

York University, Faculty of Health
School of Kinesiology and Health Science
KINE 4445 3.0 (M) PHYSIOLOGICAL BASIS OF FATIGUE
(Prerequisites/Co-requisites: KINE 2011; 3012; KINE 4010)

Course Director: Dr. Arthur Cheng (email: ajcheng@yorku.ca) – correspond through Moodle
Office: Farquharson Life Sciences Building, Room 351
Phone: 416-736-2100 ext. 30030

2019 Winter Term - Section M: Tuesday and Thursday 1:00 – 2:20pm – Stedman Lecture Hall C

Meeting Hours: You must book a time (by email) with me or the assigned TA to be sure to have sufficient time to review your questions. **NOTE:** the instructor is also generally available for questions following the class.

COURSE DESCRIPTION:

Scope: This course is an in-depth examination of the physiological process that limits muscular contractile activity in sustained, intermittent and/or physical activity. Evaluation of systems and processes impacting exercise-induced fatigue (fatigability) will range from cellular through to whole body perspectives. An evidenced-based approach using human and animal models of physical activity will include topics, such as: central limitations (central nervous system) and peripheral limitations (cellular, ionic and metabolic regulation; substrate depletion; and product accumulation(s)).

COURSE OBJECTIVES:

By the completion of this course, successful students will be able to:

- Identify appropriate definitions, protocols, designs, and methods used in the study of exercise-induced fatigue
- Describe and explain the extent to which various cellular sites contribute to exercise-induced fatigue
- Develop and apply critical thinking skills to assess fatigue mechanisms under specific situations and determine effective interventions to counteract fatigue

COURSE LEARNING OUTCOMES:

Students should be able to demonstrate mastery of the following abilities:

- Contextualize and communicate information of generally accepted concepts and principles in muscle function, fatigability and performance of physical activity.
- Be able to think critically and understand theory(ies) and recurrent issues in muscle function, fatigability and performance of physical activity.
- Apply knowledge to particular problems or situations (problem-solve) encountered within neuromuscular muscle function in exercise-induced fatigue and be aware of the limits in knowledge and methodologies when analyzing, evaluating, interpreting and disseminating information.

READINGS and TEXTBOOKS:

There is NO required course textbook and/or workbook for KINE 4445 (M)

Where appropriate, **required** readings (i.e., their content is eligible for assessment on class assessments/exams) in the form of handouts, articles from scientific journals and review articles will be identified

COURSE EVALUATION: IMPORTANT NOTE: evaluation formats require that you attend the regularly scheduled lectures.

Required Grading Components

Critical Assessment Project	10%	January 31 2019
In-Class Exam #1	30%	February 12 2019
In-Class Exam #2	30%	March 21 2019
Translational Fatigue Project – Group Assignment	30% total	
Project Proposal (Oral Presentation)	(0% - practice)	February 26 th , 28 th
Final Oral Presentation	(15%)	March 26 th , 28 th , April 2 nd
Written Report	(15%)	April 5 th , 2019

***NOTE:** The topic must be PRE-APPROVED by the instructor before January 31 2019

EXAMS: The content to be assessed for the in-class exams is sequential and non-cumulative. In the case where a student does not complete the in-class exam (**with appropriate supporting documentation**) then the content for the in-class exam (#2) will be cumulative and account for 60% of the final grade. Assessments may include combinations of multiple choice, short answer and written long answers and will cover content from lectures, in-class discussions and assigned required readings. Tests will require students to demonstrate in-depth knowledge and application of course content.

CRITICAL ASSESSMENT PROJECT– each student will be responsible for critical appraisal of a research paper (specific topics and papers will be determined by the instructor). All students are required to submit the assignment by January 31 2019 at 11:59pm by emailing a Microsoft word.doc to the instructor (not PDF format). **Be sure the assignment is the required format (Microsoft word.doc) and to allow yourself sufficient time to complete/submit the project before the deadline – the grades for late assignments will be deducted at a rate of 2% per day off of your final grade for this assignment.**

An overview of the critical appraisal approach to be used for this project will be included in the lecture material. In general, a student’s report must conform to the format/style identified in the critical appraisal lecture.

TRANSLATIONAL FATIGUE PROJECT - GROUP ASSIGNMENT - An overview of this group assignment will be included in the lecture material. Students will form groups of **3 people** and will be required to prepare: 1) an **Oral Presentation** and 2) a **Written Report** focused on providing a community individual (e.g., varsity sports, therapist, clinician) with evidence-based practical advice on how to counteract fatigue based on the needs of that individual. Students can choose their research topic **BUT**– **the student’s specific focus/topic must be approved after consultation with the course director (this must occur prior to January 31, 2019).**

1) Project Proposal: This oral presentation will be 5 min and maximum 5 powerpoint slides and will introduce the specific case scenario with at least 3 peer-reviewed journal references used to explain the potential mechanism causing fatigue under this circumstance. This presentation will help you prepare for your final graded oral presentation with student and professor feedback provided to improve your presentation material and presentation style. (0% of assignment grade)

2) Oral Presentation: This presentation will take place in-class on either March 26th, 28th or April 2nd. The presentation will be 10 min with a maximum of 10 powerpoint slides, and will be followed by a 5 min Q&A period. This presentation includes content from your Project Proposal with additional new content on the proposed intervention to counteract fatigue. (15% of assignment grade)

3) Written Report: Submit your final report describing the specific fatigue scenario being addressed, and provide evidence-based research to explain the potential cellular mechanism underlying fatigue in this scenario. Finally, propose an intervention to counteract fatigue backed by evidence-based research. The report will be 5 pages maximum including references. At least 5 primary source references must be used. (15% of assignment grade)

All written reports are (12-pt. times new roman font, double-spaced, 2.54 cm (1 inch) margins). The final Written Report must be submitted on Moodle to A. Cheng on April 5 2019 by 11:59pm. **Be sure the assignment is the required format (Microsoft word.doc) and to allow yourself sufficient time to complete/submit the project before the deadline – the grades for late assignments will be deducted at a rate of 2% per day off of your final grade for this assignment.**

Grading: The grading scheme for this course conforms to the 9-point grading system used in undergraduate programs at York. Assignments and tests/exams will be given a numeric grade out of 100, which will correspond to a letter grade (e.g. A+ = 90 to 100, A = 80 to 90, B+ = 75 to 79, etc). Should a student have issue with the grade received, a written submission to the Course Director must be received within one week of receiving the grade with specific detail on why the grade should be changed. Re-marking may result in the grade going up, down, or staying the same.

Missed assessments/exam/assignments: Students with a documented reason for missing a course assessment/exam, such as illness, compassionate grounds, etc. which is confirmed by supporting documentation (e.g. doctor's letter specifying date/duration of illness) may request accommodation from the Course Director. At the discretion of the Course Director, such students may write a missed assessment/exam as a make-up assessment/exam. Further extensions or accommodation will require students to submit a formal petition to the Faculty.

Lateness Penalty (as described above): Exceptions to the lateness penalty for valid reasons such as illness, compassionate grounds, etc., may be entertained by the Course Instructor but will require supporting documentation (e.g., a doctor's letter).

IMPORTANT COURSE INFORMATION FOR STUDENTS

All students are expected to familiarize themselves with the following information, available on the Senate Committee on Curriculum & Academic Standards webpage (see Reports, Initiatives, Documents) at http://www.yorku.ca/secretariat/senate_cte_main_pages/ccas.htm

York's Academic Honesty Policy and Procedures/Academic Integrity Website

Ethics Review Process for research involving human participants

Course requirement accommodation for students with disabilities, including physical, medical, systemic, learning and psychiatric disabilities

Student Conduct Standards

Religious Observance Accommodation

COURSE OUTLINE:

The course material below provides an overview of some of the course content. The instructor will attempt to cover the following sections and topics but not necessarily in the order presented below and/or in formal lectures. Some topics may be covered less formerly in assigned readings and/or assigned projects depending on the circumstances and needs of the class.

Background – Review of Physiology and Exercise Physiology
Skeletal muscle – motor unit, regulation of contractile function
Bioenergetics of exercise
Metabolic pathways – control, regulation and integration

Definitions and Conceptual Framework of Fatigue
Historical perspectives of fatigue and fatigability
Perceived fatigue and exercise-induced fatigue
Methodological approaches and models in the study of fatigue
Quantifying exercise-induced fatigue

Characteristics of Exercise Intensity on Fatigue

Potential Sites of Exercise-induced Fatigue
Central events – recruitment and activation muscle
upper motor neurons
motor unit recruitment
compound action potential
neuromuscular junction
Peripheral events - membrane transmission and function
sarcolemma, T-tubule, sarcoplasmic reticulum
ionic changes – sodium, potassium, chloride and calcium kinetics
Ca²⁺ regulation and sensitivity
Peripheral events - energy metabolism
substrate depletion – ATP, CP and glycogen
lactate metabolism, acetyl CoA production
accumulation of by-products – hydrogen ion; inorganic phosphate, etc
intracellular oxygen - transport by myoglobin
reactive oxygen species - ROS

Peripheral events – contractile apparatus
bio-energetic factors – metabolic control of pathways: adenosine compounds
accumulation of by-products – hydrogen ion; inorganic phosphate, etc
Ca²⁺ regulation and sensitivity of force generation
structural integrity and role of intermediate filaments