HUMAN MOVEMENT SCIENCE CURRICULUM (GRAD)

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) 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)

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.

Research Facilities

Several research facilities are available for students in the departments participating in the program. These include the Interdisciplinary Human Movement and Cassidy Plasticity Laboratories in the Division of Physical Therapy's Center for Human Movement Science and the Applied Physiology, Neuromuscular, Sports Medicine, and Applied Physiology Laboratories 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:

- 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
- A grade point average of 3.4 or better in the last two years of either the M.S. in human movement science degree or the remaining years of the student's bachelor's degree. Applicants who received a lower GPA in the last two years of their bachelor's degree may be considered if they subsequently earned a grade point average of 3.4 or better in the last two years of the M.S. program.

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.)

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 (HMSC 870)

2. Research and Inquiry
   - a research design course/ course sequence
   - 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 Osteoarthritis Prevention
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
Joseph Hart, Neuromuscular Consequences of Joint Injury; Knee Osteoarthritis Prevention
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
Bing Yu, Biomechanics; Rehabilitation; Movement Analysis; Biomechanical Modeling

Associate Professors
Erik Hanson, Exercise Physiology, Exercise Testing and Training in Clinical Populations; Exercise Oncology and Immunology
Kristen Kucera, Sport and Occupational Injury Epidemiology, Including Musculoskeletal Disorders, Ergonomics, Return to Work
Michael Lewek, Stroke Rehabilitation; Biomechanics; Neuromuscular Function
Vicki S. Mercer, Postural Control in Older Adults and Individuals with Neurological Dysfunction; Falls Prevention; Stroke Recovery
Brian Pietrosimone, Sports Medicine; Knee Osteoarthritis
Johna Register-Mihalik, Traumatic Brain Injury – Negative Consequences, Prevention, Education and Clinical Management
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
Shelby Baer, Consequences of Maladaptive Psychological Responses to Injury; Interventions on Cognitive Behavior following Joint Injury
Jessica Cassidy, Neuroimaging and Neurostimulation in Neurological Disease, Injury, and Development
J.D. DeFreese, Athlete Psychological and Physical Health and Social Functioning
Zachary Kerr, Sports Injury Surveillance; Sports-Related Injury Prevention
Adam Kiefer, Performance Enhancement and Injury Prevention in Sport
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
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
William Prentice, Department of Exercise and Sport Science

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: 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.
Rules & Requirements
Grading Status: Letter grade.
**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: Pre- or corequisites, BMME 301 and 385.
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, temperature, 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 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.

Rules & Requirements
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: 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.

Rules & Requirements
Requisites: Prerequisite, EXSS 376; permission of the instructor for students lacking the prerequisite.
Grading Status: Letter grade.