

# HUMAN MOVEMENT SCIENCE CURRICULUM (GRAD)

The Department of Health Sciences in the School of Medicine offers an interdisciplinary program of study in human movement science leading to the doctor of philosophy degree. The intent of this program is to develop research and teaching scholars who are capable of producing and disseminating new knowledge in the field of human movement science. The curriculum combines core requirements for all students in the program while allowing for considerable flexibility in designing programs of study to meet the needs of a specific area of concentration and the students' interests.

The doctoral program in human movement science is offered through the cooperative effort of the Division of Physical Therapy (UNC School of Medicine) and the Department of Exercise and Sport Science (College of Arts and Sciences). This program is designed to provide students an opportunity for doctoral study in areas that will increase our knowledge of human movement. The program focuses on contributing to the scientific basis of human movement and developing theory and methods for maintaining health, preventing disability, and improving movement ability. Focusing on normal movement and movement disability requires a special emphasis in research and education that draws upon yet differs from the focus of related sciences. Students of varied academic disciplines are accepted into the program. Students in our program study across several areas of interest in human movement:

- Biomechanics
- Brain injury / concussion
- Exercise physiology
- Injury prevention
- Neuromuscular control and motor learning
- Rehabilitation (musculoskeletal, neurological)

## Research Facilities

Several research facilities are available for students in the departments participating in the program. These include the Recovery of Gait and Neurorehabilitation (ReGain) and Cassidy Plasticity Laboratories in the Division of Physical Therapy, and the Applied Physiology, Integrative Exercise Oncology Lab, MOTION Science Institute, STAR Heel Laboratory, and the Matthew Gfeller Sport-Related Traumatic Brain Injury Research Center in the Department of Exercise and Sport Science. These laboratories are equipped with state-of-the-art instruments for measuring a range of human movement and performance through behavioral, physiological, biomechanical, cognitive, sensory, and computer modeling instrumentation.

## Admission

Student selection is based primarily on academic records and research experience. Requirements include the following:

- At least one core HMSC faculty member has agreed that he/she may serve as the applicant's mentor if the applicant is admitted to the program. This is not a guarantee of admission, but an indication that the faculty member has endorsed the application.
- A master's degree in a field related to human movement (e.g., physical therapy, exercise science, athletic training, biomedical engineering, anatomy, etc.) is preferred. In rare circumstances,

qualified candidates with a bachelor's degree will be considered for admission.

- A grade point average of 3.0 or better in the last two years of the student's most recent degree program. A typical student who is admitted has a 3.4 GPA or better.
- Coursework in the following areas, completed within the past five years, is a prerequisite for admission. Completion of coursework in these areas longer than five years ago may require completion of an admissions examination.
  - Statistics
  - Human anatomy
  - Human physiology

**AND** at least **one** of the following courses:

- Physics
- Biomechanics
- Chemistry
- Psychology
- Exercise physiology
- Motor learning/motor control/ neuromuscular control
- Neuroanatomy
- Three letters of academic recommendation
- Curriculum vitae
- Written statement of the academic/career goals and research interests
- Name of the faculty member who has agreed to mentor the applicant. (Applicants should contact a faculty member in their area of interest prior to beginning the application process.)

## Human Movement Science, Ph.D.

A key feature of this program is the interdisciplinary orientation of the combined efforts of several successful programs on the UNC – Chapel Hill campus. We believe that the advancement of the science of human movement can best be accomplished with methods and researchers across disciplines. Human movement is inherently complex and dynamic and is the product of biological, mechanical, behavioral, and environmental systems. The dynamic and complex nature of human movement provides an organizational perspective for the curriculum. Specific features of this organizing perspective include:

- An emphasis on developing and testing theory of normal and dysfunctional human movement;
- Applying these and other theories of movement to maintaining and improving human movement;
- Recognizing the multifactorial nature of human movement;
- An interdisciplinary approach to solving problems of human movement;
- Studying movement at multiple levels of analysis; and
- Addressing the unique movement problems associated with injury, disease, development and aging.

## Course Requirements

Code	Title	Hours
<b>Core Courses</b>		
2 of the following courses: <sup>1</sup>		
HMSC 700	Scientific Basis of Human Motion	6

HMSC 701	Scientific Basis of Human Motion	
HMSC 702	Physiology of Exercise	
IHMS 870	DOCTORAL SEMINAR IN HUMAN MOVEMENT SCIENCE <sup>2</sup>	4
1 course in research design <sup>3</sup>		2
EPID 600	Principles of Epidemiology for Public Health	
HMSC 886	Understanding Research	
HSCI 902	Philosophical Foundations: Assumptions Guiding Research Methodologies	
HSCI 904	Quantitative Foundations: Alternative Designs, Types of Knowledge, Generalization	
2 graduate level statistics courses <sup>3</sup>		6
BIOS 660	Probability and Statistical Inference I	
BIOS 661	Probability and Statistical Inference II	
BIOS 635	Introduction to Machine Learning	
BIOS 665	Analysis of Categorical Data	
EDUC 784	Intermediate Statistical Methods	
EPID 710	Fundamentals of Epidemiology	
EPID 716	Epidemiologic Data Analysis	
NURS 918	Intermediate Statistics: Regression Analysis	
PSYC 834	Machine Learning	
1 course in grant writing <sup>3</sup>		3
DPOP 872	Proposal Writing in DPOP	
HSCI 909	Proposal and Grant Writing	
KIN 709 (UNCG Course)		

### Electives (Advanced HMSC)

Any classes offered at UNC above 500 or equivalent courses at other institutions. Multiple Independent Study courses (HMSC 877) can be taken, but only 1 can be used toward the advanced HMSC content area. 6

### Thesis/Substitute or Dissertation

IHMS 994 Doctoral Research and Dissertation 9

**Minimum Hours** 36

<sup>1</sup> Students with previous, relevant undergraduate or master's experience may have the option of substituting one of these courses with consultation with the DGS and program coordinator.

<sup>2</sup> Students must take this 1-credit hour class four times.

<sup>3</sup> For alternative courses please consult your DGS and program coordinator.

## Milestones

The following list of milestones (non-course degree requirements) must be completed; view this list of standard milestone definitions (<https://catalog.unc.edu/graduate/degree-programs/#milestonestext>) for more information.

- Doctoral Written Exam
- Doctoral Oral Comprehensive Exam
- Doctoral Committee
- Prospectus Oral Exam
- Dissertation Defense
- Doctoral Dissertation Approved/Format Accepted

- Residence Credit
- Doctoral Exit Survey

## Professors

**Claudio Battaglini**, Management of Cancer Treatment-Related Symptoms; Prescriptive Exercise Intervention

**Troy Blackburn**, Neuromuscular Function and Motor Control; Knee Osteoarthritis Prevention

**Anthony C. Hackney**, Exercise Endocrinology–Stress Physiology

**Joseph Hart**, Neuromuscular Consequences of Joint Injury; Knee Osteoarthritis Prevention

**Kristen Kucera**, Sport and Occupational Injury Epidemiology, Including Musculoskeletal Disorders, Ergonomics, Return to Work

**Karen McCulloch**, Balance and Cognitive Interactions in Older Adults and Following Traumatic Brain Injury; Effects of Military Mild Traumatic Brain Injury on Balance and Cognitive Function, Including Dual-Task Performance and Return to Duty Implications

**Jason Mihalik**, Sports Medicine, Sports and Military Neurotrauma

**Brian Pietrosimone**, Sports Medicine; Knee Osteoarthritis

**Eric Ryan**, Exercise Physiology; Exercise Adaptation, Nutritional

Supplementation, and Aging on Neuromuscular Function

**Abbie Smith-Ryan**, Exercise Physiology; Exercise and Nutrition

Interventions; Body Composition

**Darin Padua**, Biomechanics and Sports Medicine; Knee Injury Prevention

## Associate Professors

**J.D. DeFreese**, Athlete Psychological and Physical Health and Social Functioning

**Erik Hanson**, Exercise Physiology, Exercise Testing and Training in Clinical Populations; Exercise Oncology and Immunology

**Zachary Kerr**, Sports Injury Surveillance; Sports-Related Injury Prevention

**Michael Lewek**, Stroke Rehabilitation; Biomechanics; Neuromuscular Function

**Johna Register-Mihalik**, Traumatic Brain Injury – Negative Consequences, Prevention, Education and Clinical Management

**Lee Stoner**, Interactions Between Lifestyle Behavioural Factors and Cardio-Metabolic Disorders; Assessing Cardio-Metabolic Health;

Translation of Basic and Applied Science to Affect Public Health Outcomes

**Erik Wikstrom**, Impact of Musculoskeletal Injury on Sensorimotor Control of the Lower Extremity; Ankle Joint Injury

## Assistant Professors

**Shelby Baez**, Consequences of Maladaptive Psychological Responses to Injury; Interventions on Cognitive Behavior Following Joint Injury

**Jimakaye Beck Courtney**, Engagement in Health Behaviors, Physical Activity, Alcohol

**Malia Blue**, Cardiometabolic Health in Racial and Ethnic Populations, Body Composition, Performance, Injury Risk

**Jessica Cassidy**, Neuroimaging and Neurostimulation in Neurological Disease, Injury, and Development

**Adam Kiefer**, Performance Enhancement and Injury Prevention in Sport

**Louise Thoma**, Optimizing Rehabilitation and Recovery After Orthopedic Injury and Surgery

## Affiliated Faculty

**Jacqueline H. Cole**, Department of Biomedical Engineering

**Jason Franz**, Department of Biomedical Engineering

**Steven George**, Duke Clinical Research Institute, Department of Orthopedic Surgery

**Kelly Giovanello**, Department of Psychology and Neuroscience  
**Richard Goldberg**, Department of Biomedical Engineering  
**Yvonne Golightly**, Department of Epidemiology  
**Joseph Hopfinger**, Department of Psychology  
**He Huang**, Department of Biomedical Engineering  
**Laura Linnan**, Department of Health Behavior  
**Stephen Marshall**, Gillings School of Global Public Health  
**Michelle Meyer**, Department of Emergency Medicine  
**Deborah Porterfield**, Department of Family Medicine

**HMSC 700. Scientific Basis of Human Motion. 3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 701. Scientific Basis of Human Motion. 3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 702. Physiology of Exercise. 3 Credits.**  
 The study of the physical, biochemical, and environmental factors that influence human performance. Emphasis is placed on metabolic, cardiovascular, respiratory, muscular, and endocrine systems. Three hours of lecture and two hours of laboratory per week.

**Rules & Requirements**  
**Requisites:** Prerequisites, EXSS 256 or EXSS 276 or EXSS 376.  
**Grading Status:** Letter grade.  
**Same as:** EXSS 780.

**HMSC 710. Measurement of Muscle Function. 3 Credits.**  
 This course will look at basic concepts related to the physiology underlying muscle activity and appropriate measurements of muscle function, while at the same time introduce you to data acquisition, analysis, and programming approaches to collecting and analyzing relevant muscle-function data.

**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 743. Topics in Motor Control and Motor Learning: Therapeutic Implications. 3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 770. Electronics for Human Movement Science. 1-21 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 780. Introduction to Outcomes Research in Health Care. 3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 782. Infant and Family Assessment. 2-3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 782L. Laboratory in Infant and Family Assessment. 0.5-21 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 790. Advanced Kinesiology and Biomechanics. 4 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 791. Analysis of Human Motion. 3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 793. Advanced Ortho Assessment. 4 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 795. Human Kinetics. 4 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 801. Seminar in Human Movement Science. 2 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 803. Problems in Human Movement Science. 1-3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 877. Independent Study in Human Movement Science. 1-21 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 879. Research in Human Movement Science. 1-21 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 881. The Neural Basis of Motor Control. 3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 885. Beach Course. 1-3 Credits.**  
 Human movement seminar held at the beach.

**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 886. Understanding Research. 3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 887. Developmental Motor Control. 1-3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 900. Research in Human Movement Science. 1-3 Credits.**  
 This course is designed to provide doctoral students within the Human Movement Science Curriculum with academic credit(s) to conduct research under the guidance of a research mentor.

**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 911I. Movement and Balance in Aging. 3 Credits.**  
**Rules & Requirements**  
**Grading Status:** Letter grade.

**HMSC 993. Master's Research and Thesis. 3 Credits.**  
**Rules & Requirements**  
**Repeat Rules:** May be repeated for credit.

Course work appropriate for the student's area of interest may be taken from a range of departments. The programs listed here are examples, but are not meant to be inclusive: Biomedical Engineering (BMME) (p. 4) and Exercise and Sport Science (EXSS) (p. 4). (Please refer to departmental listings for full course descriptions.)

## BMME (Biomedical Engineering)

### Graduate-level Courses

#### BMME 335. Biomaterials. 3 Credits.

Focus on the mechanical, chemical, and biocompatibility considerations of any material (e.g., metal, ceramic, or polymer) designed to interface with the body. Various applications of biomaterials are presented and analyzed, including femoral implants and vascular grafts, in order to guide students in a semester-long design project. Previously offered as BMME 510. Majors only.

#### Rules & Requirements

**Requisites:** Prerequisites, BIOL 101 and BMME 209 or BMME 150.

**Grading Status:** Letter grade.

#### BMME 375. Biomedical Microcontroller Applications. 3 Credits.

Introduction to digital computers for real-time processing and control of signals and systems. Programming input and output devices using C and assembly language is stressed. Case studies are used to present software design strategies for real-time laboratory systems. Previously offered as BMME 580. Majors only.

#### Rules & Requirements

**Requisites:** Prerequisite, BMME 201 or COMP 116, BMME 207.

**Grading Status:** Letter grade.

#### BMME 565. Biomedical Instrumentation I. 4 Credits.

Graduate students or permission of the instructor. Topics include basic electronic circuit design, analysis of medical instrumentation circuits, physiologic transducers (pressure, flow, bioelectric, temperate, and displacement). This course includes a laboratory where the student builds biomedical devices.

#### Rules & Requirements

**Grading Status:** Letter grade.

## EXSS (Exercise and Sport Science)

### Graduate-level Courses

#### EXSS 730. Management of Athletic Injuries. 3 Credits.

Permission of the instructor for nonmajors. Designed to provide basic knowledge and skills that aid in the prevention and treatment of injuries common to athletics.

#### Rules & Requirements

**Grading Status:** Letter grade.

#### EXSS 732. Human Anatomy for Athletic Trainers. 4 Credits.

Graduate standing in exercise and sport science or permission of the instructor. The study of gross human anatomy, with emphasis on the functional and clinical aspects of the neck, back, and extremities as related to athletic injuries.

#### Rules & Requirements

**Grading Status:** Letter grade.

#### EXSS 735. Sports Medicine Analysis: Special Problems Related to Sports Medicine. 3 Credits.

Permission of the instructor for nonmajors. Problem and research oriented.

#### Rules & Requirements

**Grading Status:** Letter grade.

#### EXSS 739. Practicum in Exercise, Sport, and Movement Science. 1-3 Credits.

Graduate standing in exercise and sport science or permission of the instructor. The implementation of theories and practices in a professional setting under the direction of a professional with expertise in exercise, sport and/or movement science.

#### Rules & Requirements

**Repeat Rules:** May be repeated for credit. 3 total credits. 3 total completions.

**Grading Status:** Letter grade.

#### EXSS 742. Social Issues in Exercise and Sport. 3 Credits.

A comprehensive study of race and gender discrimination, adherence, value development, violence, and other socialization factors in youth, collegiate, and Olympic sport.

#### Rules & Requirements

**Grading Status:** Letter grade.

#### EXSS 780. Physiology of Exercise. 3 Credits.

The study of the physical, biochemical, and environmental factors that influence human performance. Emphasis is placed on metabolic, cardiovascular, respiratory, muscular, and endocrine systems. Three hours of lecture and two hours of laboratory per week.

#### Rules & Requirements

**Requisites:** Prerequisites, EXSS 256 or EXSS 276 or EXSS 376.

**Grading Status:** Letter grade.

**Same as:** HMSC 702.

#### EXSS 781. Clinical Exercise Prescription and Testing. 2-3 Credits.

This course concentrates on the knowledge and skills necessary for providing exercise testing and prescription in the clinical setting, emphasizing cardiac rehabilitation.

#### Rules & Requirements

**Requisites:** Prerequisite, EXSS 376; permission of the instructor for students lacking the prerequisite.

**Grading Status:** Letter grade.

#### EXSS 782. Nutritional Aspects of Exercise. 2-3 Credits.

Graduate standing in physical education or permission of the instructor. Exploration of the role of macronutrients and micronutrients as they apply to exercise, physical conditioning, and competition. Students obtain experience in dietary analysis as it applies to athletic populations.

#### Rules & Requirements

**Grading Status:** Letter grade.

#### EXSS 783. Assessment of Physiological Functions in Exercise. 3 Credits.

Designed to develop laboratory techniques and experimental design skills as applied to the physiology of human performance.

#### Rules & Requirements

**Requisites:** Prerequisite, EXSS 780; Permission of the instructor for students lacking the prerequisite.

**Repeat Rules:** May be repeated for credit; may be repeated in the same term for different topics.

**Grading Status:** Letter grade.

**EXSS 785. Seminar in Exercise Physiology. 3 Credits.**

Graduate standing in exercise and sport science or permission of the instructor. In-depth study of selected advanced topics in exercise physiology. Emphasis on metabolism, biochemical, and cardiorespiratory physiology, with student presentations on selected topics.

**Rules & Requirements**

**Grading Status:** Letter grade.

**EXSS 890. Special Topics in Exercise and Sport Science. 1-3 Credits.**

Graduate standing or permission of the instructor. The study of special topics directed by an authority in the field.

**Rules & Requirements**

**Grading Status:** Letter grade.

**EXSS 990. Research in Exercise and Sport Science. 1-3 Credits.**

Graduate standing in exercise and sport science or permission of the instructor. Individually designed research projects conducted by students under the direction of a graduate faculty member.

**Rules & Requirements**

**Grading Status:** Letter grade.

## Contact Information

**Human Movement Science Curriculum**

Visit Program Website (<http://hmsc.unc.edu>)

**Director**

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