

The University Senate of Michigan Technological University
Proposal 13-17
(Voting Units: Academic)
“Doctor of Philosophy Degree Program in Integrative Physiology”

1. GENERAL DESCRIPTION

The faculty members of the Department of Kinesiology and Integrative Physiology (KIP) at Michigan Technological University seek to establish a Doctor of Philosophy (PhD) program in Integrative Physiology. The PhD program in Integrative Physiology is designed for students who wish to pursue careers in academia, research or industry in the areas of integrative and exercise physiology, human biomechanics, and motor learning. For questions or clarification, please contact Dr. Jason R. Carter (department chair) at jcarter@mtu.edu or 906-487-2715.

Integrative physiology can be defined as the study of organisms as functioning systems of molecules, cells, tissues, and organs. Application of these concepts and experimental approaches is used to understand human health, disease, and performance. Inside Higher Ed recently reported that kinesiology (study of human movement which encompasses aspects of integrative physiology), is “one of the fastest-growing majors in the country.”¹ Accordingly, there is a strong base of undergraduate and graduate students to draw from for this proposed graduate program, and a need for high-quality graduate programs.

¹(<http://www.insidehighered.com/news/2010/08/11/kinesiology>)

The specific learning goals for this proposed program are as follows:

Learning Goal 1: Students will demonstrate a mastery of the advanced coursework related to integrative physiology. This learning goal will be demonstrated by passing the required coursework and the written and oral comprehensive examinations, as described in Section 6.2.

Learning Goal 2: Students will demonstrate critical and independent thinking in their technical specialty within integrative physiology research. This goal will be demonstrated through annual research presentations (local, regional, and/or national), annual progress reports submitted to the graduate advisor, committee, and graduate program director (including list of abstracts, presentations, and publications), and through written and oral presentations of the dissertation.

Learning Goal 3: Students will demonstrate the ability to communicate clearly in both oral and written form. This goal will be demonstrated using the same measures as Learning Goal 2.

2. RATIONALE

The KIP department offers two Bachelor of Science (BS) degrees within the fields of kinesiology and integrative physiology, and a Master of Science (MS) degree in kinesiology, but does not currently offer a Doctor of Philosophy (PhD) degree. Over the past 10 years, KIP faculty have served as primary advisors for 11 PhD graduate students via adjunct status primarily through the graduate programs in Biological Sciences (5 graduated PhD students over past 8 years; 4 active PhD students), Biomedical Engineering (1 graduated PhD student), and Human Factors (1 graduated PhD student). These students have gone on to secure post-doctoral positions at prestigious universities (New York Medical College, Harvard University, Emory University) as well as tenure-track and lecturer positions. Based on the growth of our department and previous experiences mentoring PhD graduate students we are now ready to establish our own independent PhD program. Specifically, our motivations for establishing a PhD in Integrative Physiology include the following:

- With 6 tenure-track faculty, 2 staff members with Ph.D. degrees, and several key affiliated and adjunct faculty with specialties related to integrative physiology, the department has a critical mass to offer a nationally competitive PhD degree in Integrative Physiology.
- 80% of full-time KIP faculty are actively funded by either the National Institutes of Health (NIH) or the National Science Foundation (NSF). In addition, faculty have received funding through agencies such as the American Heart Association (AHA) and American College of Sports Medicine. Over the past year, 100% of KIP faculty have peer-review publications and external grant submissions. There is a robust research environment to support PhD students.
- Having a graduate program in the department will increase national and international visibility, which is consistent with the Michigan Tech Strategic Plan and will assist with enhanced recruitment of premiere students and faculty.
- Federal agencies such as the NIH, NSF, AHA, and American Diabetes Association all have review criteria that address “infrastructure” and “environment”. A graduate program within the department will strengthen our infrastructure and environment, particularly as it pertains to requests for graduate funding.
- Michigan Technological University has established an innovative Doctorate of Physical Therapy (DPT) partnership with Central Michigan University (CMU). This has resulted in the presence of 24 CMU DPT students on Michigan Tech’s campus each year. A long-term goal of this DPT partnership is the development of a DPT/PhD option for some of the top students. Such students would receive a DPT from Central Michigan, and a PhD from a Michigan Tech graduate program. We envision several existing PhD programs as potential partners for the DPT degree (i.e., Biomedical Engineering, Mechanical Engineering, Human Factors), and believe a PhD in Integrative Physiology will also be attractive for DPT students.

3. RELATED PROGRAMS

3.1. Related Programs at Michigan Tech

The programs most closely related to the proposed Integrative Physiology PhD program are the Biological Sciences, Applied Cognitive Science and Human Factors, and Biomedical Engineering PhD programs. These programs have several criteria that have been used to assess their success: 1) upon graduation, PhD students have demonstrated the ability to carry out an advanced and original research project, including its written and oral communication; 2) their projects have synthesized knowledge from different scientific disciplines; and 3) PhD students gain experience as research proposal writers. The departments require presentation and defense of a research proposal, and students are expected to participate in the preparation and writing of proposals for internal and external funding. There are sometimes specific coursework requirements for the PhD; and upon approval of the advisory committees, students can choose elective courses tailored to their background and research interests. Emphasis is placed on research and publication of research. The average student completes the PhD in 3-5 years. We have designed our Integrative Physiology Ph.D. with these successful programs as a template.

3.2. Related Programs at Other Institutions in Michigan

There are 3 Physiology PhD and 3 Kinesiology/Movement Science PhD degree programs in Michigan that relate to the proposed degree (see Table 1). The three existing Physiology PhD programs at University of Michigan, Michigan State, and Wayne State are heavily focused on cellular and molecular physiology. The three existing Kinesiology PhD programs at those same institutions are more focused on applied physiology. We envision our program being a balance between those two of important aspects of physiology (i.e., molecular vs. applied), thus offering

a *unique* curriculum and research experience for students. Our program will include both basic and applied courses/research, with a heavy focus on physiological interactions across systems. We evaluated these programs in order to assure that our graduates will be competitive with those from other institutions. We found that many programs have similar course requirements, and generally require some combination of oral and/or written qualifying examination. We modeled specific aspects of the proposed PhD program after the University of Michigan program, which is one of the top 3 Kinesiology Programs in the nation. Additionally, we benchmarked nationally, and modeled the proposed PhD program after the well respected and highly visible Integrative Physiology PhD program at the University of Colorado-Boulder and new Integrative Physiology PhD program at the University of Utah.

Table 1. Related Programs in Michigan

Institution	Ph.D. Degree
University of Michigan	Molecular and Integrative Physiology
University of Michigan	Movement Science
Michigan State University	Physiology
Michigan State University	Kinesiology
Wayne State University	Physiology
Wayne State University	Kinesiology & Sport Studies

4. PROJECTED ENROLLMENT

Our goal is to have 1-2 Ph.D. students for every tenured/tenure-track faculty member. We currently have six tenure-track faculty. As such, we anticipate a steady state number of approximately 6-12 Ph.D. students.

5. SCHEDULING PLANS (Extension, Evening, Regular)

We intend to offer the proposed curriculum using a *regular* scheduling plan consistent with University policy.

6. CURRICULUM DESIGN

Graduate students entering the Integrative Physiology Ph.D. program must have a Master's degree in kinesiology, physiology, biological sciences, or other relevant disciplines. Faculty from the graduate program must approve the admission of graduate student applicants. Admission will be based on holistic review of the student's application package as well as the availability of space in the program. Candidates with a Master's degree that does not include adequate background in physiology may be required to take some pre-requisite courses prior to acceptance and/or enrollment in the advanced coursework required for the PhD degree (determined by graduate director in consultation with graduate faculty).

6.1. Core Degree Requirements

The program of study and research will be planned and supervised by an advisory committee. The advisory committee must approve each candidate's course work and research topic. Students will be required to take a minimum of 30 credits beyond their master's degree, with the following requirements:

Required Core Courses (10-11 credits)

- Advanced Exercise Physiology (EH 5310; 3 credits)

- Molecular Physiology (EH 5600; 3 credits)
- Graduate Seminar (EH 6100; 1 credit)
- At least one of the following statistical courses:
 - Biostatistics for Health Science Research (BE 5550; 4 credits)
 - Regression Analysis (MA 4710; 3 credits)
 - Design and Analysis of Experiments (MA4720; 3 credits)
 - Statistical Methods (MA 5701; 3 credits)
 - Advanced Statistical Analysis and Design I (PSY 5210; 4 credits)
 - Advanced Statistical Analysis and Design II (PSY 5220; 4 credits)

Elective Courses (as determined by advisory committee)

- A list of approved elective courses within and outside the department is provided in Section 6.3, and this list will be updated annually by the department. Multiple statistical courses are strongly recommended for this degree. Courses not on this list, but deemed relevant and appropriate by the student, can be used ad hoc if written approval is obtained from the primary advisor and KIP department chair.

Research Credits (15+ credits)

- A minimum of 15 research credits are required.

6.2. Other Degree Requirements

6.2.1. Advisor and the advisory committee

Based on their research interests, graduate students must choose a primary advisor (or co-advisors), no later than the end of the first academic year. The primary advisor must hold a regular or affiliated appointment in the Department of Kinesiology and Integrative Physiology and will chair the committee. The primary advisor will help the student select members of the advisory committee. The advisory committee (in addition to the primary advisor) will consist of 2 graduate faculty members within the department and at least one graduate faculty from outside the department.

6.2.2. Qualifying exam

The qualifying exam will consist of a written and oral examination, and will evaluate fundamental and applied topics in integrative physiology. The primary advisor will be responsible for soliciting the advisory committee members for content and assessment. Graduate students will be encouraged to take the qualifying exam after about two years of doctoral study (following completion of required coursework); see Table in Section 6.2.7.

6.2.3. Dissertation proposal

The dissertation proposal should contain a review of the literature, a problem statement/rationale, study hypotheses, research design, proposed methods/research strategy, and pilot data when possible. The primary advisor, with input from the committee members, can decide on the proposal format.

6.2.4. Written dissertation

The dissertation will be written and prepared under the supervision of the committee chair and the advisory committee according to the requirements of the Graduate School. It is expected that at least one of the projects within the final written dissertation will have

been designed and executed by the student, and will include an IRB/IACUC submission and approval.

6.2.5. Final oral examination

The final requirement will be a public oral presentation and an oral examination according to the requirements of the Graduate School.

6.2.6. Annual evaluation

The faculty supervisor will perform an annual evaluation of the student's performance and progress towards degree completion. A written report highlighting the student's progress, target benchmarks for the next year, and areas for improvement will be shared with the student and graduate program director.

6.2.7. Sample timeline to degree

Time to degree completion is approximately 3-4 years.

	Year 1			Year 2			Year 3			Year 4	
	Fall	Sp	Sum	Fall	Sp	Sum	Fall	Sp	Sum	Fall	Sp
Coursework	X	X	X	X							
Qualifying Exam				X	X						
Dissertation Research					X	X	X	X	X	X	X
Dissertation Proposal						X	X				
Dissertation Defense											X
Annual Evaluation			X			X			X		

6.3. Course Offerings

6.3.1. Existing graduate courses

The following is a list of existing courses (in various departments) that demonstrates the breadth of courses currently available to students. We have sought input and obtained approval to include the non-departmental courses via the respective department chairs (i.e. BE, BL, MA, and PSY).

BE 5510 - Cardiovascular Engineering

Fundamental cardiovascular pathology and the biomedical engineering approaches being developed and used toward problems resulting in significant cardiovascular deficiency such as myocardial infarction, chronic kidney disease, atherosclerosis, and heart valve disease. Credits: 3.0

BE 5550 - Biostatistics for Health Science Research

An overview course of biostatistical methods used in the health sciences. Topics include a review of undergraduate statistical concepts, NIH, CDC, and FDA guidelines for clinical trial research, proper use of biostatistical methods including anova models, logistic regression, risk analysis, survivorship analysis and any other statistical methods that are common in the enrolled students' discipline. Credits: variable to 4.0

BE 5940 - Introduction to Tissue Engineering

Explore the application of engineering principles toward the construction/reconstruction

of human tissue. Fundamental biological principles involved in tissue engineering are reviewed from an engineering perspective with examples of engineered tissues such as blood vessels, skin, liver, cartilage and bone. Credits: 3.0

BE 6900 - Biomedical Engineering Topics

Biomedical engineering courses will be offered as professional electives dependent upon the interest of the faculty. Credits: variable to 6.0

BL 4010 - Biochemistry I

Structure, biochemical properties, and function of important biomolecules such as proteins and nucleic acids. Introduces enzyme biochemistry (structure, function, catalysis, kinetics, and inhibition). Credits: 3.0

BL 4020 - Biochemistry II

Dynamic aspects of living systems. Broad exposure to cellular metabolic pathways, intermediary metabolism and its regulation and bioenergetics. Credits: 3.0

BL 4380 - Cardiopulmonary Physiology

Using a problem-based learning approach, course examines the physiology of the human body. In-class case-study analyses provide in-depth learning about the cardiovascular and pulmonary systems and their relationship with other organ systems. Promotes development of problem-solving skills. Credits: 3.0

BL 4840 - Molecular Biology Techniques

Laboratory techniques in molecular biology, including methods of recombinant DNA technology for identification, cloning, and characterization of genes. Credits: 3.0

BL 5030 - Molecular Biology

Molecular biology of gene structure, expression and regulation. Molecular techniques and their application to biotechnology and genomes are covered. Credits: 3.0

BL 5042 - Scanning Electron Microscopy of Biological Specimens

Hands-on training in operation of the scanning electron microscope (SEM). Students prepare biological specimens of their choice for observation. Emphasis will be placed on application of advanced techniques. Successful completion of course is prerequisite to becoming a certified SEM operator in the ACMAL. Half semester. Credits: 3.0

BL 5350 - Special Topics in Physiology

A discussion of recent developments in physiology. Recent offerings have included respiratory physiology, renal physiology, clinical cardiology, and neurophysiology. Credits: variable to 10.0; Repeatable to a Max of 10

EH 4200 - Sports Nutrition Seminar

Human nutrition as it specifically applies to athletes. Specific needs for proteins, carbohydrates, fats, electrolytes and micronutrients. Use of ergogenic aids is covered. Students will research, write and present orally their findings on nutrition topics. Credits: 2.0

EH 4210 - Exercise Physiology

Focuses on the functional changes brought by acute and chronic exercise sessions. Topics include muscle structure and function, bioenergetics, cardiovascular and

respiratory adaptations, exercise training for sport, sport nutrition, ergogenic aids, and other health and fitness topics. Credits: 3.0

EH 4220 - EKG Interpretation

Course is designed for students who are going to pursue future career related to cardiac rehabilitation, physical therapy and students in the Pre-Med program. Students will learn cardiac electrophysiology, the pathophysiology, the diagnosis, and treatment of cardiac arrhythmias, and related cardiovascular diseases. Class will build bridge between basic sciences and human health. Credits: 2.0

EH 4211 - Exercise Physiology Laboratory

A companion course to EH4210. Hands-on experience in making physiological measurements as related to exercise. Cardiovascular and respiratory changes during exercise will be monitored. A virtual lab is used to simulate changes in physiological measurements that cannot be performed on live subjects. A student designed laboratory project is required. Credit: 1.0

EH 4400 - Motor Learning and Control

Designed for upper level undergraduates or graduates, this course will provide the current theories and concepts involved in the processes of motor skill acquisition and performance from a behavioral perspective. Credits: 3.0

EH 4420 - Motor Development

Designed for upper level undergraduates or graduates, this course will focus on the changes in motor behavior across a life span, and examine the study and practice of fundamental patterns within the context of development theory. Credits: 3.0

EH 4500 - Biomechanics of Human Movement

An in-depth view of the biomechanical properties of the musculoskeletal system. The course provides detailed analyses of the kinetics of human movement, material properties of the component tissues, and dynamic processes of adaptation to stress and strain of the system. Credits: 3.0

EH4511 - Biomechanics of Human Movement Lab

A companion course to EH4500. Hands-on experience, including data collection, analysis, and interpretation using various equipment in biomechanics. Credit: 1.0

EH 5310 - Advanced Exercise Physiology

This course focuses on exercise physiology in both humans and rodents. Topics include detailed muscle physiology, fatigue mechanisms, the autonomic nervous system, advanced cardiovascular adaptations with exercise, exercise metabolism, and environmental exercise physiology. The importance of translational research will be highlighted. Credits: 3.0

EH 5320 - Advanced Biomechanics

This course includes the quantitative analysis of human motion through bioinstrumentation during dynamic performance. A detailed analysis of different movements and movement techniques, from both a clinical and exercise science perspective, as well as investigations into the mechanics of tissues and their function, are integral features of this course. Students will also learn how to interpret the data recorded by biomechanical equipment, and how to apply this to the body of knowledge in sport science. Credits: 3.0

EH 5330 - Advanced Motor Behavior

Peer-reviewed literature will be utilized to acquaint students with scholarly issues and topics in motor learning and control that are relevant to their fields. The theoretical concepts related to motor control, motor learning, and motor development will be covered. Students will be expected to design a scientific research study related to their specific interest goals. Credits: 3.0

EH 5350 - Special Topics in Kinesiology

Selected additional topics in kinesiology for advanced students based on interests of faculty and students. Interested students should contact the Exercise Science, Health and Physical Education department. Credits: variable to 9.0; Repeatable to a Max of 9

EH 5500 - Stress Physiology

This course focuses on stress physiology in humans. Topics include neural and hormonal responses to mental stress, interactions between physical and mental stress, bidirectional relations between stress and disease, and health disparities associated with stress. Credits: 2.0

EH 5510 - Advanced Strength and Conditioning

Advanced theory and practice in development and administration of comprehensive strength and conditioning programs for both the athlete and individual of any level. Includes knowledge, safety concerns and skill techniques necessary for teaching and administering any strength and conditioning facility. This will be done through a combination of lecture, seminar, scientific articles and practical experience. Credits: 3.0

EH 5520 - Sleep and Circadian Physiology

This course focuses on the role of sleep and circadian rhythm on physiological control systems. Topics include basic mechanisms of the sleep-wake cycle, role of sleep and circadian clock on cardiovascular and respiratory control, overview and treatment strategies for common sleep disorders, and techniques in sleep medicine research. Course content will be delivered using a combination of lecture, seminar, scientific articles, and group work. Credits: 3.0

EH 5540 - Neuroendocrine Physiology

This course will focus on understanding how the neural and the endocrine system are regulated under both normal physiological conditions and pathophysiological states. The major objective of this course is to prepare graduate students to develop critical thinking and problem solving skills related to the function of the nervous system and endocrine system, and their complex interaction with each other. This will be done through a combination of lecture, seminar, scientific articles, lab techniques, and group work. Credits: 3.0

EH 5900 - Laboratory Techniques for Integrative Physiology

This course will expose graduate students to various methodologies in integrative physiology. Student will rotate between various laboratories and observe techniques such as microneurography, electrophysiology, molecular physiology, muscular fatigue, etc.; both human and animal methodologies will be examined. Credits: 2.0

EH 5920 - Graduate Seminar

Graduate seminars are designed to facilitate critical discussions of student research projects and peer-reviewed research in related fields. The presenter will provide an overview or seminar of the research of interest, which will establish the foundation for the discussion thereafter. Credit: 1.0

MA 4710 - Regression Analysis

Covers simple, multiple, and polynomial regression; estimation, testing, and prediction; weighted least squares, matrix approach, dummy variables, multicollinearity, model diagnostics and variable selection. A statistical computing package is an integral part of the course. Credits: 3.0

MA 4720 - Design and Analysis of Experiments

Covers construction and analysis of completely randomized, randomized block, incomplete block, Latin squares, factorial, fractional factorial, nested and split-plot designs. Also examines fixed, random and mixed effects models and multiple comparisons and contrasts. The SAS statistical package is an integral part of the course. Credits: 3.0

MA 5701 - Statistical Methods

Introduction to design, conduct, and analysis of statistical studies, with an introduction to statistical computing and preparation of statistical reports. Topics include design, descriptive, and graphical methods, probability models, parameter estimation and hypothesis testing. Credits: 3.0

PSY 5010 - Cognitive Psychology

A systematic survey of classical and contemporary research topics in human information processing and learning. Topics include models of cognition, perception/pattern recognition, attention, the nature of mental representation and processing; the architecture of memory, imagery, concepts, and prototypes; reasoning, decision making, problem solving, and cognitive development. Credits: 3.0

PSY 5210 - Advanced Statistical Analysis and Design I

An overview of research ethics, experimental design, proposal writing, and univariate statistics such as t-tests and ANOVA. Credits: 4.0

PSY 5220 - Advanced Statistical Analysis and Design II

A continuation of PSY 5210 covering multivariate and nonparametric statistics such as MANOVA, ANCOVA, Multiple Regression, factor analysis, and Chi Square. Credits: 4.0

PSY 5850 - Human Factors Psychology

Advanced concepts critical to the design of human-technological systems, such as capitalizing upon human capabilities and compensating for human limitations. Topics may include perceptual and motor abilities, human error and cognitive engineering. Credits: 3.0

PSY 6991 - Special Topics in Human Factors

Study of special topics in human factors as designed by section title. Credits: variable to 3.0; Repeatable to a Max of 9

6.3.2. New graduate courses

The Department of Kinesiology and Integrative Physiology will offer the following new graduate courses for this program. We have the expertise and sufficient number of research-active faculty to deliver this curriculum. Course proposals were approved through the Fall 2016 Curriculum Binder Process, which included review at the department-, college-, and university-level.

New core courses:

- EH 5600 - Molecular Physiology (3 credits)
- EH 6100 – Graduate Seminar (1 credit)
- EH 6900 - Doctoral Research in Integrative Physiology (variable)

New elective courses:

- BL 5044 - Human Pathophysiology (3 credits)
- EH 4990 - Exercise Pharmacology (2 credits)

7. NEW COURSE DESCRIPTIONS

BL 5044 - Human Pathophysiology

Human Pathophysiology will cover abnormal function (physiology) and investigate the signs and symptoms of major diseases in humans. The course will be an extension of Anatomy & Physiology (BL2010 and BL2020) by working through the systems of the human body. The course will include a clinical focus and will regularly use a case-study approach. Credits: 3.0

EH 5600 - Molecular Physiology

The purpose of this course is to introduce how different biochemical and molecular pathways of the cell work together to produce various physiological functions. Emphasis will be placed on the molecular and cellular mechanisms underlying physiological processes. Structure and function relationship will be addressed throughout the course. Recently published research articles in the area of molecular and cellular physiology will be discussed. Credits: 3.0

EH 6100 – Graduate Seminar

Graduate seminars are designed to facilitate critical discussions of student research projects and peer-reviewed research in related fields. The presenter will provide an overview or seminar of the research of interest, which will establish the foundation for the discussion thereafter. Credit: 1.0

EH 6900 - Doctoral Research in Integrative Physiology

An original investigation in theoretical or experimental physiology, or both, and submission of a dissertation in partial fulfillment of the requirements for the PhD degree
Credits: variable up to 9.0 per semester

EH 4990 – Exercise Pharmacology

This course focuses on understanding the fundamental concept of pharmacology and pharmacological treatment of diseases of various systems including cardiovascular, respiratory, endocrine, neuronal, hormonal and renal systems. Class will build bridge between basic sciences and human health. Credits: 2.0

8. LIBRARY AND OTHER LEARNING RESOURCES

The existing library and learning resources are adequate for the proposed graduate degree; no new resources are requested.

9. COMPUTING ACCESS FEE

No applicable fee

10. CORE AND AFFILIATED FACULTY (RESUMES)

The KIP department has six tenure/tenure-track faculty, as well as several key affiliated or adjunct faculty, that will assist with the proposed degree. The curricula vitae of these faculty members are available at the following website:

<http://www.mtu.edu/kip/graduate/doctorate>

10.1. Core KIP Faculty

Jason R. Carter, Ph.D.; Professor and Department Chair

Research Interests: Neural control of circulation, sleep physiology, sympathetic reactivity to mental stress, human performance

Qing-Hui Chen, Ph.D.; Associate Professor

Research Interests: Neurophysiology, cardiovascular physiology, cardiovascular diseases, metabolic disorders

Steven Elmer, Ph.D.; Assistant Professor and Graduate Program Director

Research Interests: Muscle physiology, biomechanics, rehabilitation, pedagogy

Zhiying (Jenny) Shan, Ph.D.; Assistant Professor

Research Interests: Neuroinflammation, neurogenic hypertension, salt sensitive hypertension

Tejin Yoon, Ph.D.; Assistant Professor

Research Interests: Biomechanics, muscle fatigue, neuromuscular control of human movement

Kevin Trewartha, Ph.D.; Assistant Professor

Research Interests: Aging, motor learning; sensorimotor neuroscience

Christopher Schwartz, Ph.D.; Lecturer and Graduate Internship Coordinator

Research Interests: Autonomic integrative physiology, hypertension, orthostatic intolerance, human performance

Stephanie Hamilton, Ph.D.; Instructor and Undergraduate Internship Coordinator

Research Interests: Biomechanics, aging, muscle stiffness

Kelly Kamm, Ph.D.; Research Scientist

Research Interests: Epidemiology, community health

10.2. Affiliated and Adjunct Faculty

John J. Durocher, Ph.D.; Assistant Professor, Department of Biological Sciences

Research Interests: Arterial stiffness, blood pressure, exercise recommendations, metabolic syndrome

L. Syd Johnson, Ph.D.; Assistant Professor, Department of Humanities

Research Interests: Bioethics, neuroethics, brain injury, concussion

Mark Randell, PT, DPT, FAAOMPT; Director of UP Health System Portage Rehab
Research Interests: Sports medicine and rehabilitation, human performance

Carl Smoot, D.O.; Director of the Portage Health Sleep Disorders Center
Research Interests: Sleep deprivation and neural control, sleep apnea, sleep and sports performance

Cameron Williams, PT, DPT, MS; DPT Site Coordinator, Central Michigan University
Research Interests: Sports medicine and rehabilitation, human performance

11. DESCRIPTION OF AVAILABLE/NEEDED EQUIPMENT

The KIP department currently has all of the necessary equipment for the proposed program. The department includes six designated research and/or teaching laboratories related to exercise and integrative physiology, biomechanics, and motor behavior. Some relevant pieces of equipment available for this program include:

Integrative Physiology Laboratory

- Microneurography nerve traffic analysis system
- Electrocardiogram units and amplifiers
- Pneumobelt for respiratory excursions
- Venous occlusion plethysmography for limb blood flow measurements (calf and forearm)
- Automated sphygmomanometer – four units
- Wrist actigraphy for sleep monitoring – four units
- Finger plethysmography (i.e., Finometer) for beat-to-beat blood pressure recordings
- 24 hour ambulatory blood pressure monitoring system -- four units
- Limb actigraphy system -- eight units
- Motorized tilt table
- Lower body negative pressure chamber
- Phlebotomy chair and all equipment/accessories needed for venipuncture

Exercise Physiology and Human Performance Laboratory

- Portable Doppler ultrasound system (GE Logiq e)
- Two Metabolic measurement systems (ParvoMedics), including one with spirometry and cardiac output attachments
- Wireless surface EMG system
- Various cycle ergometers for lower- (6) and upper- (4) body submaximal and maximal exercise testing
- Fat calipers, underwater body weighing, and other body composition equipment
- DEXA Scanner

Human Biomechanics Laboratory

- Six Vicon motion-capture cameras
- In-ground force plate in biomechanics laboratory with motion-capture cameras
- Blood lactate analyzers -- two units
- Multi-use Biopac systems for EMG, EEG, ECG, etc.
- Biodex machine for isokinetic testing
- Electrical stimulator and transcranial magnetic stimulator

- Optitrack motion capture system with 8 cameras
- Delsys wire and two wireless EMG system with motor unit decomposition options

Motor Learning and Cognitive Aging Laboratory

- KINARM integrated 2-D virtual reality robotic manipulandum for studying the control of upper limb movement

Molecular Physiology Laboratory

- Radio telemetry transducer system for rat blood pressure and activity recording
- Metabolic cage system for rat metabolism study
- Biotek synergy plate reader for DNA, RNA and protein concentration measurement, and fluorescence intensity assessment
- Biosafety cabinet
- CO₂ incubator for cell culture incubation
- Inverted Leica fluorescence microscope
- PCR machine, electrophoresis system, western blot transfer system
- Beckman centrifuge 5804R
- Bacterial incubator

Electrophysiology Laboratory

- Olympus microscope with DIC optics and epifluorescence capabilities
- Amplifier and accompanying computer with data acquisition/analysis software
- Analog-to-digital converters
- Perfusion system
- Bath chamber temperature controller
- Vibrating microtome
- Microelectrode puller
- Digital CCD camera with image analysis software
- Respirators and CO₂ monitors
- Pressure injector
- Stimulator (Master-8, A.M.P.I.) with voltage isolator
- Olympus brightfield microscope
- Tail cuff blood pressure measurement system

Additionally, the KIP department also has shared oversight of departmental exercise training equipment within the Student Development Complex. Specifically, students will have access to the 7,256 ft² student exercise training complex for aerobic and resistance training (i.e., strength and conditioning curriculum). Equipment available in this training complex include:

- *Aerobic equipment:* 12 stationary bicycles, 14 treadmills, 6 elliptical machines, 3 stairmaster machines, 3 rowing ergometers
- *Resistance equipment (free weight):* 2 full sets of 100 lb (5 lb increment) dumbbells, barbells (10-110 lbs), 5 free weight bench press units (1 incline and 1 decline), 3 squat racks, 1 military press, 3 dual cable crossover units
- *Resistance equipment (free motion and hammer strength machines) for:* bicep, tricep, deltoid, pectoralis, latissimus dorsi, rhomboids, hamstring, quadricep, gastrocnemius, soleus, and abdominal muscles

There is sufficient equipment and space currently available for the proposed graduate degree, and no new resources are requested for equipment. The department expects to continue making strategic investments of available internal (i.e., department general fund,

laboratory fees, summer teaching return, etc.) and external (i.e., external research grants) resources to build upon the existing infrastructure.

12. ESTIMATED PROGRAM COSTS

We project a gradual enrollment increase to a 3rd year steady state of 8 PhD students, and estimate costs and revenue for this new program in Table 2. The following assumptions are included in this estimate:

- The department has had two funded GA lines granted through the original Exercise Science B.S. degree approved in 2006, and have served a vital role in assisting with laboratory teaching and research within the department, as well as beyond the department (assisting with Anatomy & Physiology laboratories in Biological Sciences). Since 2006, we have added a B.S. in Sports and Fitness Management (2008) and a M.S. in Kinesiology (2014), but have not requested any new GA lines. Therefore, these two original GA lines are “funded” through revenue generated from our existing B.S. and M.S. degrees, and are thus not included as expenses within the program cost analysis.
- **The proposed Ph.D. program includes a funding request for two new GA lines supported by the administration.**
- The program cost analysis assumes 5% increase per year for both graduate tuition and minimum stipend amounts as posted by the Graduate School.
- The program cost analysis assumes 1:1 ratio of external/self-supported students at regular tuition rate (9 credits/semester) vs. research-only tuition rate (3 credits/semester) in 2017-18 and 2019-20, and 2 regular vs. 1 research-only externally/self-supported students in 2018-19.
- By year 3, we strive to have a 1:1 ratio of internal vs. externally/self-supported PhD students in our program.

Table 2. Program Cost Analysis

	2017-18	2018-19	2019-20
Total # of projected Ph.D. students	6	7	8
Existing GA lines	2	2	2
New GA lines	2	2	2
External/Self-Supported	2	3	4
Tuition per credit	\$905	\$950	\$998
External/self-support credits	24 credits	42 credits	48 credits
Tuition revenue from external/self-support	\$21,720	\$39,900	\$47,904
Cost of 2 new GA stipends	\$32,502	\$34,127	\$35,833
Income developed from program	-\$10,782	\$5,773	\$12,071

We recognize additional resources required for student recruitment and other administrative duties, but these will be handled by existing departmental budgets.

Appendix A includes additional budgetary information per University Senate policy 51-04.

13. SPACE

There are no new requests for additional space related to this program.

14. POLICIES, REGULATIONS, AND RULES

All policies, regulations, and rules have been previously outlined, and are superseded by University policy (including Graduate School policies).

15. ACCREDITATION REQUIREMENTS

An assessment plan for the evaluation of the proposed PhD program will be developed in parallel with the assessment plan for the MS degree, as required by the Michigan Tech Graduate School. Developing the assessment plans is scheduled to be complete by December 2017.

16. INTERNAL STATUS OF THE PROPOSAL

This proposal has been preliminarily reviewed and modified in consultation with the KIP department faculty, KIP graduate director, and KIP chair. We have also received feedback from the Dean of the College of Sciences and Arts, College of Sciences and Arts College Council, Deans Council, Dean of the Graduate School, and Graduate Faculty Council. We are now seeking review and feedback from Provost and University Senate.

17. PLANNED IMPLEMENTATION DATE

We aim to have this degree available in Fall 2017.

Introduced to Senate:

Adopted by Senate:

Approved by Administration:

Approved by Board of Control: