or 110 or Entomology 156; Evolution and Ecology 100 recommended. Nematode diversity as revealed by morphological and molecular evidence. Laboratory experience focuses on structural features used in taxonomy. Phylogenetic relationships based on morphological and molecular data used to construct patterns of character change among taxa. Offered in alternate years. —[I.] Nadler

210. Molecular Phylogenetic Analysis (3)

Lecture—2 hours; laboratory—3 hours. Theory and practice of inferring phylogenetic trees using molecular sequence data. Practical techniques for obtaining sequence data, advantages and disadvantages of common approaches for inferring trees, statistical methods for comparing alternative hypotheses. [Same course as Evolution and Ecology 210; Offered in alternate years. —[II.] Nadler

245. Field Nematology (1)

Fieldwork—6 days. Prerequisite: course 100. Six day demonstration and field study in applied nematology including diagnosis and prediction of nematode field problem strategies for control field plot design, and establishment in association with diverse California crops. [S/U grading only. —I. (I.)}

290. Seminar (1)

Seminar—1 hour. [S/U grading only.]—II, III. (III.)

290C. Advanced Research Conference (1)

Discussion—1 hour. Prerequisite: graduate standing and consent of instructor. Planning and results of research programs, proposals, and experiments. Discussion and critical evaluation of original research being conducted by the group. Discussion led by individual research instructors for research group. [S/U grading only.

298. Group Study (1-5)

[S/U grading only.

299. Research (1-12)

[S/U grading only.

Neurobiology, Physiology, and Behavior

(Formerly Neurobiology and Physiology)

Pre-Fall 2011 General Education (GE): ArtHum—Arts and Humanities; SciEng—Science and Engineering; SocSci—Social Sciences; ACGH—American Cultures; DD—Diverse Domestic Diversity; Wrt—Writing Experience

Fall 2011 and on Revised General Education (GE): ArtHum—Arts and Humanities; SciEng—Science and Engineering; SocSci—Social Sciences; ACGH—American Cultures; DD—Diverse Domestic Diversity; OL—Oral Skills; QL—Quantitative; SL—Scientific; VL—Visual; WC—World Cultures; Wrt—Writing Experience

Quarter Offered: I—Fall, II—Winter, III—Spring, IV—Summer; 2015-2016 offering in parentheses

443 Nature and Culture
Exercise biology deals with the mechanisms and consequences of activity from the molecular to the environmental conditions. The exercise biology major encompasses the critical aspects of an integrative program in applying the fundamental principles of Physiology and Membrane Biology. The Bachelor of Arts program provides a greater breadth of knowledge in the humanities and social sciences and is more appropriate for those who wish to apply their expertise within the human community. The Bachelor of Science program is appropriate for students who desire a strong preparation in human biology.

Advising and Career Alternatives. Meet with an Exercise Biology staff advisor in the Biology Academic Success Center (BASC), 1023 Sciences Laboratory Building; 530-752-0410; http://www.biosci.ucdavis.edu/BASC, to learn more about the best course sequences to take to prepare you for careers in basic sciences, such as applied exercise physiology, or biomechanics; for graduate study in exercise physiology or biomechanics; or for professional programs in medicine, or physical therapy, athletic training or occupational therapy. Students with further academic or professional interests in medicine and other health sciences, community service, business, sales, communications, education or coaching might find the Bachelor of Arts program attractive. The Bachelor of Science could lead to further graduate study in any field related to human biology as well as careers in medicine and other health sciences (e.g., physical therapy), biomechanics and biomedical engineering and medical equipment and pharmaceutical development and sales.

A.B. Major Requirements:

Preparatory Subject Matter ................ 37-40

Biological Sciences 2A-2B-2C .................. 14
Chemistry 2A, 2B .................................. 10
Physics 1A-1B-1C, 108 ............................ 6-10
Psychology 1 ........................................ 4
Statistics 13, 32, 100, or 102 .................. 3-4
Psychology 41 recommended

Depth Subject Matter ....................... 40-45

Biological Sciences 101, 102, 103, 110 ....... 18
Neurology, Physiology, and Behavior 101 . 5
Exercise Biology 106 and 106L ................. 7
Exercise Biology 107, 108, 109, 104L ........ 15
One additional upper division course in Exercise Biology .................. 3-4
Select one additional course from two of the three content areas listed below: 6-10

Sociology and Culture option: African American and African Studies 100; Anthropology 101; Communication 165; Comparative Literature 176; Exercise Biology 120; History 178B; Science and Society 105, 120; Science and Technology Studies 150; Sociology 122, 154, 159, 177
History and Philosophy option: Dramatic Art 114; History 135A, 135B, 136, 139A, 139B, 185A; Philosophy 108; Science and Technology Studies 130, 131
Psychology and Communication option: Agricultural and Resource Economics 112, Communication 134, 136; Exercise Biology 121, 122; Human Development 100C; Psychology 101, 121, 126, 140.
No variable unit courses or Exercise Biology 148, 148L may be used to fulfill these requirements. Consult your advisor regularly.

Total Units for the Major ..................... 77-85

B.S. Major Requirements:

Preparatory Subject Matter ................ 55-73

Biological Sciences 2A-2B-2C .................. 14
Chemistry 2A-2B-2C .............................. 15
Chemistry 8A-88 or 118A-118B-118C .... 6-12
Mathematics 17A-17B-17C or 21A-21B-21C recommended .......................... 8-12
Physics 7A-7B-7C or 9A-9B-9C-9D .......... 12-20

Psychology 1 is highly recommended for all students.

Pharmacology 21A-21B-21C-21D, 22A-22B, Physics 9A-9B-9C-9D and Engineering 6, 35 are recommended for students interested in graduate study in Biomechanics.

Depth Subject Matter .................. 50-55

Biological Sciences 101, 102, 103, 104L, 105+ may be substituted for 105 .................................. 10-13
Neurobiology, Physiology, and Behavior 101 .......................................................... 5
Exercise Biology 106 and 106L ............. 7
Exercise Biology 101, 102, 103, 104L ......... 15
Statements 100 or 102 .......................... 15
Completion of three courses (9-11 units) selected from the following: (see advisor for help in selecting appropriate course sequences)

One course from Group A ...................... 3-4
One additional course from Group A or Group B .......................................... 3-4
One additional course from Groups A, B or C ...................................................... 3-4
Group A: Exercise Biology 111, 112, 115, or 126 [laboratory courses]
Group B: Exercise Biology 110, 113, 117, 124, 125, 179
Group C: Exercise Biology 122; Applied Science Engineering 113; Engineering 102; Neurobiology, Physiology, and Behavior 112, 113, 140; Nutrition 111A

No variable unit courses or Passed/Not Passed graded courses may be used to fulfill these requirements. Consult your advisor regularly.

Total Units for the Major ..................... 105-128

Minor Program Requirements:

Exercise Biology ..................... In units

At least 15 upper division units in exercise biology from the following courses: Exercise Biology 101, 102, 103, 110, 111, 112, 113, 115, 117, 124, 126.
Exercise Biology or another approved course. An additional three upper division units from either the previous list of Exercise Biology courses OR the following courses: Exercise Biology 106; Neurobiology, Physiology, and Behavior 101; Biological Sciences, 101, 104, 105 .......................... 3

Master Adviser. Paul Salitisky for the Exercise Biology Major and Exercise Biology Minor

The Neurobiology, Physiology, and Behavior Major Program

Neurobiology, Physiology, and Behavior is a major that emphasizes the understanding of vital functions common to all animals. All animals perform certain basic functions—they grow, reproduce, move, respond to stimuli, and maintain homeostasis. The physiological mechanisms upon which these functions depend are precisely regulated and highly integrated. Actions of the nervous and endocrine systems determine behavior and the interaction between organisms and their physical and social environments. Students in this major study functional mechanisms; the control, regulation, and integration of these mechanisms; and the behavior that relates to these mechanisms. They do so at the level of the cell, the organism, and the system.

The Program. In the freshman and sophomore years, students majoring in Neurobiology, Physiology, and Behavior build a broad scientific background, taking courses in biology, biochemistry, physics, and mathematics. As juniors or seniors, students can enroll in a variety of Neurobiology, Physiology, and Behavior courses and related upper division courses. Students can participate in a number of advanced laboratory courses or may design an individual, independent project guided by a member of the faculty.
Neurobiology, Physiology, and Behavior

Career Alternatives. Completion of the Neurobiology, Physiology, and Behavior major provides the foundation for advanced study leading to careers in high school teaching, college level teaching or research. It also serves as the basis for further training in the health professions, including but not limited to: Pre-medicine, medical technology, physical therapy, pharmacy, nursing, dentistry and optometry. The major is also appropriate for those intending to seek careers in biotechnology or other biologically related industries.

B.S. Major Requirements:

Preparatory Subject Matter: 55-65
- Biological Sciences 2A-2B-2C............. 14
- Chemistry 2A-2B-2C.................. 15
- Chemistry 8A-8B or 118A-118B-118C........ 6-12
- Mathematics 17A-17B-17C or 21A-21B-21C recommended.............. 8-12
- Physics 7A-7B-7C...................... 12

Depth Subject Matter: 44-49

- Biological Sciences 101, 105 or 102+103, 104, 107................................................... 12
- Neurobiology, Physiology, and Behavior 100, 101, 102........................................ 12
- Select three or more units of laboratory course with the following list: 3-5
  - Neurobiology, Physiology, and Behavior 100L, 101L, 104L, 106, 111L, 124, 141P, 150, 194H; other courses with the approval of the master advisor.
  - Statistics 100H........................................... 30
  - Additional Neurobiology, Physiology, and Behavior courses not used in satisfaction of any other requirement; or Anthropology 154A, 154BN, or Entomology 104; or Exercise Biology 101, 102, 111. Courses 192, 197, 199 may not be used to satisfy the depth unit requirement.
  - One course from: Anthropology 151, Evolution and Ecology 100, Geology 107.............................................................. 3

Total Units for Major: 99-115

Minor Program Requirements:

Physical Human Physiology: 20
- Exercise Biology 101................................................. 4
- Neurobiology, Physiology, & Behavior 101............................................. 5
- One course from: Exercise Biology 102, 110, 118, 119, 117, 125
  - One course from: Neurobiology, Physiology, & Behavior 112, 113, 114, 122, 130, 132, 168
  - One course from: two of the following areas: Functional Anatomy: Cell Biology and Human Anatomy 101; Anthropology 156 Genetics and Development: Anthropology 153; Human Development 100C, 101, 117; Molecular and Cellular Biology 162 Immunology: Medical Microbiology 188 Nutrition: Nutrition 1118

Neurobiology, Physiology, & Behavior: 18
- Neurobiology, Physiology, & Behavior 100................................................. 4
- Five courses from:
  - Choose at least four from the following:
  - One of the following may be completed to fulfill the minor: Psychology 113, 121, 129, 135, Linguistics 175, Philosophy 103, Human Development 163
  - The Open electives are cross-listed and either offering can be used to fulfill the course requirements of Neurobiology, Physiology, and Behavior 124/Neuroscience

COURSES IN EXERCISE BIOLOGY (EXB)

Lower Division

10. Exercise and Fitness: Principles and Practice (3)
   - Lecture—3 hours. Human movement from physiological, psychological, sociological, and historical perspectives. Biology and psychology of exercise across the human lifespan. Not open for credit to students who have completed an upper division Exercise Biology course.
   - GE credit: SciEng | SE.

90C. Research Conference (1)
   - Discussion—1 hour. Prerequisite: lower division standing in Exercise Biology or related biological science and consent of instructor; concurrent enrollment in course 99. Research findings and methods in exercise biology. Presentation and discussion of research by faculty and students. May be repeated for credit. (P/NP grading only;—I, II, III, I, II, III) Barr, Shaffrath

90X. Lower Division Seminar (1-2)
   - Lecture—1-2 hours. Prerequisite: lower division standing and consent of instructor. Gives freshmen or sophomore level students the opportunity to study a special topic in the general area of Exercise Biology in a small class setting. GE credit: SciEng | SE.

92. Exercise Biology Internship (1-5)
   - Internship—3-15 hours. Prerequisite: consent of instructor, dependent on availability of intern positions. Work experience in the application of physical activity programs to teaching, recreational, clinical or research situations under department faculty supervision. May be repeated one time for credit. (P/NP grading only;—I, II, III, I, II, III)

97T. Tutoring in Exercise Biology (1-5)
   - Tutorial—3-5 hours. Prerequisite: lower division standing and consent of instructor. Assisting the professor by tutoring students in exercise biology course-related assignments. May be repeated for credit for 10 units including courses 97T, 97XT, and 97T. No tutorial units will be counted towards the Exercise Biology major. (P/NP grading only;—I, II, III, I, II, III)

97TC. No tutorial units will be counted towards the upper division units of credit allowed to students who have completed Exercise Science 104.

97T. Tutoring in Exercise Biology in the Community (1-5)
   - Tutorial—3-5 hours. Prerequisite: consent of instructor and chairperson. Tutoring in the community in exercise biology topics under the guidance of the faculty. May be repeated one time for credit. (P/NP grading only;—I, II, III, I, II, III)

97TC. Tutoring Exercise Biology in the Community (1-5)
   - Tutorial—3-5 hours. Prerequisite: consent of instructor and chairperson. Tutoring in the community in exercise biology topics under the guidance of the faculty. May be repeated one time for credit. (P/NP grading only;—I, II, III, I, II, III)

98. Directed Group Study
   - Prerequisite: consent of instructor and chairperson. (P/NP grading only;—I, II, III)

99. Special Study for Undergraduates (1-5)
   - Prerequisite: consent of instructor. (P/NP grading only;—I, II, III, I, II, III)

Upper Division

101. Exercise Physiology (4)
   - Lecture—4 hours. Prerequisite: Neurobiology, Physiology, and Behavior 160/Neuroscience 160

102. Introduction to Motor Learning and the Psychology of Sport and Exercise (4)
   - Lecture—4 hours. Prerequisite: Psychology 1 recommended. Theoretical and practical issues in motor learning, sport psychology, and exercise psychology. Emphasis on how motor skills are acquired and retained, and on the application of social psychology and human motivation studies to human performance. Only 2 units of credit allowed to students who have completed Exercise Science 104. Only 2 units of credit allowed to students who have completed Exercise Science 105. Not open for credit to students who have completed Exercise Science 104 and 105. (Former Exercise Science 104 and 105) GE credit: SocSci | SS.—I, II, III, I, II, III)

103. Analysis and Control of Human Movement (4)
   - Lecture—4 hours. Prerequisite: Cell Biology and Human Anatomy 101 and 103, or 78B. Neurobiology, Physiology, and Behavior 101 recommended. Introduction to functional anatomy, neuropsychological basis of motor control, and biomechanics of human movement. Human movement understood in the context of body structures, basic principles of physics, and functional characteristics of nerve and muscle. Only 1 unit of credit allowed to students who have completed Exercise Science 103. Only 3 units of credit allowed to students who have completed Exercise Science 104. Not open for credit to students who have completed Exercise Science 103 and 104. (Former Exercise Science 103 and 104) GE credit: SciEng | QL, SE.—III, I, II, III)

104L. Exercise Biology Laboratory (3)
   - Laboratory—3 hours; lecture—1 hour; discussion—1 hour. Prerequisite: course 101, 102, 103 (the last course may be taken concurrently). Principles and analytical procedures for assessing fundamental physiological, biomechanical, motor learning and motor control factors which underlie human movement and performance. Only 1 unit of credit allowed to students who have completed Exercise Science 101L. Only 1 unit of credit allowed to students who have completed Exercise Science 101L. Not open for credit to students who have completed Exercise Science 101L and 103. GE credit: SciEng, Wrt | SE, WE.—I, II, III, I, II, III)

106. Human Gross Anatomy (4)
   - Lecture—4 hours. Prerequisite: Biological Sciences 2A; concurrent enrollment in course 106L or Cell Biology and Human Anatomy 101 strongly recommended. Upper division students only; Pass One open to upper division Biological Sciences or Anthropology majors only; Pass 2 open to Seniors in any major; Open enrollment at the start of the quarter for upper division students in any major. Detailed study of the gross anatomical structure of the human body, with emphasis on function and clinical relevance to students entering health care professions. (Same course as Cell Biology and Human Anatomy 101) GE credit: SciEng | QL, SE —I, II, III)

106L. Human Gross Anatomy Laboratory (3)
   - Laboratory—9 hours. Prerequisite: Biological Sciences 2A; must take course 106 or Cell Biology and Human Anatomy 101 concurrently (or have already completed). Upper division students only; Pass One open to upper division Biological Sciences or Anthropology majors only; Pass 2 open to Seniors in any major; Open enrollment at the start of the quarter for upper division students in any major; mandatory attendance on first day of lab. Detailed study of prospected human cadavers in small group format with...
Neurobiology, Physiology, and Behavior

extensive hands-on experience. (Same course as Cell Biology and Human Anatomy 101L) GE credit: SciEng | SE.—III. (III.) Gomes

110. Exercise Metabolism (3)
Lecture—3 hours. Prerequisite: course 101 or Neurobiology, Physiology and Behavior 101. Exercise metabolism, with emphasis on skeletal muscle and cardiovascular system during activity and inactivity. Basics of bioenergetics, substrate utilization, and cell signaling; mechanisms that regulate these properties, and differences between skeletal muscle and cardiac muscle. GE credit: SciEng | SE.—II.—III. (III.) Shaffrath

111. Environmental Effects on Physical Performance (3)
Lecture—2 hours; discussion/laboratory—3 hours. Prerequisite: courses 101 or consent of instructor. The effects of thermal, barometric and gravitational conditions on physiological function and physical performance of humans. Acute and chronic effects, emphasizing physiological adaptations and limitations, will be studied. GE credit: SciEng | QL, SE.—II. (II.) Shaffrath

112. Clinical Exercise Physiology (4)
Lecture—3 hours; laboratory/discussion—3 hours. Prerequisite: courses 101 or consent of instructor. Physical activity as a therapeutic modality in normal and diseased populations (cardiovascular, pulmonary, diabetic). Effects of exercise and inactivity in terms of normal physiology, pathophysiology, and therapeutic benefit. Exercise fitness and disease assessment methods. GE credit: SciEng | QL, SE, VL, WE.—I. (I.) Liets

115. Biomechanical Bases of Movement (3)
Lecture—2 hours; laboratory—3 hours to alternate weekly with discussion—1 hour. Prerequisite: course 103 or consent of instructor. Biomechanical bases of human movement investigated; topics include musculo-skeletal mechanics, tissue mechanics, electromyography, and measurement and analysis techniques. Application of clinical, and work environments, including extensive analysis of locomotion. GE credit: SciEng | QL, SE, VL, WE.—I. (I.) Liets

116. Nutrition for Physically Active Persons (3)
Lecture—3 hours. Prerequisite: course 101, Neurobiology, Physiology, and Behavior 101. The role of nutrition and exercise in modifying metabolism, body composition, performance, and health of humans. GE credit: SciEng | SE.—II. (II.) Shaffrath

117. Exercise and Aging in Health and Disease (3)
Lecture—2 hours; discussion—1 hour. Prerequisite: course 101 or consent of instructor. Etiology of exercise and standard therapy for various diseases associated with aging (e.g., cardiovascular, pulmonary, and renal diseases, diabetes, obesity, lipemias, etc.). Exercise will be considered as a protective and/or therapeutic modality. GE credit: SciEng | SE.—II.—III. (III.) Shaffrath

120. Sport in American Society (3)
Lecture—3 hours. Sociological approaches to the study of sport. Contemporary American culture, including sport interaction with politics, economics, religion, gender, race, media and ethics. Socialization factors involving youth, scholastic, collegiate, and Olympic sport. (Same course as Physical Education 120) GE credit: SocSci, Div | SS.—I, II, III. (III.)

121. Advanced Sport Psychology (3)
Lecture—3 hours. Prerequisite: course 102. Psychology 1 recommended. Advanced study and consideration of major theoretical and practical issues in sport psychology. Emphasis on practical application to sport and human performance. —Salitsky

122. Psychological Effects of Physical Activity (3)
Lecture—3 hours. Prerequisite: Psychology 1; upper division standing. Physical activity is evaluated in terms of its ability to enhance the quality of life. Topics include: individual factors (self concept, type A), special populations (elderly, cardiovascular), and mental health changes (depression, anxiety). —Salitsky

124. Physiology of Maximal Human Performance (3)
Lecture—3 hours, practice—4 hours. Prerequisite: course 101 or permission of instructor; Biological Sciences 101, 102, and 103 recommended. Molecular mechanisms underlying adaptation to training. Learn how to externally and internally appreciate and apply this performance as well as learning how the frequency, intensity and timing of exercise and nutrition affect the molecular signals that underlie performance. GE credit: SciEng | QL, SE.—II. (II.) Shaffrath

125. Neuromuscular and Behavioral Aspects of Motor Control (3)
Lecture—2 hours; lecture/discussion—2 hours. Prerequisite: course 101. Factors which affect control of movement from neurological, physiological, behavioral, and mechanical viewpoints. Topics include central vs. peripheral control mechanisms, open and closed loop theories, motor programming, cognitive control, motor units, effects of bio-chemical and biomechanical influences. GE credit: SciEng | SE.—Bone

126. Tissue Mechanics (3)
Lecture—2 hours; laboratory/discussion—3 hours. Prerequisite: course 103 or Engineering 45 or consent of instructor. Structural and mechanical properties of biological tissues including bone, cartilage, ligaments, tendons, nerves, and skeletal muscle. (Same course as Engineering 126.) GE credit: SciEng | QL, SE, SL, WE,—II. (II.) Hawkins

148L. Adult Fitness Testing Laboratory (1)
Lecture—3 hours. Prerequisite: courses 148 (concurrently). Testing and practice of exercise testing applied to older adult populations. Physiological responses to and limitations of exercise testing. Application of exercise testing and training to health and diseased populations. (P/NP grading only) GE credit: SciEng.—I, II, III. (II, III.)

190C. Research Conference (1)
Discussion—1 hour. Prerequisite: upper division standing in Exercise Biology or related biological sciences and consent of instructor. Offered every fourth year. GE credit: SciEng.—I, II, III, (II, III.)

192. Exercise Biology Internship (1-12)
Internship—3.36 hours. Prerequisite: consent of instructor, dependent on availability of intern positions. Work experience in the application of physical activity programs to teaching, recreational, clinical or research situations under program faculty supervision. Written report required. May be repeated up to 15 units of credit, including course 99. (P/NP grading only.)

194H. Research Honors (2)
Independent study—6 hours. Prerequisite: senior standing, minimum of 6 units of course 199, 3,500 GPA or greater in major courses, consent of honors advisor. Completion of individual honors research project in Exercise Biology, under the guidance of an Exercise Biology faculty adviser, culminating in written honors thesis. (P/NP grading only.) GE credit: SE.—I, II, III, (II, III.)

197T. Tutoring in Exercise Biology (1-5)
Tutorial—3-1.5 hours. Prerequisite: upper division standing and consent of instructor. Assisting the instructor by tutoring students in exercise biology course-related projects. May be repeated up to 10 units of credit including courses 97T, 97TC and 97TT. No tutorial units will be counted towards the Exercise Biology major. (P/NP grading only.)—I, II, III, (II, III.)

198. Directed Group Study (1-5)
Prerequisite: consent of instructor and chairperson. (P/NP grading only) GE credit: SE.—I, II, III, (II, III.)

199. Special Study for Advanced Undergraduates (1-5)
Prerequisite: consent of chairperson. (P/NP grading only) —I, II, III, (II, III.)

Courses in Neurobiology, Physiology, and Behavior (NPB)

Lower Division

10. Elementary Human Physiology (3)
Lecture—3 hours. Introduction to physiology for non-science majors. Includes basic cell physiology and survey of major organ systems and how they function in homeostasis and human health. Not open for credit to students who have completed course 101. GE credit: SciEng.—II. (II.) Bautista, Mogilner

12. The Human Brain and Disease (3)
Lecture—3 hours. Normal function and diseases of the human brain and nervous system. Diseases discussed include Parkinson’s, Alzheimer’s, leprosy, amnesia and schizophrenia. Intended for non-science majors. Not open for credit to students who have completed courses 100, 101, 112, or Psychology 121. GE credit: SciEng.—I. (I.) Cheng, Recanatella

14. Illusions: Fooling the Brain (3)
Lecture—3 hours. Introduction to perceptual processing in the human nervous system; illusions. GE credit: SciEng | QL, SE, SL.—II. (II.) Ditterich
15. The Biology and Physiology of Aging (4)
Lecture—3 hours; discussion—1 hour. Broad examination of age-associated changes in body functions. Includes basic cell physiology, a survey of major organ systems and the age-induced alterations in systemic function. Some age-associated diseases will also be examined. Not open for credit to students who have completed course 15S. GE credit: SciEng | SE.

15V. The Biology and Physiology of Aging (4)
Web virtual lecture—3 hours; web electronic discussion—1 hour. Broad examination of the biological and physiological basis of aging in animals and plants. Concepts in demographic, evolutionary, genetic, and cell aging. Major human organ systems, age-related alterations in system function, and age-related diseases. Intended for non-science majors. Not open for credit to students who have completed course 15. GE credit: SciEng | SE; SL—III (III.) McDonald

68. Biology of Drug Addiction and Abuse (3)
Lecture—3 hours. Broad examination of addictive substances and their use/abuse. Topics include historical perspective, physiological effects, etiology, neurobiology of addiction and the impact of drugs on the individual. Intended for non-science majors. Not open for credit to students having completed course 16B. GE credit: SciEng. (III.) Ballstaadt

90A. Lower Division Seminar: Issues in Body Weight Regulation (2)
Seminar—2 hours. Prerequisite: lower division standing. Critical examination of issues in body weight regulation through shared readings, discussions, written assignments, debates and oral presentations. Limited enrollment.—C. War- den

90B. Human Color Perception (2)
Seminar—2 hours, term paper. Prerequisite: lower division standing. The neural determinants of color appearance, and why we see the world in the way we do. Discussions center around demonstrations of color phenomena and what they tell us about the human brain. Limited enrollment.—Werner

90C. Current Issues in Animal Behavior (2)
Seminar—2 hours. Prerequisite: lower division standing. The mechanisms and outcomes of sexual selection (mate choice and mate competition). Theory, current models and evidence that supports or refutes the models. Limited enrollment.—II. (II.) Hedrick

90D. Lower Division Seminar: Current Issues in Reproductive Endocrinology (2)
Seminar—2 hours. Prerequisite: lower division standing. The integrative roles of reproductive hormones in mammalian reproduction and health. Current theory and models regarding hormone function and use in reproductive health and contraception, and evidence that supports or refutes the models. Offered irregularly.

90E. Biology of Aging (2)

90F. Visual Impairment and Blindness: A World Wide Problem (2)
Seminar—2 hours. Prerequisite: lower division standing. Examination of various abnormalities of the eye and the important geographic and cultural factors that influence the epidemiology of these abnormalities. Offered irregularly.

91C. Research Conference (1)
Discussion—1 hour. Prerequisite: Lower division standing in Neuroscience, Physiology, and Behavior or related biological science and consent of instructor; concurrent enrollment in course 99. Research studies and methods in neuroscience, physiology, and/or behavior. Presentation and discussion of research by faculty and students. (P/NP grading only)—II, III (III.)

92. Internship (1-12)
Internship—3-36 hours. Prerequisite: lower division standing; consent of instructor. Work experience off and on campus in all subject areas offered in the Department of Neuroscience, Physiology, and Behavior. Internships supervised by a member of the faculty. May be repeated for credit. (P/NP grading only)—II, III (III.)

98. Directed Group Study (1-5)
Prerequisite: lower division standing and consent of instructor. (P/NP grading only)—II, III (III.)

99. Special Study for Undergraduates (1-5)
Prerequisite: lower division standing and consent of instructor. (P/NP grading only)—II, III (III.)

Upper Division

100. Neurobiology (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: Biological Sciences 1AB or 2ABC, Physics 9 ABC or 7ABC.Brains and nervous systems and neural circuits. Coordination of movement. Development of nervous systems. Vision, hearing, and feature extraction by the central nervous system. The cell biology of transmission and memory. Not open for credit to students who have completed course 112, 160, 161 or 162, or Neuroscience 221 or 222. GE credit: QL—I, II, III (II, III.) Carstens, Cheng, Miller, Sutter, Zito

100L. Neurobiology Laboratory (3)
Lecture—1 hour; laboratory—3 hours; extensive writing or discussion. Prerequisite: course 100 (may be taken concurrently). Experimental basis of neurobiology principles. Course 100. Topics include neurophysiology, sensory systems, motor systems, cellular neuroscience, cognitive neuroscience, and quantitative data analysis and modeling techniques. GE credit: SciEng | SE—III (III.)Goldman

100Q. Quantitative Foundations of Neurobiology (1)
Autotutorial—1.5 hours; extensive problem solving—1.5 hours. Prerequisite: course 100 (may be taken concurrently). Emphasis on a foundation in the mathematical models used to study phenomena in neurobiology. Offered irregularly. GE credit: QL. VL.—Magliner, Sutter

101. Systemic Physiology (5)
Lecture—5 hours. Prerequisite: Biological Sciences 1A, or 2A and Chemistry 2B; Physics 1B or 7C strongly recommended. Systematic physiology with emphasis on concepts of human physiology. Functions of major organ systems and the structure of those systems described as a basis for understanding the functions. GE credit: SciEng | SE—I, II, III (II, III.) Bautista, Debello, Fuller, Furlow, Gomes, Ishida, Liets Urey, Weidner

101L. Systemic Physiology Laboratory (3)
Laboratory—3 hours; discussion—2 hours; term paper. Prerequisite: course 101. Selected experiments to illustrate functional characteristics of organ systems discussed in course 101. (I, II, III (II, III.) Bautista, Liets

102. Animal Behavior (3)
Lecture—3 hours. Prerequisite: Biological Sciences 1A, 1B, 1C, or 2A, 2B, 2C. Basic principles of behavioral organization in vertebrate and invertebrate animals. Underlying physiological and ethological mechanisms. The evolution of behavior, with special emphasis on behavior under natural conditions. Not open for credit to students who have completed course 155. (Former course 155.) GE credit: SC—II, III (II, III.) Britten, Hahn, Nevitt

102G. Quantitative Topics in Animal Behavior (1)
Autotutorial—1.5 hours; extensive problem solving—1.5 hours. Prerequisite: Mathematics 16B; course 102 (may be taken concurrently). Study of the quantitative concepts and exemplar models used in animal behavior. Offered irregularly. GE credit: SciEng.—II. (II.)

103. Cellular Physiology/Neurobiology (3)
Lecture—3 hours. Prerequisite: Biological Sciences 103 or 105, and Physics 7C recommended. Cellular physiology with emphasis on membrane transport processes in the cell membrane. Fundamental physical-chemical and biological mechanisms of membrane transport will be considered in relation to cytoplasmic homeostasis, communication between cells, and the cellular mechanisms of sensory and motor transduction. Not open for credit to students who have completed course 100B (Former course 100B). Offered irregularly.

104L. Cellular Physiology/Neurobiology Laboratory (4)
Lecture—1 hour; laboratory—3 hours; discussion—1 hour; term paper or discussion. Prerequisite: courses 101 and 101L; Biological Sciences 103 or 105. Experiments in the physical and chemical processes of cells and tissues. GE credit: Wrt.—II. (II.) Horwitz

105. Introduction to Computer Models (4)
Lecture—3 hours; lecture/laboratory—1 hour. Prerequisite: Mathematics 16C or the equivalent, Physics 7C, Chemistry 2C, or course 100 or 101. Introduction to the ideas, mathematical techniques and computer tools required for developing models of cellular processes in physiology and neurobiology. Applications include models of ion channels, action potentials, Ca2+ oscillations, respiration, and muscle contractions. Offered irregularly.

106. Experiments in Neurobiology, Physiology, and Behavior: Design and Execution (2)
Laboratory—7.5 hours; discussion—0.5 hours. Prerequisite: course 100 or 101 or 102, and 199 and consent of instructor. Design and execution of experiments in neurobiology, physiology, and/or behavior. Students choose and design a project in consultation with the sponsoring faculty member. May be repeated one time for credit to complete the project, with consent of instructor. An additional repeat is permitted for a different project under the guidance of another faculty member. (P/NP grading only.) GE credit: OL, QL, VL, WE.—II, III, III (II, III.) Rosenquist

107. Cell Signaling in Health and Disease (3)
Lecture—3 hours. Prerequisite: Biological Sciences 102 or 105. Basics of cell signaling pathways, their disruption in disease, and their current utility and future potential as therapeutic targets. Focus on signaling pathways specific to nervous, endocrine and immune systems, and those fundamental to all cells. GE credit: SL—II. (II.) Trimmer

111C. Advanced Systemic Physiology Laboratory (3)
Lecture—1 hour; laboratory—6 hours. Prerequisite: courses 101, 101L, Statistics 13; course 112, 113, or 114 recommended. Interfacing physiological recording equipment with computers, data acquisition and analysis using the microcomputer; data interpretation within the framework of physiological concepts. Offered irregularly. GE credit: QL, VL, WE.

111L Advanced Systemic Physiology Laboratory (4)
Lecture—1 hour; discussion—2 hours; laboratory—6 hours; term paper. Prerequisite: courses 101 and 101L. Selected comprehensive experiments in the autonomic nervous system and the cardiovascular, respiratory, and neuromuscular systems. Emphasis on conceptual and methodological approaches in demonstrating the physiology of organ systems. GE credit: Wrt.—II. (II.) Liets

112. Neuroscience (3)
Lecture—3 hours. Prerequisite: course 100 or 101. Presentation of concepts in neuroscience including sensory systems, motor systems, and higher neural integration. Emphasis on mammalian nervous system. Offered irregularly. GE credit: SL.
113. Cardiovascular, Respiratory, and Renal Physiology (4)
Lecture—4 hours. Prerequisite: course 101. Chemistry 88, Physics 7B and 7C recommended. An intense and advanced presentation of concepts in cardiovascular, respiratory, and renal physiology including discussion of acid-base balance.

114. Gastrointestinal Physiology (3)
Lecture—3 hours. Prerequisite: course 101; Biological Sciences 105 or 103 recommended, 105 preferred. Gastrointestinal anatomy and physiology. Digestion, secretion, absorption, motility, comparative physiology and pathophysiology. Strong emphasis on neural and hormonal regulation and on cellular mechanisms of secretion and absorption. —I. (I.) Baustista, Horwitz

117. Avian Physiology (3)
Lecture—3 hours. Prerequisite: Biological Sciences 18, or 2A and 28 and Chemistry 28; course 101 strongly recommended. Physiology of the various systems of birds with emphasis on digestion, respiration, excretion, and endocrine systems. —III. (III.) Hahn, Klasing

121. Physiology of Reproduction (4)
Lecture—4 hours. Prerequisite: course 101. Physiological mechanisms related to reproduction, breeding efficiency, and sex. Special reference to domestic animals. GE credit: QL, SL. —II. (II.) Berger

121L. Physiology of Reproduction Laboratory (1)
Laboratory—3 hours. Prerequisite: course 121 recommended (may be taken concurrently). Experiments on the reproductive systems of domestic animals including male and female gametes. (P/NP grading only) —II. (II.) Berger

122. Developmental Endocrinology (3)
Lecture—3 hours. Prerequisite: course 101. Hormonal control of development, maturation and senescence from the cellular to the organismal level, with emphasis on the human. Prenatal and neonatal life, childhood, adolescence, adulthood and pregnancy, as well as the endocrinology of aging. Offered irregularly.

123. Comparative Vertebrate Organology (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: Biological Science 1A and 1B or 2A and 28. Functional anatomy of major organ systems in vertebrates. Each system examined from cellular to gross level in fish, birds, and mammals. Emphasis on how differentiated cell types are integrated into tissues and organs to perform diverse physiological functions. (Same course as Anatomy, Physiology and Cell Biology 100 A or B). —II. (II.) Peterson

124. Comparative Neuroanatomy (4)
Lecture—3 hours; laboratory—2 hours. Prerequisite: Psychology 101, or course 100 or 101. Overview of the neuroanatomy of the nervous system in a variety of mammalian and non-mammalian vertebrates. Examine changes or modifications to neural structures as a result of morphological or behavioral specializations. (Same course as Psychology 124.) GE credit: SL. —II. (II.) Krubitzer, Rezac

125. Comparative Physiology: Neurointegrative Mechanisms (3)
Lecture—3 hours. Prerequisite: course 101. Comparisons of physiological functions in the animal kingdom: the nervous systems of integration including aspects of phylogenetic development at both neuronal and systemic levels. Offered irregularly.

126. Comparative Physiology: Sensory Systems (3)
Lecture—3 hours. Prerequisite: course 100 or 101. Basic physiological mechanisms involved in sensory systems. Comparative approach to considerations of mechanoreception, audition, lateral lines, touch, echolocation, equilibration, chemosensory systems (olfaction, taste, pheromones), photosensory systems (vision, infrared detection, UV detection), electroreception, and pain. Emphasis on receptors. Offered irregularly.

127. Comparative Physiology: Circulation (3)
Lecture—3 hours. Prerequisite: course 101. Comparisons of physiological functions in the animal kingdom: circulation. Comparative approach to cardiovascular function in vertebrates and invertebrates. Offered irregularly. GE credit: VL, VI.

128. Comparative Physiology: Endocrinology (3)
Lecture—3 hours. Prerequisite: course 101. Comparisons of physiological functions in the animal kingdom: animal hormones and their functions. —II. (II.) Furlow, Chen

129. Comparative Physiology: Respiration (3)
Lecture—3 hours. Prerequisite: course 101. Comparisons of physiological functions in the animal kingdom: respiration.

130. Physiology of the Endocrine Glands (4)
Lecture—4 hours. Prerequisite: course 101. Advanced presentation of concepts in endocrinology with emphasis on the role of hormones in reproduction, metabolism, and disease. GE credit: VL. —I. (I.) Adams

132. Nature vs. Nurture: Physiological Interactions Among Genes, Nutrients and Health (3)
Lecture—3 hours. Prerequisite: Biological Sciences 1A or 2A or consent of the instructor. Biochemical, physiological, genetic, and nutritional causes of important medical conditions such as obesity, anorexia, heart disease and diabetes. One unit of credit allowed to students who have completed course 131. GE credit: SciEng. —I. (I.) Thimney, Warden

139. Frontiers in Physiology (3)
Lecture—2 hours; discussion—1 hour. Prerequisite: courses 100 and 101; 102 (may be taken concurrently). Lectures by leading authorities and discussions of the latest research in newly emerging areas in physiology. Offered every fourth year. Offered irregularly. GE credit: SciEng | QL, SE

140. Principles of Environmental Physiology (3)
Lecture—3 hours. Prerequisite: course 101; Biological Sciences 102 recommended. Physiological aspects of interactions of organisms and environment, cellular, system, and organismal levels. Emphasis on regulatory responses/mechanisms to thermal, pressure, gravity and light environmental variables. Not open for credit to students who have completed course 148. (Former course 148.) GE credit: WE. —III. Fuller

141. Physiological Adaptation of Marine Organisms (3)
Lecture—2 hours; laboratory—3 hours. Prerequisite: upper division standing; consent of the instructor; residence at Bodega Marine Laboratory required. Students must submit application available at http://www.bml.ucdavis.edu. Physiological adaptation to the environment among organisms in marine and estuarine habitats. GE credit: QL, VI, WE. —III. Chang, Cheng, Cher

141P. Physiological Adaptation of Marine Organisms/Advanced Laboratory Topics (3)
Laboratory—12 hours; discussion—1 hour. Prerequisites: course 141 concurrently; residence at Bodega Marine Laboratory required. Students must submit application available at http://www.bml.ucdavis.edu. Training in scientific research from hypothesis to publication, including methods in library research. Research related to a topic covered in course 141. GE credit: VI, WE. —III. Chang, Cheng

150. Advanced Animal Behavior (4)
Lecture—3 hours; laboratory—3 hours. Prerequisite: course 102 or Psychology 101. Advanced integrative survey of biological principles of behavioral organization, emphasizing historical roots, current research directions, conceptual issues and controversies. Laboratory exercises on the description and analysis of the behavior of captive and free-living animals. (Same course as Psychology 122.) Offered irregularly. —Hahn

152. Hormones and Behavior (3)
Lecture—3 hours. Prerequisite: course 101, and either course 102 or Psychology 101. Endocrine physiology with an emphasis on the principles of behavioral control. Fundamental relationships between hormones and various behaviors engaged in by the organism during its lifetime. Role of hormones in behavioral homeostasis, social behavior, reproductive behavior, parental behavior, adaptation to stress. (Same course as Psychology 123.) —III. (III.) Bales, Furlow, Hahn, Trainer, Wingfield

159. Frontiers in Behavior (3)
Lecture—2 hours; discussion—1 hour. Prerequisite: courses 100, 101, 102. Lectures by leading authorities and discussion of the latest research in newly emerging areas in behavioral biology. Offered every fourth year. Offered irregularly. GE credit: SciEng | QL, SE

160. Molecular and Cellular Neurobiology (3)
Lecture—1.5 hours; discussion—1.5 hours. Prerequisite: course 100, Biological Sciences 101 and consent of instructor. Selected topics in neurobiology. Topics include channel biophysics, action potential propagation, intracellular signal transduction pathways, synaptic physiology and quantal analysis, cellular mechanisms of synaptic plasticity, and neuromodulation of synaptic circuitry. (Same course as Neuroscience 160.) GE credit: VL

160L. Advanced Cellular Neurobiology Laboratory (4)
Laboratory—12 hours. Prerequisite: course 160, Physics 7C recommended. Students will learn to record neural activity, to interpret their recordings, and to label neurons with antibodies against neurotransmitters.

161. Developmental Neurobiology (3)
Lecture—3 hours. Prerequisite: course 100 or 101. Issues, theoretical concepts, and methodologies in developmental neurobiology. Topics include prenatal and postnatal differentiation of neurons, and plasticity in the mature and aging brain. Integration of neurochemical, structural, physiological and behavioral perspectives. GE credit: SciEng | SE. —II. (II.) McAllister, Zito

162. Neural Mechanisms of Behavior (3)
Lecture—3 hours. Prerequisite: course 100 or 101. The relationship between brain and behavior. Identification and analysis of the relevant neural circuits involved. Examples of systems considered are birdsong, locomotion, echolocation. —III. (III.) Britten

163. Systems Neuroscience (3)
Lecture—3 hours. Prerequisite: course 100 or equivalent basic neuroscience training with consent of instructor. Concepts and tools in systems neuroscience e.g., measuring and manipulating neural activity, structure of neocortex, sensory processing, motor control, short-term and long-term storage of information, neural codes, neural mechanisms underlying cognitive functions. GE credit: SE. —III. (III.) Dittrich

164. Mammalian Vision (4)
Lecture—3 hours; discussion—1 hour. Prerequisite: courses 100, 112, or Psychology 101. Basic structure and function of the mammalian visual system, from the formation of images on the retina through visually guided behavior and perception. Emphasis on biological mechanisms underlying vision. —II. (II.) Britten, Werner

165. Neurobiology of Speech Perception (3)
Lecture—3 hours. Prerequisite: course 100 or 101, or consent of instructor. Interdisciplinary approach to speech perception with emphasis on the nervous systems involved. Topics include auditory processing in time and space, intelligibility in noisy environments, visual speech, evolution of vocal communication, models of speech perception, development, and hearing impairment. GE credit: —III. (III.) Miller