



HK*4610 Health and Injury Biomechanics

Fall 2020

Section(s): C01

Department of Human Health and Nutritional Sciences

Credit Weight: 0.50

Version 1.00 - September 08, 2020

1 Course Details

1.1 Calendar Description

This course presents an overview of bone and joint function from a biomechanics perspective, within the framework of health and injury. Particular emphasis is placed on the influence of biomechanical signals on the regulation of bone and joint structure and function. Individual diseases, such as osteoarthritis, will be considered as they impact the various tissues of the joint (cartilage, ligament and bone) and the neuromuscular system. The laboratory will provide supplementary material illustrating particular aspects of musculoskeletal function including in vivo and in vitro biomechanical testing.

Pre-Requisites: ENGG*3150 or HK*2270

1.2 Course Description

This course presents an overview of neuromuscular tissue function in health, injury and disease from a biomechanics perspective. Particular emphasis is placed on understanding and applying biomechanical principles to the characterization of soft tissue, bone and joint structure and function, in health and injury. The impact of individual diseases, such as osteoarthritis and osteoporosis, will be studied in the context of their effect on the various tissues (cartilage, ligament, muscle and bone) comprising the neuromuscular system. Clinical applications of these biomechanical principles will be emphasized in the second half of the course to address the diagnosis, assessment, treatment and clinical management of conditions affecting the neuromuscular system, in health and disease. The laboratory component will expose the student to practical and clinical skills relevant to the assessment of the neuromuscular system, interpretation of clinical tests and formulation of clinical impression/diagnosis in the physical assessment of the patient in health and disease.

1.3 Timetable

Lectures will be conducted in both asynchronous (recorded lectures) and synchronous (live) format. Pre-recorded lectures will be made available to students Sunday evenings, unless otherwise communicated. Labs/tutorials will be conducted during regular class time. A

schedule of the live video labs/tutorials will be available to students in advance. Please refer to Courselink for ongoing updates of the schedule throughout the semester.

Labs: Monday, Wednesday and Friday, 10:30-11:30am. Labs will be conducted virtually with a link being provided ahead of time.

1.4 Final Exam

Mon Dec 7, 2020 - 11:30am-1:30pm (online)

Format TBA

2 Instructional Support

2.1 Instructional Support Team

Instructor:	Craig Dixon PT, MScPT
Email:	cdixon07@uoguelph.ca
Office:	Health and Performance Centre, JT Powell Building,
Office Hours:	To be held virtually Mondays 10:30-11:30am or by appointment.

2.2 Teaching Assistants

Teaching Assistant:	Emma Plater
Email:	plater@uoguelph.ca
Teaching Assistant:	Jeremy Canham
Email:	canhamj@uoguelph.ca

3 Learning Resources

There is no required textbook for this course.

3.1 Required Resources

Courselink (website) (Website)

All course material, news, announcements, online quizzes and grades will be administered and/or regularly updated on the HK*4610 Courselink site.

Study materials including lecture and lab notes, and supplementary readings will be added to the site on an ongoing basis.

You are responsible for checking the site regularly to keep up to date on all course activities.

4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Characterize mechanisms of tissue injury in bone, tendon, ligament, cartilage and muscle tissues using basic principles of biomechanics, tissue and fluid mechanics.
 2. Understand the key clinical features of musculoskeletal injuries and disease, and applying these to clinical assessment and diagnosis of a patient.
 3. Understand and apply principles of evidence-based rehabilitation and injury management principles to the clinical management of musculoskeletal injury and disease.
 4. Learn to perform a clinical history and orthopedic/neurologic physical examination/assessment.
 5. Interpret the findings of a clinical history and physical examination to confer a clinical opinion/impression/diagnosis.
 6. Learn how to communicate clinical findings with other health professionals, including how to record SOAP notes.
 7. Understand physiologic mechanisms of acute and chronic pain and how to clinically assess patients with chronic pain.
-

5 Teaching and Learning Activities

Course topics

- Clinical Biomechanics review
- Tissue mechanics, structure and function of:
 - bone
 - tendon
 - ligament

cartilage

joints

nerve

- Injury and healing
- Clinical epidemiology
- Acute and chronic pain
- Injury prevention
- Clinical applications of biomechanics
 - diagnosis and assessment of injury
 - management of musculoskeletal injury and disease

5.1 Lecture

Week 1

Topics: Introduction

1. Orientation to teaching team
2. Overview of course (resources, lectures, discussion boards, potential extra-curricular opportunities, grade breakdown)
3. Academic integrity
4. Course objectives

Week 2

Topics: Review of Clinical Biomechanics

1. Application of the 3 laws of physics in injuries
2. Types of forces (application of torque and moment of inertia in sport and injuries)
3. Review of material / structural characteristics of biological tissues
4. Stress-Strain Curves (components, analysis)
5. Viscoelasticity (stress-relaxation, creep, hysteresis)

Week 3

Topics: Tendon & Ligament

1. Types of connective tissue
2. Components of connective tissue
3. Material/structural characteristics of tendon/ligament
4. Factors influencing biomechanical properties (including effect of exercise)
5. Tendinopathies (including exercise management)
6. Ligament sprains

Week 4

Topics: Bone

1. Composition of bone
2. Anatomy of bone
3. Growth plate injuries
4. Determinants of bone strength
5. Osteoporosis
6. How to maintain bone mass
7. Fractures (types, initial and subsequent management)

Week 5

Topics: Cartilage & Joint

1. Cartilage structure and function
2. Types of cartilage
3. Biomechanics of cartilage
4. Osteoarthritis
5. Meniscal injuries

JOINT

1. Types
2. Osteokinematics
3. Arthrokinematics

Week 6

Topics: Nerve

1. Nervous system overview (nerve cell, white vs grey matter, organization, spinal cord anatomy)
2. Neurobiomechanics (stress-strain curve, mechanical interface, tension/compression injuries, viscoelastic properties of nerve)
3. Upper vs Lower Motor Neuron Syndromes
4. Spinal pathways (anatomy/physiology, clinical presentation with lesion)

5. Neurological evaluation (dermatomes, myotomes, reflexes, nerve root vs peripheral nerve)

6. Spinal Cord Injury (types, clinical presentations)

Week 7

Topics: Clinical Assessment

1. Components of a clinical assessment

2. Taking a clinical history (assessing irritability)

3. Biopsychosocial factors

4. Objective assessment (differentiating inert vs contractile injuries, grading strength, assessing joint stability/end-feels, special tests)

5. Outcome measures

6. ICF Biopsychosocial Model of Health

7. Making SMART goals

8. Treatment considerations

Week 8

Topics: Cervical Spine

1. Anatomy review

2. Vertebral artery
3. Neuro scan (dermatomes, myotomes, reflexes, pathological reflexes)
4. Differentiating upper vs lower motor neuron syndromes
5. Neurobiomechanics
6. Upper limb neurodynamic testing
5. Cervical radiculopathy

Week 9

Topics: Upper Extremity

1. Glenohumeral joint anatomy
2. Scapulothoracic joint (static/dynamic assessment, scapulohumeral rhythm, dysfunction)
3. Shoulder impingement (force couples, types, treatment)
4. Glenohumeral instabilities (Panjabi's model of stability, types, bony injury, clinical presentation, treatment)
5. Thoracic outlet syndrome (types, causes, clinical presentation, clinical presentation, treatment - neuromobilization)
6. Scaphoid Fracture (avascular necrosis, prognosis)

Week 10

Topics: Lumbar Spine

1. Anatomy review
2. Biomechanics of the lumbar spine
3. Neuro scan (dermatomes, myotomes, reflexes, pathological reflexes)
4. Lower limb neurodynamic testing
5. Lumbar spine pathology (disc herniation, spondylosis, spondylolysis, spondylolysis, stenosis)
6. Cauda Equina Syndrome
7. CORE back assessment

Week 11

Topics: Lower Extremity

1. Anatomy review
2. Biomechanics of the tibiofemoral joint, patellofemoral joint
3. Patellar instability / patellofemoral pain syndrome
4. Ligament injuries
5. Compartment syndrome vs shin splints vs stress fractures

Week 12**Topics:** Foot & Ankle

1. Anatomy review (4 regions of the foot, arches of the foot)
2. Biomechanics of the foot/ankle (mechanisms for pronation/supination)
3. Ligament sprains
4. Plantar Fasciitis
5. Morton's neuroma

Week 13**Topics:** FINAL EXAM REVIEW**Thu, Sep 10 - Wed, Dec 2****Topics:** Tentative Lecture Schedule - Fall 2020

Week	Dates	Topic	Other
1	Sept 10 - 13	Introduction	
2	Sept 14 - 20	Review of Clinical Biomechanics	Quiz 1 (CourseLink by Sept 20 at 11:59pm)
3	Sept 21 - 27	Tendon/Ligament	Quiz 2 (CourseLink by Sept 27 at 11:59pm)
4	Sept 28 - Oct 4	Bone	Quiz 3 (CourseLink by Oct 4 at 11:59pm)
5	Oct 5 - 11	Cartilage/Joint	Quiz 4 (CourseLink by Oct 11 at 11:59pm)
6	Oct 12 - 18	Nerve	Quiz 5 (CourseLink by Oct 18 at 11:59pm)
7	Oct 19 - 25	Overview of a Clinical Assessment	Lab
8	Oct 26 - Nov 1	Cervical Spine	Lab - Practice Case Group Selection

9	Nov 2 - 14	Upper Extremity	Case Assignment 1 (Dropbox by Nov 14 at 11:59pm)
10	Nov 9 - 15	Lumbar Spine	Lab Group Selection
11	Nov 16 - 22	Lower Extremity	Case Assignment 2 (Dropbox by Nov 22 at 11:59pm)
12	Nov 23 - Dec 1	Foot & Ankle	Lab
13	Nov 30 - Dec 2	Review	
	Mon Dec 7	Final Exam	11:30am-1:30pm Cumulative Online

6 Assessments

6.1 Assessment Details

Online Quizzes (25%)

Date: See Lecture Schedule

Learning Outcome: 1, 2, 3

A total of 5 online quizzes will be offered. Each quiz is worth 5%.

The quizzes will be done through Courselink using Respondus. These are not cumulative. Each quiz will cover its respective week's worth of material.

Problem-Based Cases (40%)

Learning Outcome: 1, 2, 3, 4, 5, 6, 7

Case Study 1 (20%): Nov 14, 2020 at 11:59pm via Dropbox

Case Study 2 (20%): Nov 22, 2020 at 11:59pm via Dropbox

There will be two problem-based case studies for which students will apply concepts learned in the course to simulated patients. With Problem-based learning, students will develop critical thinking, clinical reasoning and evidence-based practice skills. The rationale for employing this learning method is to prepare students for the type of teaching style that the vast majority of post-graduate professional schools now use (ie. Medicine,

Physiotherapy, etc.). It will also provide students with insight into the thought processes of clinicians as they work through assessments and determine the most appropriate and effective evidence-base care.

Students will arrange themselves into groups of 3 the week prior to the case being uploaded to Courselink. Any student without a group will be automatically allocated to a group by Courselink at the group selection deadline. A written version of the subjective history and summary of the objective findings will be uploaded to Courselink for students to follow along while the instructor acts through a mock assessment with a simulated patient via a recorded Zoom video. Students will have one week to complete the assignment. Students will begin by synthesizing the findings of the assessment, identifying potential biopsychosocial factors, coming up with a working diagnosis, determining prognosis, establishing functional goals and designing a treatment plan around the patient's goals.

Students will be asked to submit the assignment via Dropbox by the due date (see Course Schedule). Only one student per group will need to submit the assignment. The outline for the assignment and rubric will be made available on Courselink. Both case studies will follow the same outline and rubric; though, the first will evaluate a condition of the upper extremity, while the second will evaluate a condition of the lower extremity.

Final Exam (35%)

Date: Mon, Dec 7, 11:30 AM - 1:30 PM, Online

Learning Outcome: 1, 2, 3, 4, 5, 6, 7

Cumulative.

Format TBA.

7 Department of Human Health and Nutritional Sciences Statements

7.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. [B.Sc. Academic Advising](#) or [Program Counsellors](#)

7.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist.
<http://www.learningcommons.uoguelph.ca/>
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: <http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help> and <http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help>

7.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.
<https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention. <https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations.
<http://www.selfregulationskills.ca/>

7.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) <http://www.e-laws.gov.on.ca/index.html>. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar.
(<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml>)

8 University Statements

8.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

8.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

8.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

8.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

8.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is

required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

8.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community—faculty, staff, and students—to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

8.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

8.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma

programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>

8.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via CourseLink and/or class email. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

8.10 Illness

The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.
