



# **HHNS\*6130 Advanced Skeletal Muscle Metabolism in Humans**

Winter 2023

Section(s): C01

Department of Human Health and Nutritional Sciences

Credit Weight: 0.50

Version 2.00 - January 11, 2023

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## **1 Course Details**

### **1.1 Calendar Description**

This course examines how the energy provision pathways in human skeletal muscle and associated organs meet the energy demands of the muscle cell during a variety of metabolically demanding situations.

### **1.2 Course Description**

The objective of this course is to solidify, and expand upon, skeletal muscle metabolism taught at the Undergraduate level. This course is designed to examine selected areas and topics in contemporary human skeletal muscle metabolism at an advanced level. It is expected that the student is familiar with skeletal muscle metabolism to the depth provided by Newsholme and Leech's 1983 Biochemistry for the Medical Sciences. The majority of learning will occur during discussions of state-of-the-art research papers.

While Undergraduate courses are focused on learning the rate-limiting enzymes/control points regulating metabolism, this course is designed to force the student to apply this information, and to critically think about research design and interpretation. The course will focus on skeletal muscle but other organs/systems will be discussed when relevant (liver, adipose tissue, circulation etc.). The emphasis will be on catabolic processes, but selected anabolic processes will also be addressed. Throughout the course we attempt to determine

how the energy provision pathways meet the energy demands of the muscle cell during varying situations, and how the body handles the various by-products of metabolism. Many of these topics will not be specifically addressed but are discussed during several of the weeks. We will focus primarily on the rate-limiting enzymes involved in fatty acid and carbohydrate metabolism and how these are regulated at rest, during the onset of exercise, during steady-state exercise, as well as how these processes are affected by training/detraining and obesity/diabetes. The students will be introduced to the underlying concepts in a short informal lecture, and strengthened through journal club discussions and a critical evaluation of the scientific. This course therefore represents a unique opportunity to merge many facets of your previous University training, including molecular biology, physiology, cell biology and lifestyle genomics, to understand the regulation of exercise metabolism, and to apply this knowledge to conditions (e.g. training and disease).

The goal for this course is to ensure that the student will emerge with a greater understanding of skeletal muscle metabolism, as well as fully appreciate the notion of the 'specificity of training', as different training regimes will be discussed in the context of genetic adaptations. In addition, students will explore the metabolic alterations that occur with common diseases (examples include obesity, insulin resistance, type 2 diabetes) and how exercise can recover health of the individual by altering skeletal muscle metabolism.

### 1.3 Timetable

Timetable is subject to change. Please see WebAdvisor for the latest information.

While the University reserves the right to adjust lectures to a virtual platform in response to growing health concerns, currently lectures are scheduled face-to-face on Wednesday mornings 8:30-11:20 AM in ANNU 002. Lectures will remain face-to-face unless the University adjusts and/or mandates a virtual course delivery.

#### **Attendance Expectations:**

Since lecture and Research Presentation content will be assessed in the final exam, it is strongly encouraged that students attend all lectures. In addition, there are grades assigned to professional behaviour during the class, which involves participation and preparation for each class. The structural overview of lectures will be made available on the website and students who have missed classes will need to interact with the course instructor and/or their fellow students to obtain the material. While appointments can be made to discuss course content with the instructor for missed classes, you will not be able to answer questions on the

exams pertaining to lectures missed (i.e. you will have fewer questions to select from).

The following is a tentative schedule for the course

Jan 11 - Introduction to Advanced Skeletal Muscle Metabolism

Jan 18 - Excitation contraction coupling and Ca<sup>2+</sup> homeostasis

Jan 25 - Glucose Transport & Signalling

Feb 1 - Fatty Acid Transport & Signalling

Feb 8 - Glycogen droplets and synthesis

Feb 15 - CHO Metabolism – PHOS, PFK and PDH

Feb 22 - No classes - WINTER BREAK WEEK - Feb 21-25

Pick up 48hr TAKE-HOME exam after WEEK 6 class anytime between Feb 15 and 27

Mar 1 - Fat Metabolism – Regulation of IMTG lipolysis

Mar 8- Fat Metabolism – Regulation of mitochondrial lipid transport

Mar 15 - Mitochondrial Bioenergetics and Biogenesis

Mar 22 - Mitochondrial dysfunction with pathologies

Mar 29 - Control of muscle protein synthesis

April 5 - Group presentations

Pick up 48hr TAKE-HOME exam after WEEK 12 class anytime between April 5 and 15

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.

## 1.4 Final Exam

This course involves a take-home mid-term and final examination. You will have 48 hrs to complete each examination, and the commencement of the exam will be scheduled with the instructor. Usually students can start the examination anytime within a 10 day 'window'

after the 6th (mid-term) and 12th (final) week.

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## 2 Instructional Support

### 2.1 Instructional Support Team

<b>Instructor:</b>	Graham Holloway
<b>Email:</b>	ghollowa@uoguelph.ca
<b>Telephone:</b>	+1-519-824-4120 x53688
<b>Office:</b>	ANNU 330
<b>Office Hours:</b>	To be determined during the first class

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## 3 Learning Resources

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## 4 Learning Outcomes

### 4.1 Course Learning Outcomes

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

1. Possess an extensive understanding of the current state of knowledge regarding the regulation of skeletal muscle metabolism
  2. Fully understand mechanisms that influence the interaction between carbohydrate and fatty acid catabolism
  3. Understand mechanisms thought to cause various diseases
  4. Possess an extensive understanding of the current state of knowledge regarding how exercise training affects gene regulation
  5. Have a thorough appreciation of exercise physiology, with a particular emphasis on skeletal muscle
  6. Understand how exercise combats many diseases at the molecular level in muscle
  7. Successfully work in small groups
  8. Improve scientific writing and oral presentation skills
  9. Critically evaluate scientific reports
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## 5 Teaching and Learning Activities

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## 6 Assessments

### 6.1 Marking Schemes & Distributions

The workload will be heavy each week given the articles to read and the occasional need for background reading. Therefore, there are only three formal evaluations, in addition to providing an assessment (and feedback) on your professional behaviour throughout the course.

**1. Take-home Exam (35%)**- The exam will be emailed to individuals between February 15-27 to ensure the independent exam is completed in 48 hr period between class 6 and 7. Students will be able to determine the examination start date/time within this window, and while they can choose to complete the examination during the winter break, importantly this is not required as students have sufficient time to complete the examination before or after the winter break. The examination will provide 6-10 questions covering the topics from the first half of the course and students will be required to select and answer only 2 questions, however students will not be allowed to answer 2 questions from the same week/topic.

**2. Final Exam (35%)**- A similar format to the mid-term will be followed, where the final examination will be a 48hr independent take-home that commences at a student selected time over a 10-day window (April 5-15th). The exam will require you to answer two questions from 6-10 options covering the topics from the last half of the course, and students cannot answer 2 questions from the same week/topic.

Please note that these are take home examinations, however they **MUST be completed independently!** Any indication that you completed this examination with the assistance of others will result in a grade of zero.

**3. Group lecture (20%)**– These will occur on the final day of class. Students will be expected to provide rationale and background information on a given topic, and then accurately summarize the literature provided to you by the instructor.

**4. Professional behaviour (10%)**– Each student will be expected to come to class and participate in group discussions in a professional manner. Expectations will be discussed during the first class. The course instructor will provide specific feedback on strengths/areas for improvement, as well as a grade worth 5% each (10% total), after the 6th and 12th class.

Group lecture: Presentation topics will be selected by the instructor. It is expected that topics relate to the general focus of the course, however, student groups will be required to use journal articles, books, etc to further develop each topic. Students are expected to search and read current scientific literature, including original research papers, relevant to their topic. The instructor can provide students with a short list of recommended readings as required to aid in the learning process.

Groups will consist of ~3 students, depending on the class size. PowerPoint presentations will be ~30 minutes in length, and it is obligatory that each student in the group present material related to the topic. Each presentation will be followed by 5 minutes of questions. Student attendance at these presentations is **mandatory** and students will be required to meet and work as a group outside of scheduled lecture times to succeed.

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## 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>)

## **7.5 Course Offering Information Disclaimer**

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

# **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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

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, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. 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

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

## 8.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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