

York University
Faculty Of Health
School Of Kinesiology And Health Science

KINE 4445 3.0 (M)

PHYSIOLOGICAL BASIS OF FATIGUE

Course Director: Dr. A. Belcastro
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2013-2014 Winter Term
Section M: Tuesday and Thursday 1:00 – 2:20pm – HNE 001

Office hours are on Monday from 11:00am to noon and Wednesday from 1:00-2:00pm in Room #333 N. Bethune College. NOTE: the instructor is 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 and intermittent physical activity. Evaluation of systems and processes impacting contractile activity 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:

1. identify appropriate definitions, protocols, designs, and methods used in the study of fatigue
2. describe the sequence of central to peripheral fatigue leading to limits in the performance of physical activity
3. explain foundations of muscle fatigue, in particular how specific factors are linked to impairments of cellular processes
4. evaluate how areas/sites of fatigue (e.g. neuromuscular, ionic, metabolic, contractile, structural) relate to force decrease and recovery
5. develop and apply critical thinking skills to assess, monitor and evaluate that prevent/retard the development of fatigue through supplementation and/or training

COURSE LEARNING OUTCOMES:

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

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

READINGS and TEXTBOOKS:

Readings: Most of the reading materials for the course are articles from scientific journals and review articles; **there is no formal textbook**. The citations for research and review articles will be identified coincident with and/or in advance of the relevant lecture(s). If required some background material in the form of book chapters and figures/diagrams will be identified.

Prerequisites/Co-requisites: KINE 2011; 3012; KINE 4010.

COURSE OUTLINE:

- I. Introduction
 - A. Definitions of fatigue/failure.
 - B. Is fatigue the same as a loss of capacity?
 - C. Does fatigue always limit performance?
 - D. Are there different types of fatigue?
 - E. Review of Physiology – the Resting State
- II. Potential Sites Of Fatigue
 - A. Central events that fail to adequately activate muscle
 - a. upper motor neurons
 - b. motor unit recruitment
 - c. compound action potential
 - d. neuromuscular junction
 - B. Peripheral events that fail to adequately activate muscle
 1. Membrane Transmission and Function
 - a. sarcolemmal transmission
 - b. T-tubule

- c. sarcoplasmic reticulum
 - 2. Intramuscular processes
 - a. Ionic changes – sodium, potassium, chloride and calcium kinetics
 - b. bio-energetic factors – metabolic control of pathways: adenosine compounds
 - c. contractile apparatus – force generation and structural integrity
 - (1) Ca²⁺ sensitivity
 - (2) accumulation of by-products – hydrogen ion; inorganic phosphate
 - (3) structure-function - proteases
 - d. energy metabolism
 - (1) substrate depletion – ATP, CP and glycogen
 - (2) lactate removal, acetyl CoA production
 - (3) intracellular oxygen - transport by myoglobin
 - (4) reactive oxygen species - ROS
 - C. Supporting factors
 - a. muscle blood flow and mean arterial pressure
 - b. maintenance of plasma volume
 - c. thermal stress and the cutaneous circulation
 - III. Supplementation and Training adaptations that defend against fatigue
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COURSE EVALUATION: IMPORTANT NOTE: *evaluation formats require that you attend the regularly scheduled lectures.*

Required Grading Components

- In-class Assessment #1 25% (February 6 2014)
- In-class Assessment #2 25% (March 20 2014)
- Fatigue Activity Report 50% (PRE-APPROVED Topic Required)

Optional Bonus (during last two week of classes):

- Fatigue Presentation 10% (PRE-APPROVED Topic Required)

IN-CLASS ASSESSMENTS: The two in-class assessments are sequential in nature but non-cumulative when performed in the appropriate sequence (i.e., #1: #2). In the case where a student does not complete assessment #1 then assessment #2 will be cumulative count towards 50% of the final grade. Regardless of the sequence in which in-class assessments are completed, **ALL in-class assessments must be completed prior to submitting and recording a grade for the activity report.** Assessments will include combinations of multiple choice, short answer and written long answers and will cover content from lectures and assigned readings. Tests will require students to demonstrate in-depth knowledge and application of course content.

FATIGUE ACTIVITY REPORT - students will be required to prepare a Fatigue Activity Report focused on one of several various fatigue sites/factors discussed in class – **specific topic to be provided and approved after consultation with the by the course director.** The Activity Report (3 pages maximum, not including references and tables/figures) must demonstrate inquiry, critical analysis and problem solving abilities. The content of the report will be based on scenarios and/or data for various fatigue sites/factors – topics to be provided and approved by the course director. The student can exercise choice in the topic/module to be completed but the choice must be confirmed with the instructor by February 4 2014 and the final report must be submitted electronically on April 10 2014 by 11:59pm.

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: Activity Report Assignments received later than the due date will be penalized (*one-half letter grade (1 grade point) per day that assignment is late*). 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