UF Department of Applied Physiology and Kinesiology
College of Health and Human Performance
UNIVERSITY of FLORIDA

# EXERCISE METABOLISM

**APK7117 | Class # 16912| 3 Credits | Fall 2025**

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## Course Info

**INSTRUCTOR**

**Orlando Laitano, Ph.D.**
Office: FLG Room 118
Office Phone: 294-1713
Email: orlando.laitano@ufl.edu
Preferred Method of Contact: Email through Canvas

**OFFICE HOURS**

2 hours/week, Details will be provided on CANVAS

**MEETING TIME/LOCATION**

FLG 225, W Period 4 - 6 (10:40 AM - 1:40 PM)

### COURSE DESCRIPTION

This course examines the principles of metabolic regulation during exercise and the chronic adaptations of skeletal muscle metabolism, with emphasis on bioenergetics, lactate dynamics, mitochondrial function, and exercise-induced metabolic signaling. The course integrates lectures, research discussions, and problem-based learning.

### PREREQUISITE KNOWLEDGE AND SKILLS

Graduate course in exercise physiology required.

### REQUIRED AND RECOMMENDED MATERIALS

Purchase of a textbook is not required. Suggested reading and copies of the lecture slides will be posted on the course website (Canvas) prior to each lecture.

### COURSE FORMAT

This course will follow an integrative approach toward understanding exercise metabolism and will incorporate a problem-based learning method that will emphasize the importance of both critical thinking and a thorough understanding of the course materials. The class will meet for 3 hours each week for lectures. Lecture time will be generally divided among the following activities:

1) didactic presentations to provide background on the weekly topic.

2) student presentations of research papers to foster scholarly skills (scientific communication, synthesis of research).
3) student discussion of the papers in the context of the weekly topic.

Questions are encouraged at any time during the lectures. *Students will be expected to be active participants through in-class discussions and presentations.*

### COURSE LEARNING OBJECTIVES:

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

- Understand the fundamentals of principal of bioenergetics.
- Critically evaluate techniques for studying metabolism at the cellular, tissue, and whole-organism levels, and justify their appropriate application in research contexts.
- List and discuss the primary sources of reactive oxygen species in muscle cells. Describe the regulation of metabolism by reactive oxygen species and calcium.
- Define the lactate threshold and discuss the potential mechanisms responsible for the rise in blood lactate concentration during exercise. Discuss the various fates of lactate molecules produced in skeletal muscle fibers.
- Describe the condition driving the fuel selection during exercises.
- Discuss the limiting factors for and the determinants of maximal oxygen uptake.
- Describe respiratory and circulatory response to exercises and their limiting factors to endurance and strength performance.
- Describe the pathways responsible for angiogenesis following exercises and the mechanism of fast to slow muscle fiber switching induced by endurance training.
- List main myokines that regulate skeletal muscle metabolism and lipogenesis.
- Analyze the cellular events during myocardial ischemia-reperfusion and interpret their relevance to exercise preconditioning.
- Discuss the mechanisms responsible for exercise-induced preconditioning of both cardiac and skeletal muscles.

## Course & University Policies

### ATTENDANCE

Attendance is encouraged for all class time sessions. It will be part of the Class Participation grade (see below). You will be excused from class if you have a legitimate reason to be gone; please send an email before class starts as to why you need to miss the class. These will be kept on file for the semester. Please note: the University has specific reasons that are acceptable for missing classes, which apply to both undergraduate and graduate students. More information here.

*"In general, acceptable reasons for absence from or failure to participate in class include illness, serious family emergencies, special curricular requirements (e.g., judging trips, field trips, professional conferences), military obligation, severe weather conditions, religious holidays and participation in official university activities such as music performances, athletic competition or debate. Absences from class for court-imposed legal obligations (e.g., jury duty or subpoena) must be excused. Other reasons also may be approved."*

## PERSONAL CONDUCT & ACADEMIC INTEGRITY

Students are expected to exhibit behaviors that reflect highly upon themselves and our University. Students are expected to join the lecture on time, but tardiness is acceptable when personal conflicts require the student to enter the lecture later than the scheduled time. Students are expected to be quiet and cause minimal disturbance to the class if they enter the lecture hall late.

Laptop computers and tablet devices for note taking are allowed to be used during the course. Upon entry into the lecture, please silence your cell phone and do not answer the phone or respond to a text message during class.

For open book exams or written assignments, the instructor submits all material to TURNITIN.com, which is designed to determine whether what you have written is original material. Penalties for plagiarism will be enforced in this class. It may have extreme consequences such as receiving an F (failure) for the entire class, depending on the severity of the infraction. Understanding this aspect of scholarship is required to prepare you as a scientist, scholar and professional. Failure to adhere to the UF Honor Code will result in disciplinary action by the university. UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code". On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Student Honor Code and Conduct Code (Regulation 4.040) specifies a number of behaviors that are in violation of this code, as well as the process for reported allegations and sanctions that may be implemented. All potential violations of the code will be reported to Student Conduct and Conflict Resolution. If a student is found responsible for an Honor Code violation in this course, the instructor will enter a Grade Adjustment sanction which may be up to or including failure of the course. Furthermore, you are obliged to report any condition that facilitates academic misconduct in others. Please contact the instructor directly if you have any concerns about ongoing misconduct.

## APPROPRIATE USE OF AI TECHNOLOGY

The University of Florida supports responsible and ethical AI use in keeping with the UF Best Practices for Generative AI. Students must use UF-verified platforms, safeguard data privacy, and comply with all academic integrity policies. The use of generative AI (e.g., ChatGPT) is allowed only when clearly disclosed (e.g., "I used ChatGPT version X on [date] for brainstorming.") and must be cited. All submissions must reflect your own critical thinking and scholarly work. Refer to course-specific guidelines below for approved uses and restrictions.

- The use of approved AI enabled tool is permitted for idea generation or grammar support in literature reviews, provided students disclose usage and critically evaluate outputs.

- The use of approved AI enabled tools is prohibited in course assignments and exams as it substantially compromises the student's ability to achieve the stated learning objectives of the course.

## IN-CLASS RECORDING

Students are allowed to record audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2)

in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or guest lecturer during a class session. Publication without permission of the instructor is prohibited.

To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### EXAM MAKE-UP POLICY

If you miss an exam due to an excused absence, a make-up exam will be scheduled at the earliest feasible date. If an exam is missed due to an unexcused absence, no close book exams can be rescheduled. A make-up exam for open book exam may be scheduled, but 10 points will be deducted from the final score for every 3 days of delay. No make-up exam for open book exams can be rescheduled once the results of exam have been released. "Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found in the online catalog.

### ACCOMMODATING STUDENTS WITH DISABILITIES

Students with disabilities who experience learning barriers and would like to request academic accommodation should connect with the Disability Resource Center by visiting their Get Started page. It is important for students to share their accommodation letter with their instructor and discuss their access needs as early as possible in the semester.

### COURSE EVALUATIONS

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at this link. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via UF BlueEra. Summaries of course evaluation results are available to students at this link.

## Getting Help

### UNIVERSITY POLICIES AND STUDENT RESOURCES

For information on university-wide policies regarding academic integrity, accommodations, evaluations, and campus resources, please visit this link. The link provides the most up-to-date guidance and support services available to all UF students. Course-specific policies outlined here operate in alignment with these university standards.

### APK ADMINISTRATORS

For suggestions or concerns related to APK courses or programming, please reach out to any of the following:

- Dr. David Vaillancourt (he/him), APK Department Chair, vcourt@ufl.edu
- Dr. Demetra Christou (she/her), APK Department Vice Chair, ddchristou@hhp.ufl.edu
- Dr. Steve Coombes (he/him), APK Graduate Coordinator, rachaelseidler@ufl.edu
- Dr. Anna Gardner (she/her), APK Undergraduate Coordinator, akgardner@ufl.edu

## Grading

Grades will be assigned based on points earned in the course. The point value of three examinations, presentation, participation and literature review are as follows:

| Evaluation Components (Number of each) | Points Per Component | Approximate % of Total Grade |
|---|---|---|
| Exams (3) | 25 pts each = 75 pts | 75% |
| Literature Review (1) | 10 pts each = 10 pts | 10% |
| Class Participation (1) | 5 pts each = 5 pts | 5% |
| Article Presentation (1) | 10 pts each = 10 pts | 10% |

**Exams:** There will be two midterm exams and a final exam. The final will not be comprehensive. The first two exams will be closed-book, meaning that no outside materials (notes, slides, textbooks, or digital resources) may be used—students are expected to demonstrate mastery of the material from memory through short-answer questions. The final exam will be open-book, meaning that students may use their own course notes, lecture slides, and assigned readings. While materials may be consulted, responses must be written in the student's own words and demonstrate synthesis and critical analysis rather than copying directly.

****For Ph.D. students and thesis-track Master's students***, **Exam 3** will also include a one-on-one oral component with questions covering course material and its relation to their own research projects. These three exams will comprise 75% of the course grade.

Exams are designed to test both factual knowledge (closed book) and integrative/critical thinking (open book + oral).

**Assignments:** There will be limited assignments for this course. If necessary, one or two assignment(s) will be given at later stage of the course as a practice for the format of the assay-based final exam. The assignments will be posted on canvas. Completion of the assignments will not be required but will be considered in Class Participation (below). In addition, gaining feedback on the practice questions from the instructor will positively impact students to properly construct answers during the final exam.

**Class Participation/Presentations:** Each student will be responsible for 1-2 paper presentations throughout the semester. Discussion of the topics, and challenging each other (and the professor!) about statements Class discussion and student presentations will comprise 15% of the grade. A portion of these

discussion points will be given just for showing up to class, and those who are more vocal in class will receive full credit. For each week's paper presentation, every student is expected to post at least one discussion question for the presenter and the class, to be discussed during the class. Failure to post discussion questions each week will result in penalties in your participation credit. A detailed grading rubric for this assessment will be posted in CANVAS.

**Extra Credit Opportunities:** Students may earn extra credit by attending the Center for Exercise Science (CES) Seminar Series and/or the Myology Institute Seminars. Attendance at these events provides exposure to current research and professional perspectives in the field of exercise physiology and muscle biology. Schedules for these talks will be posted on Canvas and updated throughout the semester. To receive credit, students must sign in at the event or submit a brief (1–2 paragraph) reflection on the presentation within one week of attendance.

**Literature review:** Each student will choose one topic of the course and write a literature review. Topics on exercise metabolism that are not covered in the course are also acceptable with prior approval from the instructor. The literature review should be in the format of a short review, with no less than 8 pages, letter-size paper, double space, 12 pt fonts, with at least 20 references. A detailed grading rubric for this assessment will be posted in CANVAS for you to use to prepare, but the parts that will be graded include structure (40%, including length), depth of discussion (20%); accuracy (20%) and cohesiveness (20%).

## GRADING SCALE

Lecture exam scores and homework grades will be posted on the canvas course website typically within 48-96 hours after the date of the exam. Final grades in the class will be determined by the total points earned during the semester. Grades will be calculated to the nearest 2 decimal places. More detailed information regarding current UF grading policies can be found here. Any requests for additional extra credit or special exceptions to these grading policies will be respectfully ignored.

| Letter Grade | Percent of Total Points Associated with Each Letter Grade | GPA Impact of Each Letter Grade |
|---|---|---|
| A | 94.00-100% | 4.0 |
| A- | 90-93.99% | 3.67 |
| B+ | 87.00-89.99% | 3.33 |
| B | 80.00-86.99% | 3.0 |
| C+ | 77.00-79.99% | 2.33 |
| C | 70.00-76.99% | 2.0 |
| D+ | 67.00-69.99% | 1.33 |
| D | 60.00-66.99% | 1.0 |
| E | 0-59.99% | 0 |

## Weekly Course Schedule

### WEEKLY SCHEDULE

| Week | Dates | Lecture Topics |
|---|---|---|
| **Part 1: Fundamentals of Bioenergetics** | | |
| 1 | Aug 27 | Syllabus.<br>How to prepare an article presentation.<br>Foundations of exercise metabolism. |
| 2 | Sep 3 | Guest lecture: Dr. Terence Ryan.<br>Electron transport chain/oxidative phosphorylation: theory and measurements. |
| 3 | Sep 10 | Metabolic regulation by ROS and $Ca^{2+}$. |
| 4 | Sep 17 | Exam 1: Weeks 1-3 |
| **Part 2: Metabolic Response to Exercises** | | |
| 5 | Sep 24 | Exercise and Lactate metabolism. |
| 6 | Oct 1 | Fuel selection during exercise. |
| 7 | Oct 8 | Respiratory and circulatory response to exercise. |
| 8 | Oct 15 | Metabolic limitations to endurance performance. |
| 9 | Oct 22 | Exam 2: Weeks 5-8<br>Literature review topic due. |
| **Part 3: Metabolic Adaptation to Exercises** | | |
| 10 | Oct 29 | Metabolic Adaptation 1: Angiogenesis and Mitochondrial Proliferation/Health; Mitochondrial myopathy. |
| 11 | Nov 5 | Metabolic Adaptation 2: Skeletal Muscle Secretome. |
| 12 | Nov 12 | Exercises preconditioning in Cardiac and Skeletal Muscle. |
| 13 | Nov 19 | Literature review Due by Nov 24th 5pm! |
| 14 | Nov 26 | NO CLASS THIS WEEK-HAPPY THANKSGIVING! |
| 15 | Dec 3 | Final Exam |

### SUCCESS AND STUDY TIPS

To ensure success of this course, all students are encouraged to read the course materials provided on CANVAS before class, attend the lectures, ask questions during and after class, and engage in discussions

during class. An important aspect of this is reading the papers for discussion so that participation is possible. Contact the instructor when you have doubts about the materials and topics for each week.