

HUMAN MOVEMENT SCIENCE CURRICULUM (GRAD)

Contact Information

Human Movement Science Curriculum

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

Vicki Mercer, Director

The Department of Allied 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 doctoral program in human movement science is offered through the cooperative effort of the Division of Physical Therapy (UNC School of Medicine), the Department of Exercise and Sport Science (College of Arts and Sciences), and the Department of Biomedical Engineering (Gillings School of Global Public Health). 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)

Note: The Division of Physical Therapy retired the M.S. in human movement science degree, so applicants are no longer being accepted for the M.S. as a terminal degree. Bachelor's level applicants will be considered, given appropriate background and experience in movement science research.

Research Facilities

Several research facilities are available for students in the departments participating in the program. These include the Motion Analysis, Interdisciplinary Human Movement, and Neural Plasticity Laboratories in the Division of Physical Therapy's Center for Human Movement Science; the Applied Physiology, Cadaver/Anatomy, Neuromuscular, Matthew Gfeller Sport-Related Traumatic Brain Injury Research Center, Exercise Oncology, and Sports Medicine Laboratories in the Department of Exercise and Sport Science; and the Orthopedic Biomechanics Laboratory in the Department of Orthopedics. 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:

- 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, but 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.
- GRE scores in the 50th percentile or higher. Only official scores submitted from ETS will be accepted. In rare cases, admission is granted when scores are below the 50th percentile.
- 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.
 - Introductory graduate-level statistics
 - Human anatomy
 - Human physiology
 - Physics or biomechanics
 - Chemistry
 - Psychology
- 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.)

The curriculum core requirements allow flexibility in designing programs of study to meet the student's interests. Each student's program of study is developed under the guidance of his or her advisor and committee, and includes three major components:

1. Human Movement Science (16 credit hours)

- 6 credits of Human Movement Science core courses
HMSC 700, HMSC 701, and HMSC 702
- 6 credits of advanced Human Movement Science content
- 4 credits of doctoral seminar in Human Movement Science (IHMS 870)

2. Research and Inquiry

- a research design course
- 2 graduate level statistics courses
- a grant writing course
- research ethics training

3. Practical Experience

- 2 research experiences
- 2 teaching experiences
- doctoral examination
- dissertation prospectus
- written dissertation and dissertation defense

These are minimal requirements. Other specific requirements will vary depending on the student's background, area of interest, and planned career path.

Professors

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

Troy Blackburn, Neuromuscular Function and Motor Control; Knee Injury Prevention

Carol A. Giuliani, Neural Basis of Motor Control; Disability in Aging; Stroke Recovery; Movement Analysis

Deborah Givens, Neuromuscular Control and Painful Musculoskeletal Conditions; Efficacy of Interventions for Low Back Pain and Hip and Knee Osteoarthritis

Michael T. Gross, Biomechanics; Sports Medicine; Orthopedics; Orthotics

Kevin M. Guskiewicz, Athletic Training; Sports Medicine; Neurotrauma

Anthony C. Hackney, Exercise Endocrinology—Stress Physiology

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

Darin Padua, Biomechanics and Sports Medicine; Knee Injury Prevention

Debbie E. Thorpe, Pediatrics; Motor Learning; Developmental Disabilities Across the Lifespan; Aquatics

Bing Yu, Biomechanics; Rehabilitation; Movement Analysis; Biomechanical Modeling

Associate Professors

Michael Lewek, Stroke Rehabilitation; Biomechanics; Neuromuscular Function

Vicki S. Mercer, Postural Control in Older Adults and Individuals with Neurological Dysfunction; Stroke Recovery

Jason Mihalik, Sports Medicine, Sports and Military Neurotrauma

Brian Pietrosimone, Sports Medicine; Knee Osteoarthritis

Prudence Plummer, Cognitive-Motor Interactions During Walking; Interventions for Dual-Task Interference; Stroke; Multiple Sclerosis; Clinical Trials

Eric Ryan, Exercise Physiology; Exercise Adaptation, Nutritional Supplementation, and Aging on Neuromuscular Function

Abbie Smith-Ryan, Exercise Physiology; Exercise and Nutrition Interventions; Body Composition

Paul S. Weinhold, Biomechanics of Repetitive Motion Injury; Tissue Engineering

Assistant Professors

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

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

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

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

Affiliated Faculty

Jacqueline H. Cole, Department of Biomedical Engineering

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

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

Deborah Porterfield, Department of Family Medicine

William Prentice, Department of Exercise and Sport Science

Tim Sell, Duke Department of Orthopedic Surgery

HMSC 700. Scientific Basis of Human Motion. 3 Credits.

HMSC 701. Scientific Basis of Human Motion. 3 Credits.

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.

Requisites: Prerequisite, EXSS 276 or 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.

Grading status: Letter grade.

HMSC 743. Topics in Motor Control and Motor Learning: Therapeutic Implications. 3 Credits.

HMSC 770. Electronics for Human Movement Science. 1-21 Credits.

HMSC 780. Introduction to Outcomes Research in Health Care. 3 Credits.

HMSC 782. Infant and Family Assessment. 2-3 Credits.

HMSC 782L. Laboratory in Infant and Family Assessment. 0.5-21 Credits.

HMSC 790. Advanced Kinesiology and Biomechanics. 4 Credits.

HMSC 791. Analysis of Human Motion. 3 Credits.

HMSC 793. Advanced Ortho Assessment. 4 Credits.

HMSC 795. Human Kinetics. 4 Credits.

HMSC 801. Seminar in Human Movement Science. 2 Credits.

HMSC 803. Problems in Human Movement Science. 1-3 Credits.

HMSC 877. Independent Study in Human Movement Science. 1-21 Credits.

HMSC 879. Research in Human Movement Science. 1-21 Credits.

HMSC 881. The Neural Basis of Motor Control. 3 Credits.

HMSC 885. Beach Course. 1-3 Credits.

Human movement seminar held at the beach.

Grading status: Letter grade.

HMSC 886. Understanding Research. 3 Credits.

HMSC 887. Developmental Motor Control. 1-3 Credits.

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.

Grading status: Letter grade.

HMSC 911I. Movement and Balance in Aging. 3 Credits.

HMSC 993. Master's Research and Thesis. 3 Credits.

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. 3) and Exercise and Sport Science (EXSS) (p. 3). (Please refer to departmental listings for full course descriptions.)

BMME (Biomedical Engineering)

Graduate-level Courses

BMME 510. 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.

Requisites: Prerequisites, BIOL 101 and BMME 150; corequisites BIOL 252 and 252L.

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.

Grading status: Letter grade.

BMME 580. Microcontroller Applications I. 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.

Requisites: Prerequisites, BIOL 252, BMME 350, and COMP 116 or BMME 201; co-requisite, BMME 351.

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.

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.

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.

Grading status: Letter grade.

EXSS 739. Practicum in Athletic Training. 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 competent practitioner.

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.

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.

Requisites: Prerequisite, EXSS 276 or 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.

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.

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.

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.

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.

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.

Grading status: Letter grade.