Cellular and Integrative Physiology, Ph.D.

smhileman@hsc.wvu.edu (shileman@hsc.wvu.edu)

Degrees Offered

• Doctor of Philosophy
• Joint Doctor of Medicine and Doctor of Philosophy

Nature of the Program

Physiology is a dynamic life science that focuses on the study of biological systems at many levels of complexity, ranging from genes and molecules to cells and organisms. Thus, training in physiology has the ultimate goal of linking molecular and cellular information to functional outcomes. Currently, groundbreaking research and discovery in the life sciences are more interdisciplinary than ever, and students studying within the realm of physiology can expect to work with a wide range of scientists, including pharmacologists who are focused in a complementary field: namely, the study of how drugs affect biological systems and how biological systems affect drugs.

The goal of the doctoral program in Cellular and Integrative Physiology is to engage students in creating a new approach to the life sciences, with the aim of explaining how the higher-level properties of complex systems appear from the interactions amongst their parts and environmental inputs. Our program provides a multidisciplinary approach to modern life sciences, drawing on faculty expertise from several departments and centers in the Schools of Medicine and Pharmacy.

Completion of the Ph.D. degree is realized when the student publishes at least one original, peer-reviewed manuscript in the biomedical research literature and successfully presents this original research to faculty of the graduate dissertation committee and the program/department. Typically, four to five years are required to realize this goal.

The program’s participating research faculty consists of scientists from the Department of Physiology & Pharmacology, NIOSH/CDC, and the Rockefeller Neurosciences Institute. As a result, this multidimensional program includes activities in the following:

• Inhalation Toxicology
• Integrative and Systems Physiology
• Pathophysiology
• Translational Research
• Pharmacology

It also integrates information from genetics, functional genomics, and proteomics into whole animal and human physiology.

This interactive and cross-disciplinary environment, together with an atmosphere filled with enthusiasm and passion for scientific discovery, makes our program a uniquely exciting place for doing research and the training of students. Specific topics of research emphasis include the following:

• Protein Regulators of Hormone and Neurotransmitter Signal Transduction
• Free Radical Biology in Diabetes and Obesity
• Impact of Toxicants on Cardiovascular Function and Health
• Respiratory Function and Control in Health and Disease
• Neuroendocrine Control of Reproduction
• Stroke Physiology

Students will leave our program better able to identify important unsolved scientific problems and with an appreciation of how to select problems for which quantitative and theoretical approaches will be most productive.

ADMINISTRATION

CHAIR
• Tim Nurkiewicz - Ph.D.

ADMINISTRATOR
• Tammy McPherson - (Sr. Administrative Official)
ASSOC. CHAIR FOR RESEARCH
• Eric Kelley - Ph.D.

ASSOC. CHAIR FOR EDUCATION
• Mark Paternostro - Ph.D.

FACULTY
GRADUATE PROGRAM DIRECTOR
• Stan Hileman - Ph.D.
  (Director)
• Robert Brock - Ph.D.
  (Assistant Director)

CHAIR
• Tim Nurkiewicz - Ph.D.

REGULAR MENTORS
• Paul Chantler - Ph.D.
  (Cardiovascular)
• Robert Goodman - Ph.D.
  (Endocrine & Neuroscience)
• Stanley Hileman - Ph.D.
  (Endocrine & Neuroscience)
• Salik Hussain - Ph.D.
  (Respiratory Toxicology)
• Eric Kelley - Ph.D.
  (Redox Physiology)
• Timothy Nurkiewicz - Ph.D.
  (Cardiovascular)
• Mark Olfert - Ph.D.
  (Cardiovascular & Respiratory)
• Vazhaikkurichi Rajendran - Ph.D.
  (Gastrointestinal Electrophysiology)
• David Siderovski - Ph.D.
  (G-Protein Coupled Receptors)
• James Simpkins - Ph.D.
  (Cardiovascular)

NIOSH MENTORS
• Patti Erdely - Ph.D.
• Aaron Erdely - Ph.D.
• Jeffrey Fedan - Ph.D.
• Richard Johnson - Ph.D.
• Dale Porter - Ph.D.
• Anna Shvedova - Ph.D.

RESEARCH ASSISTANT PROFESSOR
• Elizabeth Bowdridge - Ph.D.

Doctor of Philosophy
MAJOR REQUIREMENTS

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<tr>
<th>Course</th>
<th>Title</th>
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<tr>
<td>BMS 700</td>
<td>Scientific Integrity</td>
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<td>BMS 701</td>
<td>Scientific Rigor and Ethics</td>
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<td>Biomedical Research Methods</td>
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<td>BMS 707</td>
<td>Experiential Learning for Biomedical Trainees</td>
<td>2</td>
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<td>BMS 720</td>
<td>Scientific Writing</td>
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<td>PSIO 744</td>
<td>Graduate Seminar</td>
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<td>Graduate Physiology and Pharmacology 1</td>
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<td>PSIO 776</td>
<td>Graduate Physiology and Pharmacology 2</td>
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<td>BMS 702</td>
<td>Biomedical Lab Experience</td>
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<td>BMS 747</td>
<td>Foundations for Contemporary Biomedical Research 1</td>
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<td>BMS 777</td>
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<tr>
<td>BMS 715</td>
<td>Molecular Genetics</td>
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<td>CCB 730</td>
<td>Cancer Cell Biology</td>
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<td>PHAR 779</td>
<td>Drug Discovery</td>
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<td>MICB 784B</td>
<td>Special Problems in Microbiology</td>
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<td>MICB 784C</td>
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<td>PSIO 790</td>
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<td>PSIO 793</td>
<td>Special Topics (Physiology Issues)</td>
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<tr>
<td>PSIO 793</td>
<td>Special Topics</td>
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<tr>
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<td>Special Topics</td>
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<td>PSIO 795</td>
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<td>Total Hours</td>
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**Seminars and Research Forum**

Students register for one credit of seminar each academic year while in residence.

**Journal Club**

Students are required to enroll in Journal Club each semester. The course involves the presentation and discussion of current research papers and will help acquaint students with the variety of methods used in scientific research.

**Doctoral Research**

Students will conduct research with a dissertation mentor during time in the program. Students register for research credits each semester, and their performance is graded by their dissertation mentor.

**Qualifying and Dissertation Proposal/Ph.D. Candidacy**

The oral qualifying exam is given at the end of the second year of study. The candidacy exam is completed in the third year of study. Admission to Ph.D. candidacy occurs following the successful defense of the dissertation proposal.

**Dissertation Defense and First-Author Paper Requirement**

Students are allowed to defend their dissertation when a minimum of one manuscript with student as the first author, based on dissertation research, is accepted in a peer-reviewed journal. The final examination for the Ph.D. degree consists of orally defending a written dissertation in a public seminar and then in private to the dissertation committee. An external examiner, a distinguished scientist external to WVU, is required to participate at the dissertation defense. Satisfactory performance in the oral defense will result in recommendation for granting of the Ph.D. degree.

**Suggested Plan of Study***

**First Year**

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
<th>Summer Hours</th>
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<td>BMS 700</td>
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<td>Electives</td>
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<td>BMS 701</td>
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### Second Year

<table>
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<tr>
<th>Course</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
<th>Summer Hours</th>
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<td>PSIO 750 or 751</td>
<td>3 Electives</td>
<td>6 BMS 720</td>
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<tr>
<td>PSIO 797</td>
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<td>1 PSIO 797</td>
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<tr>
<td>Electives</td>
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| Total                  | 12         | 11           | 3            |

### Third Year

<table>
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<tr>
<th>Course</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
<th>Summer Hours</th>
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<tbody>
<tr>
<td>Elective (as needed)</td>
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<td>9 PSIO 797</td>
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<tr>
<td>PSIO 744</td>
<td>1</td>
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<tr>
<td>PSIO 797</td>
<td>5</td>
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| Total                  | 9          | 9            | 3            |

### Fourth Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
<th>Summer Hours</th>
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<tr>
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<td>1 PSIO 797</td>
<td>9 PSIO 797</td>
<td>3</td>
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<tr>
<td>PSIO 797</td>
<td>8</td>
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| Total                  | 9          | 9            | 3            |

Total credit hours: 89

**NOTE:** The graduate curriculum is finalized with a plan of study once the mentor and laboratory have been selected in the first year. The plan of study is developed by the graduate committee in consultation with the student. The courses listed above include the required and elective coursework necessary for the student to finalize his/her plan of study. When the student enters the laboratory of his/her doctoral dissertation mentor repetitive enrollments in research, seminars, and colloquia are typical and will determine total hours necessary for degree completion.

*This is a suggested plan of study. Course sequences and length of time in program may vary depending on student and altered total credit hours.

### Major Learning Outcomes

**CELLULAR AND INTEGRATIVE PHYSIOLOGY**

The student learning and programmatic outcomes of the Cellular and Integrative Physiology Graduate Program are similar to those put forth by the Human Anatomy & Physiology Society (HAPS) and the American Physiological Society (APS). They are as follows:

**Fundamental Content & Process Goals**

1. Recognize the anatomy and explain physiological functions of body systems.

2. Recognize and explain the principle of homeostasis and the use of feedback loops to control physiological systems.

3. Use anatomical knowledge to predict physiological consequences, and use knowledge of function to predict the features of anatomical structures.

4. Recognize and explain the interrelationships within and between anatomical and physiological systems of the body.

5. Synthesize ideas to make a connection between knowledge of anatomy and physiology and real-world situations, including healthy lifestyle decisions and homeostatic imbalances.

**Broader Process Goals**

6. Demonstrate information literacy skills to access, evaluate, and use resources to stay current in the field of physiology.

7. Examine issues related to physiology from an evidence-based perspective.

8. Communicate clearly and in a way that reflects knowledge and understanding of physiology and demonstrates the ability to adapt information to different audiences and applications.
COURSES

PSIO 541. Integrative Physiology. 4 Hours.
PR: First professional year standing in the School of Pharmacy. A systematic examination of the homeostatic functions of the human body with emphasis on the physicochemical mechanisms involved. Pathophysiology and clinical correlations related to pharmacy are introduced in relation to normal physiology.

PSIO 580. Systems Physiology. 4 Hours.
PR: PSIO 241 or PSIO 441 with a minimum grade of C-. This course is designed to provide students with a systematic examination of homeostatic functions with emphasis on integrative, systems physiology. The course focuses on how complex relationships between organ systems allows the body to adapt to stressors to maintain homeostasis. Students will apply problem solving and critical thinking in evaluating physiological changes to stressors such as disease, injury and aging.

PSIO 593. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

PSIO 742. Physiological Methods 2. 1-4 Hours.
PR: Consent. Research techniques and strategies for physiology.

PSIO 743. Fundamentals of Physiology. 5 Hours.
PR: College physics, algebra, chemistry, and consent. (For dental students and a limited number of full-time graduate students.) Analysis of basic facts and concepts relating to cellular processes, organ systems, and their control.

PSIO 744. Graduate Seminar. 1-3 Hours.
PR: Graduate standing and consent. (Grading may be S/U.).

PSIO 750. Graduate Physiology and Pharmacology 1. 3 Hours.
This is a flipped classroom format course that integrates the basic knowledge (molecular, sub-cellular, cellular, and tissue components) of cardiovascular, respiratory and kidney system function. It also includes the application of basic pharmacology to the fundamental understanding of human health and disease as it relates to these systems.

PSIO 751. Graduate Physiology and Pharmacology 2. 3 Hours.
This course is designed to integrate basic knowledge (molecular, sub-cellular and tissue components) of gastrointestinal, endocrine and neural system function. It also includes the application of basic pharmacology to the fundamental understanding of human health and disease as it relates to these systems. This is a flipped classroom format course.

PSIO 760. Human Physiology. 6 Hours.
A blended online medical physiology course with weekly face-to-face class meetings for first-year medical students who took a leave of absence and will repeat their first year.

PSIO 775. History of Physiology. 1 Hour.
This course will examine historical and seminal papers that have shaped the course of physiology research and that provide the foundation for our current understanding of various physiological systems.

PSIO 790. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of physiology. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading may be P/F.).

PSIO 791. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

PSIO 792. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

PSIO 793. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

PSIO 795. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

PSIO 796. Graduate Seminar. 1-3 Hours.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

PSIO 797. Research. 1-9 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

PSIO 801. Summer Medical Physiology. 7 Hours.
An online course designed for medical students who need to remediate the physiology portion of WVU SOM: CCMD 730 (or equivalent), prior to entering their second year. Course will be taught on a Pass/Fail basis.
PSIO 820. Principles of Medical Physiology. 5 Hours.
PR: Medical students must satisfactorily pass all first-year MD Degree courses to enroll in this course. Principles of Medical Physiology examines the functions of the human body required for the study of clinical medicine with an emphasis on the connections of physiology to pathology and pharmacology. Topics include the physiology of muscle, cardiovascular, renal, pulmonary, gastrointestinal and endocrine systems. The course also includes integration of physiological principles to special situations (pregnancy, aging, exercise, stress).