HUMAN MOVEMENT SCIENCE CURRICULUM (GRAD)

Contact Information
Human Movement Science Curriculum
http://hmsc.unc.edu

VICKI MERCER, Interim 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 performance. 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 the spectrum of the following three primary areas of interest in human movement:

• Biomechanics
• Exercise physiology
• Neuromuscular control and motor learning

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
  • 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 are strongly encouraged to 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 needs of each track and the student’s interests. Other specific requirements will vary depending on the student’s background and program track. Each student’s program of study is developed under the guidance of his or her advisor and committee. Among these requirements are the core courses HMSC 700, HMSC 701, and HMSC 702 (nine credits). Degree requirements also include a first-year review, a doctoral written exam, a preliminary oral exam, a dissertation proposal, a dissertation defense, and a written dissertation. Other specific requirements will vary depending on the student’s background and program track.

Professors
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, Orthotists
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, Return to Duty Implications
Darin Padua, Biomechanics and Sports Medicine, Knee Injury Prevention
Bing Yu, Biomechanics, Rehabilitation, Movement Analysis, Biomechanical Modeling
Associate Professors
Claudio Battaglini, Management of Cancer Treatment-Related Symptoms, Prescriptive Exercise Intervention
Troy Blackburn, Neuromuscular Function and Motor Control, Knee Injury Prevention
Michael Lewek, Stroke Rehabilitation, Biomechanics, Neuromuscular Function
Vicki S. Mercer, Postural Control in Older Adults and Individuals with Neurological Dysfunction, Stroke Recovery
Debbie E. Thorpe, Pediatrics, Motor Learning, Developmental Disabilities across the Lifespan, Aquatics
Kelly Giovanello, Biomechanics of Repetitive Motion Injury, Tissue Engineering
Laura Linnan, Exercise and Sport Science (EXSS) (p. 2).
Affiliated Faculty
Erik Hansen, Exercise Physiology, Exercise Testing and Training in Clinical Populations, Exercise Oncology and Immunology
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
Johna Register-Mihalik, Negative Consequences, Prevention, Education and Clinical Management Traumatic Brain Injury
Eric Ryan, Exercise Physiology, Exercise Adaptation, Nutritional Supplementation, and Aging on Neuromuscular Function
Abbie Smith-Ryan, Exercise Physiology, Exercise and Nutrition Interventions, Body Composition
Erik Wikstrom, Impact of Musculoskeletal Injury on Sensorimotor Control of the Lower Extremity, Ankle Joint Injury

Assistant Professors
Erik Hanson, Exercise Physiology, Exercise Testing and Training in Clinical Populations, Exercise Oncology and Immunology
Jason Mihalik, Sports Medicine, Sports and Military Neurotrauma
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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.
Grading status: Letter grade.

BMME 520. Fundamentals of Materials Engineering. 3 Credits.
The structure, defects, thermodynamics, kinetics, and properties (mechanical, electrical, thermal, and magnetic) of matter (metals, ceramics, polymers, and composites) will be considered.
Grading status: Letter grade.

BMME 530. Digital Signal Processing I. 3 Credits.
This is an introduction to methods of automatic computation of specific relevance to biomedical problems. Sampling theory, analog-to-digital conversion, digital filtering will be explored in depth.
Requisites: Prerequisite, COMP 110 or 116.
Grading status: Letter grade.

BMME 556. Biomedical Instrumentation I. 4 Credits.
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.
Requisites: Prerequisite, PHYS 351.
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.

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.

EXSS 735. Sports Medicine Analysis: Special Problems Related to Sports Medicine. 3 Credits.
Permission of the instructor for nonmajors. Problem and research oriented.

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.
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.

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.
**Same as:** HMSC 702.

EXSS 781. Clinical Exercise Prescription and Testing. 2-3 Credits.
Students who take EXSS 410L must pass with B or equivalent. 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 or 410L; permission of the instructor for students lacking the prerequisite.

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.

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.

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.

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.

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.