

INTEGRATIVE PHYSIOLOGY

The Department of Integrative Physiology offers a variety of graduate study opportunities that range from a coursework-only master's degree option to MS and PhD research-intensive options. To facilitate maximal flexibility in the design of a student's program, the Department has established a minimum number of required courses that must be completed by all graduate students and the remainder of the program can be individualized to meet the long-term goals of the student.

A graduate degree in integrative physiology provides opportunities for careers in academia, industry, and the health professions. The placement list of PhD and MS graduates (<https://www.colorado.edu/iphy/graduate/placement-recent-phd-and-ms-graduates/>) indicates some of the jobs and educational programs that our graduate students have found after completion of the PhD or MS degree.

Course code for this program is IPHY.

Master's Degree

- Integrative Physiology - Master of Science (MS) (<https://catalog.colorado.edu/graduate/colleges-schools/arts-sciences/programs-study/integrative-physiology/integrative-physiology-master-science-ms/>)

Doctoral Degree

- Integrative Physiology - Doctor of Philosophy (PhD) (<https://catalog.colorado.edu/graduate/colleges-schools/arts-sciences/programs-study/integrative-physiology/integrative-physiology-doctor-philosophy-phd/>)

Faculty

While many faculty teach both undergraduate and graduate students, some instruct students at the undergraduate level only. For more information, contact the faculty member's home department.

Alderete, Tanya Lynn (https://experts.colorado.edu/display/fisid_159723/)
Assistant Professor; PhD, University of Southern California

Bekoff, Anne (https://experts.colorado.edu/display/fisid_100613/)
Professor Emeritus; PhD, Washington University

Boyko, Marie (https://experts.colorado.edu/display/fisid_100073/)
Senior Instructor Emeritus; MA, University of Colorado Boulder

Brunt, Vienna E (https://experts.colorado.edu/display/fisid_158297/)
Assistant Professor Adjunct; PhD, University of Oregon

Bustamante, Heidi Margarita (https://experts.colorado.edu/display/fisid_146491/)
Associate Teaching Professor; MS, University of Colorado Boulder

Byrnes, William (https://experts.colorado.edu/display/fisid_100643/)
Associate Professor Emeritus; PhD, University of Wisconsin–Madison

Carey, Cynthia
Professor Emerita

Casagrand, Janet L. (https://experts.colorado.edu/display/fisid_100934/)
Associate Teaching Professor; PhD, Case Western Reserve University

Chonchol, Michel
Professor Adjunct; MD, Universidad Central de Venezuela, Caracas

Clayton, S. Zachary
Assistant Research Professor

Craighead, H Daniel (https://experts.colorado.edu/display/fisid_159477/)
Assistant Research Professor; PhD, Pennsylvania State University

Depner, Christopher
Assistant Professor Adjunct; PhD, Oregon State University

DeSouza, Christopher A. (https://experts.colorado.edu/display/fisid_107460/)
Distinguished Professor; PhD, University of Maryland, College Park

Diniz-Behn, Cecelia
Assistant Professor Adjunct

Eaton, Robert
Professor Emeritus

Ehringer, Marissa A. (https://experts.colorado.edu/display/fisid_126595/)
Professor, Chair; PhD, University of Colorado Denver

Enoka, Roger M. (https://experts.colorado.edu/display/fisid_110122/)
Associate Chair, Professor; PhD, University of Washington

Fleshner, Monika R. (https://experts.colorado.edu/display/fisid_103304/)
Professor; PhD, University of Colorado Boulder

Floriano, Maureen (https://experts.colorado.edu/display/fisid_169506/)
Assistant Teaching Professor; PhD, Case Western Reserve University

Foley, Teresa E. (https://experts.colorado.edu/display/fisid_147351/)
Teaching Professor of Distinction; PhD, University of Colorado Boulder

Fowler, John S.
Professor Emeritus

Gleeson, Todd T. (https://experts.colorado.edu/display/fisid_105480/)
Professor Emeritus; PhD, University of California, Irvine

Grabowski, Alena Marie (https://experts.colorado.edu/display/fisid_149727/)
Associate Professor; PhD, University of Colorado Boulder

Harsh, John R. (https://experts.colorado.edu/display/fisid_155406/)
Professor Adjunct

Hayman, Allison P. (https://experts.colorado.edu/display/fisid_156275/)
Assistant Professor Adjunct

Heisler, Ruth E. (https://experts.colorado.edu/display/fisid_103195/)
Teaching Professor of Distinction; MA, University of Colorado Boulder

Hobbs, Steven L. (https://experts.colorado.edu/display/fisid_143724/)
Associate Teaching Professor; PhD, University of Colorado Boulder

Hoeffler, Charles Albert (https://experts.colorado.edu/display/fisid_153384/)
Associate Professor; PhD, University of Arizona

Johnson, Thomas E. (https://experts.colorado.edu/display/fisid_104242/)
Professor Emeritus; PhD, University of Washington

Kim, Sewan (https://experts.colorado.edu/display/fisid_174402/)
Assistant Teaching Professor; PhD, University of Colorado Boulder

Kram, Rodger (https://experts.colorado.edu/display/fisid_118476/)
Associate Professor Emeritus; Ph.D., Harvard University

LeBourgeois, Monique Katherine
Associate Professor; PhD, University of Southern Mississippi

Link, Christopher D. (https://experts.colorado.edu/display/fisid_109073/)
Associate Professor; PhD, University of Massachusetts at Amherst

Lowry, Christopher (https://experts.colorado.edu/display/fisid_143371/)
Professor; PhD, Oregon State University

Lynch, G. Robert
Professor Emeritus

Maldonado, Tammy A. (https://experts.colorado.edu/individual/fisid_104105/)
Assistant Teaching Professor; PhD, University of Colorado Boulder

Mazzeo, Robert (https://experts.colorado.edu/display/fisid_101031/)
Associate Professor Emeritus, Associate Chair; PhD, University of California, Berkeley

McQueen, Matthew B. (https://experts.colorado.edu/display/fisid_143785/)
Professor Adjunct; DSc, Harvard University

Melanson, Edward
Professor Adjunct

Moore, Russell (https://experts.colorado.edu/display/fisid_105756/)
Professor; PhD, Washington State University

Norris, David O.
Professor Emeritus

Nowak, Kristen
Assistant Professor Adjunct

Opp, Mark R. (https://experts.colorado.edu/display/fisid_158898/)
Professor; PhD, Washington State University

Robichaux, Waldean
Professor Emeritus

Rossmann, J. Matthew (https://experts.colorado.edu/display/fisid_156619/)
Assistant Research Professor; PhD, University of Utah

Rowe, K. Rachel (https://experts.colorado.edu/display/fisid_168365/)
Assistant Professor; PhD, University of Kentucky

Saul, Leif J. (https://experts.colorado.edu/display/fisid_116130/)
Associate Teaching Professor; PhD, University of California, Berkeley

Schaetzel, Amanda E. (https://experts.colorado.edu/display/fisid_154385/)
Assistant Teaching Professor; PhD, University of Colorado Boulder

Seals, Douglas R. (https://experts.colorado.edu/display/fisid_103375/)
Distinguished Professor; PhD, University of Wisconsin–Madison

Sherwood, David
Associate Professor Emeritus

Shi, Jia (https://experts.colorado.edu/display/fisid_143673/)
Associate Teaching Professor; PhD, Boston University

Stitzel, Jerry A. (https://experts.colorado.edu/display/fisid_102954/)
Professor; PhD, Johns Hopkins University

Stob, Nicole R. (https://experts.colorado.edu/individual/fisid_134529/)
Assistant Teaching Professor; PhD, Colorado State University

Tan, Andrew Q. (https://experts.colorado.edu/display/fisid_167426/)
Assistant Teaching Professor; PhD, Northwestern University

Tsai, Pei-San (https://experts.colorado.edu/display/fisid_115292/)
Professor; PhD, University of California, Berkeley

Wright Jr., Kenneth P. (https://experts.colorado.edu/display/fisid_125586/)
Distinguished Professor; PhD, Bowling Green State University

Courses

IPHY 5010 (1) Graduate Student Research Forum

Special topics spanning the broad scope of integrative physiology are covered in a seminar-style format. Presentations by current IPHY faculty are augmented by graduate student presentations of thesis and dissertation work.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 5060 (4) Cell Physiology

Focuses on the molecular machines and cellular sub-compartments that allow cells to renew, replicate, and function in the context of multicellular organisms. Students must enroll in lecture and recitation sections.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4060

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 5100 (2) Colloquium in Integrative Physiology

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 5102 (2) Introduction to Physiology Genomics

Covers recent developments in genomics: a body of revolutionary new approaches that deal with the analysis of all the DNA sequence in the cell. Relies on a genomics text and student presentation/discussion aided by a study guide.

Requisites: Restricted to Integrative Physiology (IPHY or C-IPHY) or Psychology (PSYC) graduate students only.

Recommended: Prerequisite IPHY 5200.

IPHY 5200 (3) Physiological Genetics and Genomics

Covers fundamental concepts in molecular genetics/genomics with physiological applications. Topics include structure and function of nucleic acids, genome structure, genetic and genomic research tools, methods for identifying disease-causing mutations, regulation of gene expression, pharmacogenetics, gene therapy and ethical issues in modern genomics. First course of a 3-course series recommended for IBG students. Includes a recitation section.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4200 and PSYC 5200

Requisites: Restricted to Integrative Physiology (IPHY or C-IPHY) or Psychology (PSYC) graduate students only.

IPHY 5262 (3) Application of Bioinformatics and Genomics

Explore public websites, databases, and bioinformatic tools that can be used for analysis of genomic data. These include NCBI Resources, genome databases, gene expression databases, tools for nucleotide and algorithms analyses and protein databases. Students develop a mini-grant proposal that is required to incorporate use of some of the tools covered.

Requisites: Restricted to Integrative Physiology (IPHY or C-IPHY) or Psychology (PSYC) graduate students only.

Recommended: Prerequisite IPHY 5200 and IPHY 5102.

IPHY 5300 (3) Statistical Genetics for Complex Traits

Focuses on the methods of mapping complex disease genes in both population and family-based samples. Topics include both linkage and association analyses of qualitative and quantitative phenotypes.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 5440 (4) Endocrinology

Introduces mammalian endocrine system. Provides a thorough analysis of chemical communication by hormones and related bioregulators with emphasis on the major endocrine systems such as the thyroid, gonad, pituitary and the brain. Department enforced prerequisites: one year of general biology (lecture + lab) and one year of general chemistry (lecture + lab).

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4440

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 5540 (5) Biomechanics

Applies the principles of physics and physiology to analyze the movement of humans and other animals. Assesses the mechanical properties of muscles, tendons, ligaments and bones. Quantitatively analyzes forces, torque, mechanical energy, power impulses and momentum associated with human movement.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4540

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

Recommended: Prerequisite one semester of physiology and one semester of general physics (lecture + lab).

IPHY 5550 (3) Exercise Biochemistry

Examines the underlying biochemical mechanisms that are responsible for the physiological adaptations to short- and long-term dynamic exercise including carbohydrate, fat, and protein metabolism. The interaction of key biochemical alterations as it relates to disease (diabetes, obesity, and aging) and exercise will be addressed.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

Recommended: Prerequisite IPHY 4650 and one year of general chemistry (lecture + lab).

IPHY 5580 (3) Sleep Physiology

Describes the physiology, neurobiology, physiology and functions neurobiology of sleep and circadian rhythms; explains the impact of sleep, sleep deprivation, and circadian rhythms, as well as sleep and circadian disruptions and disorders on immune, endocrine, thermoregulatory, cardiovascular, respiratory, and neural systems; systems, as well as examines changes in sleep and circadian rhythms across the the life span. The integrative nature of sleep and circadian rhythms in normal physiological and cognitive functions and their importance in health and disease processes will be emphasized. Department enforced prerequisite: statistics equivalent.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4580

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 5600 (3) Immunology

Studies the immune system, a multi-cellular system that functions to protect us from disease. Introduces concepts associated with the development and function of individual cells of the immune system (T-cells, B-cells, neutrophils, dendritic cells, macrophages), as well as their integrative roles in physiology and host defense.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4600

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

Recommended: Prerequisites one year of general biology (lecture + lab) and one year of general chemistry (lecture + lab); IPHY 3470.

IPHY 5650 (5) Exercise Physiology

Examines physiological and biochemical adjustments that occur in the body with acute and chronic exercise. Topics center on physiological mechanisms pertaining to metabolic, cardiovascular, and hormonal alterations, the role of exercise in health and disease, soreness and fatigue, immune function, as well as exercise during varied environmental conditions.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4650

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

Recommended: Prerequisite one semester of physiology and one semester of physiology lab.

IPHY 5720 (4) Neurophysiology

Explores the function of the nervous system, including how the properties of neurons influence nervous system activity, how the nervous system controls the activity of muscles and how the sensory effects of muscle activity influence the function of the nervous system. Department enforced prerequisites: one year of general biology (lecture + lab) and one year of general chemistry (lecture + lab), IPHY 2800 (or equivalent); IPHY 3410.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4720

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

Grading Basis: Letter Grade

IPHY 5730 (3) Integrative Motor Control

Investigates human motor control by integrating concepts from exercise physiology, biomechanics, and sport psychology. Applications are made to clinical and educational exercise contexts.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4730

Recommended: Prerequisites IPHY 3410 and IPHY 3470.

IPHY 5740 (3) Theory of Motor Skill Learning

Offers a critical analysis of motor learning theories, including Adam's closed loop theory, Schmidt's schema theory and the influence of contextual interference on learning and performance. Also covers feedback and practice organization. Projects and presentations required.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4740

Requisites: Restricted to Integrative Physiology (IPHY or C-IPHY) or Psychology (PSYC) graduate students only.

IPHY 5780 (3) Sleep, Circadian Rhythms, and Health

Examines the history of the fields of sleep and circadian rhythms; lifespan development of sleep and rhythms; observational, physiological, and clinical measures of sleep; screening for sleep and circadian disorders; associations between poor sleep and circadian misalignment and health; and evidenced-based sleep and circadian interventions/preventions in healthy and clinical samples. Dept. enforced requisite: one year of biology (lecture and lab); statistics course.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4780

IPHY 5800 (4) Advanced Statistics and Research Methods in Integrative Physiology

Introduces advanced statistical techniques important for analyzing data rising in biomedical research, including physiology. Statistical reasoning will be emphasized through problem solving and applications using statistical software packages.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

Recommended: Prerequisite IPHY 2800.

IPHY 5840 (1-6) Graduate Independent Study

Repeatable: Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 5880 (3) Advanced Data Analysis in Biomedical Research

Provides advanced training on statistics and scientific reasoning in laboratory and clinical research. Conceptual foundations of classical and modern statistical techniques is reviewed. Multiple class projects consist of written reports on statistical analysis of data representative of the student's field of interest. The use of statistical packages, primarily R, is required.

Equivalent - Duplicate Degree Credit Not Granted: IPHY 4880

Requisites: Requires prerequisite course of IPHY 5800 (minimum grade B).

Grading Basis: Letter Grade

IPHY 5900 (3) Data Literacy in Biomedical Research

Provides a platform to develop a deeper understanding of quantitative biomedical research, current trends, challenges, and limitations. The course complements graduate statistical training by introducing topics relevant to open science and data literacy, including reproducibility, data privacy challenges, and the importance of good data management. Challenges in advanced statistical data evaluation and analysis in biomedical research settings will be discussed.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

Recommended: Prerequisite IPHY 5800.

Grading Basis: Letter Grade

IPHY 6010 (1-3) Seminar

Presents special topics in integrative physiology.

Repeatable: Repeatable for up to 15.00 total credit hours. Allows multiple enrollment in term.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 6650 (3) Cellular Cardiovascular Physiology

Focuses on the cellular control of cardiac and smooth muscle contraction, at rest and in response to acute and chronic exercise. Addresses certain pathophysiological and physiological adaptive mechanisms.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

Recommended: Prerequisite IPHY 4650.

IPHY 6660 (3) Locomotion Energetics and Biomechanics

Critiques and discusses both classic and cutting edge scientific research in the area of terrestrial locomotion.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

Recommended: Prerequisites IPHY 4540 and IPHY 4650.

IPHY 6670 (2) Hypothesis Testing in Locomotion Biomechanics

Focuses on the scientific process including formulating and testing hypotheses in studies of locomotion. Students analyze primary articles to determine whether the studies tested hypotheses and to generate new hypotheses that logically follow from previous studies.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 6680 (3) Matlab for Physiological and Biomechanical Research

Introduces Matlab programming skills needed to write and modify programs for data acquisition and analysis, statistics, plotting, and simulation.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 6830 (3) Professional Skills for the Research Scientist

Discusses grant and manuscript writing, scientific presentations, peer-review, setting up/directing a research laboratory, research ethics, mentoring and other professional skills.

Requisites: Restricted to Integrative Physiology (IPHY) doctoral students only.

IPHY 6840 (1-3) Research Project

Involves a scholarly investigation of a selected topic using literature and/or experimental techniques. Advisor required.

Repeatable: Repeatable for up to 3.00 total credit hours. Allows multiple enrollment in term.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 6940 (1) Master's Candidate for Degree

Registration intended for students preparing for a thesis defense, final examination, culminating activity, or completion of degree.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 6950 (1-6) Master's Thesis

Must have 4 credit hours and may be repeated up to 6 total credits.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to Integrative Physiology (IPHY) or Integrative Physiology Concurrent Degree (C-IPHY) graduate students only.

IPHY 8990 (1-10) Doctoral Dissertation

All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School section.

Requisites: Restricted to Intergrative Physiology (IPHY) doctoral students only.