

BIOMECHANICS

The mission of the Division of Biomechanics and Research Development is to serve not only the University of Nebraska at Omaha but the entire University of Nebraska system and the state of Nebraska by (a) educating and developing a dynamic workforce to meet our scientific needs at a national and international level and by (b) enhancing economic growth through development of biotechnology and biomechanical intellectual property produced by students and faculty performing innovative research in the multiple laboratories of the Biomechanics Research Building. The research performed in the Division will provide a new understanding of the dynamic aspects of human and animal biomechanics via multidisciplinary approaches. In particular, we aim to achieve the following specific objectives:

1. Quantitatively characterize and improve our understanding of the complex biomechanical systems in healthy and abnormal states via innovative analyses.
2. Educate and train students, basic scientists, and clinicians, so that they may apply concepts of biomechanics in their careers as educators and researchers.
3. Develop new diagnostic and prognostic tests and related biomechanical technology for a variety of movement and cardiovascular disorders and aging.
4. Provide biomechanically related services to interested parties and University and community partners.
5. Participate in community outreach activities that involve biomechanically related educational opportunities.

Biomechanics is the study of forces that act on the body and the effects they produce. It is an intersection of biology, physiology, anatomy, physics, mathematics, and chemistry. Biomechanics is a rapidly growing discipline that has many applications in robotics, forensics, ergonomics, clinical assessment and rehabilitation of movement disorders, design of prosthetics, sports performance, sports equipment design, safety, etc.

The B.S. in Biomechanics is an excellent choice for students planning to a) pursue graduate education and careers in research, b) work in biomechanically related industry and hospital laboratories, and c) pursue graduate education in professional schools for physical therapy, occupational therapy, medicine and other science-based programs.

The Minor in Biomechanics is ideal for those students who have a major outside of Biomechanics and would benefit from learning the basic principles of Biomechanics.

Other Information

Once students are admitted to the Bachelor of Science in Biomechanics they will be in the College of Education, Health, and Human Sciences and will be required to maintain a cumulative college GPA of 2.5/4.0 scale and grades of "C-" or better in the core courses to remain in good standing in the College of Education, Health, and Human Sciences.

The department highly encourages students to engage in undergraduate research with a faculty mentor. A list of Biomechanics faculty can be found on our website (<http://www.unomaha.edu/college-of-education/biomechanics-core-facility/about-us/directory/>). There are also many undergraduate volunteer and student worker opportunities available in the Department.

Fast Track Program

The Department of Biomechanics has developed a Fast Track program for highly qualified and motivated students providing the opportunity to complete a bachelor's degree and a master's degree in an accelerated time frame. With Fast Track, students may count up to 9 graduate hours toward

the completion of their undergraduate program as well as the graduate degree program.

Program Specifics:

- This program is available for undergraduate students pursuing a BS in Biomechanics desiring to pursue a MS in Biomechanics.
- Students must have completed no less than 60 undergraduate hours
- Students must have a minimum undergraduate GPA of 3.0
- Students must complete the Fast Track Approval form and obtain all signatures and submit to the Office of Graduate Studies prior to first enrollment in a graduate course
- Students will work with their undergraduate advisor to register for the graduate courses
- A minimum cumulative GPA of 3.0 is required for graduate coursework to remain in good standing
- Students remain undergraduates until they meet all the requirements for the undergraduate degree and are eligible for all rights and privileges granted undergraduate status including financial aid.
- Near the end of the undergraduate program, formal application to the graduate program is required. The application fee will be waived, the applicant will need to contact the Office of Graduate Studies for a fee waiver code.
 - Admission to Fast Track does NOT guarantee admission to the graduate program.
 - Applicants for this program are highly encouraged to pursue research opportunities in the Department of Biomechanics or comparable programs.
 - The admit term must be after the completion term of the undergraduate degree.

All 8000 level BMCH courses are eligible for students part of the Fast Track program.

Contact Information

Department of Biomechanics
Biomechanics Research Building

402.554.3228

unobiomechanics@unomaha.edu

Website (<https://www.unomaha.edu/college-of-education/biomechanics-core-facility/>)

Degrees Offered

- Biomechanics, Bachelor of Science (<http://catalog.unomaha.edu/undergraduate/college-education/biomechanics/biomechanics-bs/>)

Writing in the Discipline

BMCH 4990 Capstone Design in Biomechanics II

Minors Offered

- Biomechanics Minor (<http://catalog.unomaha.edu/undergraduate/college-education/biomechanics/biomechanics-minor/>)
- Sports Biomechanics Minor (<http://catalog.unomaha.edu/undergraduate/college-education/biomechanics/sports-biomechanics-minor/>)

Biomechanics is the study of the mechanical laws that create human and animal motion. Biomechanics applies principles from engineering,

mechanics, physics, and biology to study human and animal movement. Biomechanics majors have the ability to pursue a wide variety of careers. These careers range from being technologically centered to human health centered.

Potential career opportunities/settings:

- Physical and Occupational Therapy*
 - Physical Therapist
 - Occupational Therapist
- Prosthetics and Orthotics*
 - Prosthetist
- Medical Device Design
 - Research Scientist
- Clinical Research
 - Gait Analysis Biomechanist
- Robotics
 - Field Application Engineer
 - Robotics Technician
- Ergonomics
 - Ergonomist
- Medicine* (Orthopedics, Cardiology, Neurology)
 - Orthopedic Surgery
 - Sports Medicine
- Athletic Training*
 - Athletic Trainer
- Sports Performance
 - Footwear Material Developer
 - Footwear Research and Development

*Requires graduate study

BMCH 1000 INTRODUCTION TO BIOMECHANICS (3 credits)

This is an introductory course in biomechanics that provides a brief history, an orientation to the profession, and explores the current trends and problems and their implications for the discipline.

Distribution: Social Science General Education course

BMCH 1100 ETHICS OF SCIENTIFIC RESEARCH (3 credits)

This course is a survey of the main ethical issues in scientific research.

Distribution: Humanities and Fine Arts General Education course

BMCH 2200 ANALYTICAL METHODS IN BIOMECHANICS (3 credits)

Through this course, students will learn the fundamentals of programming and problem solving for biomechanics with Matlab and Excel. Students will also learn the attributes and uses of other programming languages.

BMCH 2400 HUMAN PHYSIOLOGY & ANATOMY I (4 credits)

The study of the structure and function of the systems of the body with an emphasis on the skeletal, muscular, cardiovascular and respiratory systems.

Distribution: Natural/Physical Sci General Education lecture&lab

BMCH 2500 HUMAN PHYSIOLOGY AND ANATOMY II (4 credits)

The study of the structure and function of the systems of the body with an emphasis on the nervous system, special senses, digestive system, endocrine system, metabolism and body temperature regulation, lymphatic system, and urinary system.

Prerequisite(s): PE 2400 or BMCH 2400 with a grade of C- or better.

BMCH 3000 BIOMECHANICAL STATICS & DYNAMICS (3 credits)

This course is the study and exploration of the effect of forces on biological systems, mainly the human body, during static and dynamic situations.

Prerequisite(s): PHYS 2110, PHYS 1154

BMCH 4000 BIOMATERIALS (3 credits)

Students will learn the classification, properties, characterization methods, body interactions, applications, and design principles of biomaterials. (Cross-listed with BMCH 8006).

BMCH 4010 WEARABLE MATERIALS FOR BIOMECHANICAL PERFORMANCE I (3 credits)

This course contains lecture and lab components focused on the design and characterization of wearable materials used in biomechanical and biomedical applications for heat management, moisture removal, and respiratory protection. Students will learn the classification, properties, evaluation methods, and design principles of wearable materials. (Cross-listed with BMCH 8016).

Prerequisite(s): BMCH 4000 or BMCH 4670 or Department Permission

BMCH 4100 BIOINSPIRED ROBOTICS (3 credits)

The goal of the course is to involve students in an interdisciplinary vision of biomechanics, biology, engineering and architecture by learning how humans and other animals function in their environment. These design principles from nature can be translated into novel devices, structures, and robots. (Cross-listed with BMCH 8106).

BMCH 4110 3D PRINTING IN HEALTHCARE (3 credits)

A study of basic principles and applications of additive manufacturing (i.e., 3D printing) in healthcare settings. This course will incorporate introductory lectures, practical applications, case studies, and hands-on experiences incorporating basic design techniques and 3D printing. Students will be exposed to various 3D printing techniques and approaches. This course will equip students with knowledge and hands-on experience of basic design techniques and 3D printing. Students will demonstrate, evaluate, and apply technical knowledge about computer aided design and 3D printing. The final project includes a presentation of short grant proposal. (Cross-listed with BMCH 8116).

BMCH 4200 METHODS IN BIOMECHANICS I (3 credits)

In this course students learn about the methods and equipment used in biomechanics as well as the analysis of data collected from those methods. Course experiences include both lecture and lab based learning. (Cross-listed with BMCH 8206).

Prerequisite(s): BMCH 3000, BMCH 2200 with a grade of C- or better or department permission.

BMCH 4210 METHODS IN BIOMECHANICS II (3 credits)

In this course students learn about advanced methods and equipment used in biomechanics, as well as the analysis of data collected from those methods. Course experiences include both lecture and lab based learning. This course builds on the experience gained in BMCH 4200/8206, Methods in Biomechanics I. (Cross-listed with BMCH 8216).

Prerequisite(s): BMCH 4200 with a grade of C- or better or department permission.

BMCH 4630 BIOMECHANICS (3 credits)

A study of the forces that act on a human body and the effects that they produce.

Prerequisite(s): BMCH 2400 [previously PE 2400] or PE 2880 or BIOL 2740 or equivalent, AND PHYS 1110 and PHYS 1154 OR MATH 1950 to be taken concurrently or completed previously with a grade of C- or better.

BMCH 4640 ORTHOPEDIC BIOMECHANICS (3 credits)

Orthopedic Biomechanics focuses on the use of biomechanical principles and scientific methods to address clinical questions that are of particular interest to professionals such as orthopedic surgeons, physical therapists, rehabilitation specialists, and others. (Cross-listed with BMCH 8646).

Prerequisite(s): BMCH 4630 or department permission.

BMCH 4650 NEUROMECHANICS OF HUMAN MOVEMENT (3 credits)

A study of basic principles of neural process as they relate to human voluntary movement. Applications of neural and mechanical principles through observations and assessment of movement, from learning to performance, as well as development. (Cross-listed with NEUR 4650).

Prerequisite(s): BMCH 1000 or PE 2430.

BMCH 4660 CLINICAL IMMERSION FOR RESEARCH AND DESIGN (3 credits)

This course will involve exposure to current clinical practices, identification of unmet clinical needs, and information regarding future career options. In this course, students will be matched with local clinical sites to provide a unique opportunity for innovative and interdisciplinary approaches to problem solving subject to practical constraints. Concepts in clinical rehabilitation, integrated assessments, regulation of medical devices in health care will be covered. This course will review the latest research efforts for rehabilitation in the context of device design and implementation. (Cross-listed with BMCH 8666).

Prerequisite(s): BMCH 4630 or equivalent and Instructor Permission. Not open to non-degree graduate students.

BMCH 4670 INTRODUCTION TO MECHANICS OF BIOMATERIALS (3 credits)

In this course students will learn how to analyze the stresses and strains in different structures under complex loading conditions with extensive examples from biomaterials and materials generally used in the medical device field. (Cross-listed with BMCH 8676).

Prerequisite(s): BMCH 3000 or Department Permission

BMCH 4680 SPORTS BIOMECHANICS (3 credits)

This course is intended to provide students with a foundational knowledge on how to analyze sport movements through biomechanical analytical methods. Students will utilize foundational biomechanical principles and apply them to a variety of sports and associated movements. (Cross-listed with BMCH 8686).

Prerequisite(s): BMCH 4630 or KINS 4100 or Instructor Permission

BMCH 4690 CARDIOVASCULAR BIOMECHANICS (3 credits)

This course will introduce students to cardiovascular biomechanics, emphasizing the integration of analytical and experimental methods to better understand the mechanobiology of tissues. (Cross-listed with BMCH 8696).

Prerequisite(s): BMCH 3000, BMCH 4670, or Department Permission

BMCH 4980 CAPSTONE DESIGN IN BIOMECHANICS I (4 credits)

Teams of senior-level students work with sponsors and faculty advisers to develop solutions to real problems in the biomechanics and health-care related fields.

Prerequisite(s): Department Permission.

BMCH 4990 CAPSTONE DESIGN IN BIOMECHANICS II (4 credits)

Teams of senior-level students work with sponsors and faculty advisers to develop solutions to real problems in the biomechanics and health-care related fields. The Capstone Design II course is intended to further develop and validate the concept direction chosen during Capstone Design I by designing the specific details necessary to build and test a proof-of-concept prototype.

Prerequisite(s): BMCH 4980, or department permission.