

# Cellular and Integrative Physiology

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## Degrees Offered

- Doctor of Philosophy
- Joint Doctor of Medicine and Doctor of Philosophy

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.

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. 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 successfully presents the research results 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 Center for Cardiovascular and Respiratory Sciences, NIOSH/CDC, Center for Neuroscience, and the Blanchette Rockefeller Neurosciences Institute. As a result, this multidimensional program includes activities in the following:

- Integrative and systems physiology
- Pathophysiology
- Pharmacology
- Translational research
- Small animal physiology, biomedical engineering
- Biophysics

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:

- Hemodynamics and Cardiovascular Control in Health and Disease
- Microcirculation and Cellular Biophysics
- Respiratory Function and Control in Health and Disease
- Neuroendocrine Control of Reproduction
- Neural Control of Sensory 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.

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## FACULTY

### GRADUATE PROGRAM DIRECTOR

- Robert Brock - Ph.D.  
(Cardiovascular)

### CHAIR

- David Siderovski - Ph.D.  
(Neuroscience & Signaling)

### REGULAR MENTORS

- Julie Brefczynski-Lewis - Ph.D.  
(Neuroscience)
- Robert Goodman - Ph.D.

(Endocrine &amp; Neuroscience)

- Timothy Nurkiewicz - Ph.D.  
(Cardiovascular)
- Han-Gang Yu - Ph.D.  
(Cardiovascular)
- S. Jamal Mustafa - Ph.D.  
(Cardiovascular)
- Stephen Alway - Ph.D.  
(Muscular)
- Paul Chantler - Ph.D.  
(Cardiovascular)
- Stanley Hileman - Ph.D.  
(Endocrine & Neuroscience)
- Eric Kelley - Ph.D.  
(Redox Physiology)
- Mark Olfert - Ph.D.  
(Cardiovascular & Respiratory)
- Bernard Schreurs - Ph.D.  
(Neuroscience)
- Vincent Setola - Ph.D.  
(Neuroscience & Signaling)
- James Simpkins - Ph.D.  
(Cardiovascular)

**NIOSH MENTORS**

- Patti Erdely - Ph.D.
- Aaron Erdely - Ph.D.
- Jeffrey Fedan - Ph.D.
- Dale Porter - Ph.D.
- Anna Shvedova - Ph.D.

**Doctor of Philosophy****MAJOR REQUIREMENTS**

Scientific Integrity		2
BMS 700	Scientific Integrity	
BMS 706	Cellular Methods	1
BMS 707	Experiential Learning for Biomedical Trainees	2
BMS 720	Scientific Writing	2
Graduate Seminar		4
PSIO 744	Graduate Seminar	
PSIO 750	Graduate Physiology and Pharmacology 1	3
PSIO 751	Graduate Physiology and Pharmacology 2	3
BMS 702	Biomedical Lab Experience	2
BMS 747	Foundations for Contemporary Biomedical Research I	4
BMS 777	Foundations for Contemporary Biomedical Research 2	4
Research		40
PSIO 797	Research	
Graduate Colloquium		7
PSIO 799	Graduate Colloquium	
Electives:		15
BMS 715	Molecular Genetics	
CCB 730	Cancer Cell Biology	
PHAR 779	Drugs: Bench to Market	
MICB 784B	Special Problems in Microbiology	

MICB 784C	Special Problems in Microbiology	
PSIO 790	Teaching Practicum	
PSIO 791	ADTP:Physiology Issues	
PSIO 792	Directed Study	
PSIO 793	Special Topics	
PSIO 795	Independent Study	
Qualifying Exam		
Candidacy Exam		
Dissertation Defense		
Total Hours		89

### 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

Fall	Hours Spring	Hours Summer	Hours
BMS 700	1 Electives	3 PSIO 797	3
BMS 706	1 BMS 700	1	
BMS 702	2 PSIO 744	1	
BMS 747	4 PSIO 750 or 751	3	
BMS 777	4 PSIO 797	2	
	PSIO 799	1	
	12	11	3

### Second Year

Fall	Hours Spring	Hours Summer	Hours
PSIO 750 or 751	3 Electives	6 BMS 720	2
PSIO 797	2 PSIO 744	1 PSIO 797	1
Electives	3 PSIO 797	1	
PSIO 799	1 PSIO 799	1	
	9	9	3

### Third Year

Fall	Hours Spring	Hours Summer	Hours
Elective (as needed)	3 PSIO 797	8 BMS 707	2
PSIO 744	1 PSIO 799	1 PSIO 797	1

PSIO 797	4			
PSIO 799	1			
	9		9	3
<b>Fourth Year</b>				
<b>Fall</b>	<b>Hours Spring</b>		<b>Hours Summer</b>	<b>Hours</b>
PSIO 744	1 PSIO 797		8 PSIO 797	3
PSIO 797	7 PSIO 799		1	
PSIO 799	1			
	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 Goals

### 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 593A. 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 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 791A-B. Advanced Topics. 1-3 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 793A-C. Special Topics. 1-6 Hours.**

A study of contemporary topics selected from recent developments in the field.

**PSIO 794. Seminar. 1-6 Hours.**

Special seminars arranged for advanced graduate students.

**PSIO 795. Independent Study. 1-9 Hours.**

Faculty supervised study of topics not available through regular course offerings.

**PSIO 796. Graduate Seminar. 1 Hour.**

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. 1-15 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 798. Thesis or Dissertation. 1-6 Hours.**

PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

**PSIO 799. Graduate Colloquium. 1-6 Hours.**

PR: Consent. For graduate students not seeking course work credit but who wish to meet residency requirements, use the University's facilities, and participate in its academic and cultural programs. Note: Graduate students who are not actively involved in coursework or research are entitled, through enrollment in their department's 699/799 Graduate Colloquium to consult with graduate faculty, participate in both formal and informal academic activities sponsored by their program, and retain all of the rights and privileges of duly enrolled students. Grading is P/F; colloquium credit may not be counted against credit requirements for masters programs. Registration for one credit of 699/799 graduate colloquium satisfies the University requirement of registration in the semester in which graduation occurs.

**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.