Exercise Physiology

Degrees Offered

• Doctor of Philosophy
• Joint Doctor of Medicine and Doctor of Philosophy
• Master of Science

Chair and Director of Undergraduate Education

Randall W. Bryner, Ed.D., Associate Professor, rbryner@hsc.wvu.edu; (rbryner@hsc.wvu.edu) https://medicine.hsc.wvu.edu/ep/students/bachelor-of-science/

Senior Assistant Dean for Research and Graduate Education

John M. Hollander, Ph.D., Professor, jhollander@hsc.wvu.edu; (johollander@hsc.wvu.edu) https://medicine.hsc.wvu.edu/ep/students/phd-program/

Director of M.S. Studies and Director of Human Performance Lab

Paul D. Chantler, Ph.D., Associate Professor, pchantler@hsc.wvu.edu https://medicine.hsc.wvu.edu/ep/students/master-of-science/

Nature of the Program

DOCTORAL PROGRAM

Exercise physiology is the comprehensive study of the biophysical, biomechanical and biochemical processes that contribute to movement production and disease progression. Advances in exercise physiology research have provided the foundation for human enhancement and medical treatment. The focus of the program is to promote student innovation and foster the development of independent thought. Students and faculty interact in a collegial fashion facilitating open inquiry and collaborative science.

Students entering the Exercise Physiology doctoral program have the ability to select a specialization in one of three research tracks: 1) Cardiovascular and Metabolic Diseases (CMD); 2) Muscle Pathophysiology (MPP); and 3) Rehabilitation Science and Engineering (RSE).

• **Cardiovascular and Metabolic Diseases (CMD):** Cardiovascular and respiratory function/dysfunction are studied at cellular, molecular, genetic and whole organ level in human and animal models that mimic chronic diseases, such as obesity, diabetes mellitus, stroke, and environmental exposure. Mitochondrial dysfunction, vascular remodeling, blood flow disruption, exercise and metabolic dysfunction are specific interests.

• **Muscle Pathophysiology (MPP):** Muscle function and dysfunction are studied under conditions of aging, cancer, disuse and obesity at the cellular, molecular, genetic and whole organ levels. Mechanisms contributing to dysfunction and therapeutic interventions are tested utilizing appropriate pre-clinical and clinical experimental models.

• **Rehabilitation Science and Engineering (RSE):** The research focus is on enhancing the understanding of the basic processes associated with sensorimotor control of reaching movements, balance, and locomotion after central or peripheral damage using tissue engineering, neurophysiology, biomechanics and computational neuroscience methodologies.

The philosophy of the program is to provide flexibility in coursework to support the student’s research interest in accordance with the selected track. The student and faculty mentor will define an individualized curriculum to address specific requirements for accomplishing the dissertation research. The program fosters a high degree of collaboration among faculty with interests in clinical medicine and basic research. Completion of the doctoral degree is realized when the student successfully disseminates the research results in peer-reviewed journals, national/international conferences, and to the dissertation committee. Typically, five years are required to realize this goal.

Current areas of scientific inquiry among the faculty in exercise physiology include the following:

• Aging and repetitive use injury in skeletal muscle
• Cancer cachexia and muscle wasting diseases
• Mitochondria dysfunction in pathophysiological states
• Metabolic syndrome and diabetes mellitus
• Control of movement in health and disease
• Development of assisted technologies and wearable devices
• Assessment and enhancement of human performance
• Microvascular dysfunction in disease states
• Physiologic basis of angiogenesis in pulmonary and skeletal muscle tissue
• Stem cell biology and mechanical signal and tissue regeneration
• Mechanisms of stroke and post-stroke recovery

Upon completion of the doctoral degree, the student will be capable of undertaking a career in a traditional research setting (academic, industrial, government, etc…). The acquired training will also prepare students for careers outside of a traditional research setting. Students will be periodically exposed to diverse opportunities for career development.

MASTER OF SCIENCE

The master’s of science has two track emphases, clinical and thesis.

Clinical track students engage in an intensive curriculum consisting of 35 (summer, fall, spring, summer) required credits. Didactic coursework in biological and health sciences comprise a significant portion of the curriculum. Students gain experience working with individuals with cardiovascular, metabolic, neuromuscular, cancer etc. in which exercise has been shown to be an effective treatment. Another aspect of the clinical track is the clinical internships which are performed in Phase I (inpatient), Phase II (outpatient), and Phase III (maintenance) cardiac rehabilitation programs as well as observation opportunities within in the WVU Heart and Vascular Institute, and Bariatric Surgery. Students are also encouraged to become involved with any of the various clinically related research projects being performed within the Division of Exercise Physiology. From this hands-on experience, and the didactic coursework, the clinical master students are well prepared to take the Clinical Exercise Physiologist (CEP) exam as well as serve the clinical populations. Clinical Master Students also assist clinical faculty in the WVU Human Performance Laboratory with functional assessment, risk factor modification, exercise prescription, and monitoring hemodynamic responses in populations with various medical conditions.

Thesis track is a two-year program and it is designed for students who wish to engage in an intensive research training experience, in preparation for further training in a Ph.D., or MD or similar postgraduate program. The thesis track student selects a research mentor and committee from faculty within the division of exercise physiology (or an afflicted group) based on their research interests. The first year consists of didactic coursework, while learning the necessary research skills and tools to conduct research. In the second year, the thesis track student can focus heavily on all aspects of research, the production and oral defense of a research thesis.

The faculty who will act as primary mentors in exercise physiology have research and/or clinical expertise in:

• Heart disease
• Motor unit recruitment in stroke and disability
• Biomechanical and motor control for gait in stroke or spinal cord injury
• Muscle injury and repair
• Cancer cachexia and muscle wasting diseases
• Aging and sarcopenia in skeletal muscle
• Cardiac and skeletal muscle growth and function
• Vascular dysfunction with the metabolic diseases
• Physiologic basis of lung disease
• Exercise-induced angiogenesis
• Stem cell biology and mechanical signal and tissue regeneration
• Arthritis control and exercise
• Aquatic Therapy applications to health and disease

Learning Objectives for Clinical Track

To prepare clinical exercise physiologists who:

1. Are proficient, evidence-based and patient-centered exercise physiology professionals.
2. Demonstrate effective collaboration in an interprofessional healthcare model.
3. Demonstrate integrative and critical thinking skills to allow application of scientific knowledge for clinical applications.
4. Demonstrate professionalism and career skills in clinical settings.
5. Demonstrate proficiency in modern applications in patient care.

Learning Objectives for Thesis Track
To prepare research based exercise physiologists who:

1. Demonstrate proficiency in applying theories, and knowledge to address fundamental questions in health specific issues related to exercise physiology.
2. Develop technical skills for conducting experimental procedures.
3. Develop skills in critical thinking in order to state research hypotheses, and to analyze and interpret research data using appropriate methodology and statistics.
4. Demonstrate skills in scientific written and oral communication.
5. Develop and apply key scientific traits such as professionalism and integrity, while understanding the principles of ethics associated with appropriate research conduct.

**FACULTY**

**PROFESSOR**

- John M. Hollander - Ph.D. (University of Wisconsin-Madison)
  Diabetes, Mitochondria Dysfunction, Molecular Regulation of Heart Disease

**ASSOCIATE PROFESSORS**

- Daniel E. Bonner - MS (West Virginia University)
  Clinical Exercise Physiology
- Randall W. Bryner - Ed.D. (West Virginia University)
  Diabetes, Exercise, and Cancer
- Paul D. Chantler - Ph.D. (Liverpool John Moores University)
  Metabolic Syndrom, Vascular Biology, Effects of Aging and CV Dieases on Arterial and Venticular Structure and Function
- David Donley - MS (West Virginia University)
  Exercise and Metabolic Syndrome
- Diana Gilleland - MS (West Virginia University)
  Clinical Exercise Physiology
- Jean McCrory - Ph.D. (Penn State University)
  Biomechanics, gait, foot injuries
- Beth Nardella - M.A. (West Virginia University)
  Writing Instructor, Global Engagement Coordinator
- I Mark Olfert - Ph.D. (Loma Linda)
  Angiogenesis, respiratory physiology, toxicology
- Emidio E. Pistilli - Ph.D (West Virginia University)
  Muscular Dystrophy, Muscle Injury, Cytokines, Cancer Biology
- Lori Sherlock - Ed.D. (West Virginia University)
  Aquatic Therapy in Obesity
- Sergiy Yakovenko - Ph.D. (University of Alberta)
  Neuromuscular Integration of Movement

**ASSISTANT PROFESSORS**

- James Thomas - M.S. (West Virginia University)
  Exercise, Children, Strength Training
- Emily Ryan - Ph.D. (Kent State University)
  Obesity Exercise

**ADJUNCT ASSOCIATE PROFESSOR**

- Ming Pei - Ph.D. (Beijing University, China)
  Stem Cells, Cartilage Repair

**ADJUNCT ASSISTANT PROFESSOR**

- Brent Baker - Ph.D. (West Virginia University)
  Muscle injury, rehabilitation, genomics
**Master of Science**

**Degree Requirements**

A minimum GPA of 3.0 is required in all courses
A grade of B or higher must be earned in all required courses

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<th>Course</th>
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<td>EXPH 567</td>
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<td>PSIO 593</td>
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<td>Lab Techniques and Methods 2</td>
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**Total Hours** 35-45

**Doctor of Philosophy**

**Degree Requirements**

Minimum overall GPA of 3.0 required.
Minimum GPA of 3.0 in all EXPH courses required.
A grade of B- must be earned in all required courses.

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<td>Experiential Learning for Biomedical Trainees</td>
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<td>Foundations for Contemporary Biomedical Research 1</td>
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**Total Hours** 87
Students will complete the BMS course sequence including the laboratory rotations before beginning to work with a dissertation research mentor and starting the specialized doctoral courses in the Exercise Physiology program.

**Seminars and Research Forum**

Students will present three seminars during their graduate study. The first seminar is on a topic outside of the student’s research area. The second seminar is the public presentation of the dissertation proposal, which is the background and proposed research for the dissertation project. The third seminar is the public presentation of the dissertation defense.

**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.

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

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 the student as 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. Satisfactory performance in the oral defense will result in recommendation for granting of the PhD.

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Total credit hours: 87

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**

**DOCTOR OF PHILOSOPHY (PHD) IN EXERCISE PHYSIOLOGY**

Students will:

- Attain a comprehensive understanding of the biophysical, biomechanical and biochemical processes that contribute to movement production and disease progression
- Learn to apply theories and methodologies to address fundamental questions in health-specific issues related to exercise physiology
- Obtain independent and critical thinking skills requisite for designing, conducting, and interpreting research data in an effort to advance knowledge related to health and disease through creative and innovative research
- Effectively communicate knowledge through oral and written means by disseminating research findings that have the potential to improve health and quality of life
- Demonstrate principles of ethics associated with appropriate research conduct
- Acquire technical skills requisite for conducting experimental procedures

**MASTER OF SCIENCE (MS) IN EXERCISE PHYSIOLOGY**

This program is designed with a clinical and a thesis track. The clinical track specializes in working with persons with diseases such as obesity, cardiovascular disease, and diabetes and aging. The thesis track provides opportunities for students to study mechanisms leading to and contributing to health diseases and disparities and to understand the impact of exercise on these health issues. The graduates of the masters program clinical track will become leaders who will supervise Exercise Physiologists in hospitals, rehabilitation, aquatic therapy programs, fitness, or academic settings. Some will use the clinical training in this degree to strengthen their application to medical school or another professional program. The MS clinical track will provide students the research basis from which to launch additional training in a research intensive doctoral or professional program.

Students will:

- Critically apply theories, methodologies, and knowledge to address fundamental questions in health specific issues related to exercise physiology
- Demonstrate skills in written and oral communication and critical thinking by critically analyzing research that is significant and novel in exercise physiology and within the sub-discipline associated with it
- Plan and conduct this research or implement this project under the guidance and approval of their research mentors while developing the intellectual independence that typifies true scholarship (thesis track students)
- Critically evaluate published research data and demonstrate clinical skills in working with patients and evaluating health and exercise-stress test data for appropriate exercise treatment (clinical track students)
- Follow the principles of ethics associated with appropriate research conduct (thesis track students) or clinical treatment of patients (clinical track students)
- Interact productively with people from diverse backgrounds including mentors and team members/peers with integrity and professionalism

**COURSES**

**EXPH 564. Applied Biomechanics. 3 Hours.**
PR: Department approval. This course will provide students with the principles of the analysis of human movement biomechanics, including but not limited to: anthropometry, signal processing, kinetics, kinematics, electromyography, isokinetic strength assessment, and basic programming.

**EXPH 567. Exercise Physiology 2. 4 Hours.**
PR: Consent. Comprehensive knowledge of the functioning of body systems during exercise, the acute and chronic adaptations that occur, and the practical application of this to health and disease.

**EXPH 583. Neuromechanics. 4 Hours.**
Core concepts in Neuromechanics. Fundamental concepts in computational neuroscience and biomechanics with applications to the analyses of movement control.

**EXPH 650. Advanced Anatomy for Exercise Physiology. 3 Hours.**
Provides an advanced, in-depth, integrative understanding of human anatomy. A regional approach will be used to learn typical and atypical anatomical structures of the human body. Clinical correlations will made throughout each topical area.

**EXPH 651. Advanced Gross Anatomy for Exercise Physiology. 2 Hours.**
PR or CONC: EXPH 650. Provides graduate Exercise Physiology students with integrative advanced dissection experience, leading to a comprehensive understanding of human anatomy. The student will engage in dissection activities associated with the content of co-requisite lectures. A regional approach will be used to learn typical and atypical anatomical structures of the human body.
EXPH 661. Clinical Research Methods 1. 1 Hour.
Develops skills to understand, design, assess, and evaluate clinical techniques and research that are relevant to Clinical Exercise Physiologists, including pathologies resulting from lack of exercise. Students will evaluate clinical scientific literature and case studies of various disease conditions and incorporate exercise testing and prescription in small group, student-centered, problem-based learning activities.

EXPH 662. Clinical Research Methods 2. 1 Hour.
PR: EXPH 661. Advance the foundation knowledge from Clinical Research Methods 1. Advance skills to understand, design, assess, and evaluate clinical techniques and research, including pathologies resulting from lack of exercise. Students will evaluate clinical scientific literature and case studies of various disease conditions and incorporate exercise testing and prescription in small group, student-centered, problem-based learning activities. Completion of this course.

EXPH 668. Diabetes and Exercise. 3 Hours.
PR: Graduate standing, consent. In-depth study of topics related to the comprehensive management of patients with diabetes mellitus, with special emphasis on the use of exercise in diabetes care.

EXPH 670. Lab Techniques and Methods 2. 3 Hours.
PR: Graduate standing, consent. This course teaches the techniques and methods used to monitor physiologic systems in humans during rest and exercise. It includes methods used to assess the health status of individuals desirous of exercise testing or prescription.

EXPH 671. Stress Testing. 3 Hours.
PR: EXPH 670, consent. In-depth study of graded exercise testing in laboratory or field situations. The course includes protocols for athletes, asymptomatic individuals, and special populations.

EXPH 672. Professional Field Placement. 1-18 Hours.
PR: Consent. Prearranged program to be planned, supervised, and evaluated for credit by faculty and field supervisors. Involves temporary placement with public or private enterprise for professional competence development. (Internship.).

EXPH 673. Exercise Prescription. 3 Hours.
This course will provide graduate students an understanding of the exercise prescription process and the exercise management of patients with chronic diseases.

EXPH 680. Advanced Clinical Exercise Physiology. 3 Hours.
PR: Graduate Standing. Presentation of scientific techniques utilized by clinical exercise physiologists to assess fitness in healthy and disease populations. This course will refine clinical competencies needed to safely administering various fitness assessments in clinical populations in which the risk of untoward events increases.

EXPH 681. Clinical Exercise Prescription. 5 Hours.
PR: EXPH 670 and EXPH 680. This course will present current established exercise guidelines for the safe evaluation of functional capacities and the establishment of safe, effective exercise prescriptions for individuals with cardiovascular and/or metabolic diseases.

EXPH 682. Research Design and Methods. 4 Hours.
An advanced level of important concepts involved in the design of experimental studies in Exercise Physiology. The main focus will be on understanding the essential techniques for study design, data collection, its critical evaluation, and research reporting.

EXPH 683. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

EXPH 693. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

EXPH 695. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

EXPH 696. 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.

EXPH 697. Research. 1-9 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or dissertation. (Grading may be S/ U.).

EXPH 698. 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.

EXPH 699. Graduate Colloquium. 1-6 Hours.
PR: Consent. For graduate students not seeking coursework 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.
EXPH 777. Journal Club. 1 Hour.
PR: Instructor consent. An in-depth examination and discussion of recent publications, research ideas and research projects/data-encompassing topics and research relevant to Exercise Physiology or pathologies resulting from lack of exercise.

EXPH 786. Musculoskeletal Biology. 3 Hours.
Introduction to current research approaches in musculoskeletal biology of exercise physiology. This course will stress critical thinking, and refine skills related to research design and evaluation of research methods used in exercise physiology.

EXPH 787. Cardiopulmonary Physiology. 3 Hours.
An advanced survey of important concepts involved in cardiovascular/ cardiopulmonary physiology and pathophysiology. The main focus will be on understanding the changes to cardiovascular/pulmonary system brought about by physiological stimuli such as exercise, aging, and disease states.

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

EXPH 791. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation in advanced subjects which are not covered in regularly scheduled courses. Study may be independent or through specially scheduled lectures.

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

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

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

EXPH 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.

EXPH 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.).