

CELL PHYSIOLOGY & BIOPHYSICS OF EXERCISE

PET5936 3 credit hours SPRING 2020

INSTRUCTOR:

Lead Instructor: Terence Ryan, Ph.D.
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Preferred Method of Contact: email

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Preferred Method of Contact: email

OFFICE HOURS:

office hours by appointment, or as announced in class:
For all general questions: TR (lead instructor)
For help with specific topics: TR or TC as appropriate

MEETING TIME/LOCATION: example: FLG 235, Tues period 4-6 (10:40-1:40)

COURSE DESCRIPTION: This is a special topics class that covers a comprehensive view of the cell biology, with some focus as it applies to the discipline of exercise.

PREREQUISITE KNOWLEDGE AND SKILLS: Undergraduate chemistry and preferably physics. Previous coursework in introductory biochemistry and or molecular biology is helpful but not required. Senior undergraduates may utilize the course as a high-level elective by permission of the instructor.

REQUIRED AND RECOMMENDED MATERIALS: Required materials:

Textbook: Alberts et al. ESSENTIAL CELL BIOLOGY ISBN: 0393680363 5th Edition:
Publisher: W. W. NORTON & COMPANY ©2019 (hardbound, digital or paperback available)

Access to computer and CANVAS.

COURSE FORMAT: Course material is largely presented as live lecture. Occasionally, lectures may be substituted to a pre-recorded format, when needed for scheduling. Students will have copies of the lecture material on Canvas to work from. Students will also be expected to learn from regular reading assignments in the Alberts et al. textbook or may be given additional reading in online-accessible manuscripts or reviews. In general, class time each week will include 2 periods of lecture and one period of reinforcement, active learning or specialized learning activities.

COURSE LEARNING OBJECTIVES:

Elementary building blocks of the cell.

1. To recognize the basic chemical building blocks of the cell and cell membrane, including fatty acids, phospholipids, proteins, nucleic acids, etc.
2. To be able to describe the mechanisms by which cells communicate with the extracellular environment, other cells, or messenger molecules by processes of membrane transport, receptor binding, ion movement, etc.

Origins of the electrical behavior of the cell

3. To be able to identify the primary proteins, ions and structures involved in maintaining a resting electrical potential across the cell membrane
4. Be able to describe how an action potential is formed in various cells and how it propagates down the cell membrane.

Bioenergetics and mitochondrial function

5. To identify the primary sources of energy that the cell uses to do mechanical or chemical work.
6. To distinguish energy pathways involved with glucose, fatty acid and protein metabolism to produce ATP.
7. To be able to identify the origins of the mitochondria and its basic and varied functions in the cell.
8. To be able to link the metabolism of metabolic substrates with electron flow and the production of the electrochemical gradient across the inner mitochondrial membrane. Be able to describe how this gradient is utilized for ATP production.

How protein is synthesized and how protein structure is determined.

9. Identify the basic mechanisms by which RNA is coded from DNA and how it is made ready for interaction with ribosomal machinery.
10. Be able to identify the basic chemical characteristics of amino acid building blocks in the cell, how their chemical characteristics defines function and structure and how these relate back to the basic DNA code.
11. Recognize the primary pathways by which ribosomes translate RNA message into intact protein.
12. Be able to describe the functions of endoplasmic reticulum and golgi in protein processing and what systems are in place to ensure fidelity of protein synthesis.

Basic methods in cell biology research

13. Become familiar with biochemical methods such as western blot, ELISA, quantitative PCR, RNAseq, sequencing, etc.
14. Understand how scientists manipulate the genetic code in living animals and cells by techniques such as RNA interference, transgene expression, CRISPR, CRE-LOX, and other genetic models used in biomedical research.
15. Understand the basic principles of isolating cells and studying them in vitro.

The Cytoskeleton, Molecular motors and how they are regulated.

16. Be able to define the basic elements of the cytoskeleton that are part of every cell, including microfilaments, microtubules and spectrin.
17. Be able to recognize the role of the cytoskeleton in the dynamic properties of cell behavior and how molecular motors interact with the cytoskeleton to initiate movement.
18. Be able to describe how molecular motors are regulated to initiate movement or to perform specific functions.

How cells make decisions: Introduction to Cell signaling and Complexity

19. Be able to describe the basic chemical pathways (post translational modifications) can be used to pass information and to initiate change in cells, including pathways toward phosphorylation, oxidation, nitration, methylation and acetylation.
20. Recognize basic mechanisms by which signaling may alter transcriptional activity.
21. Identify the most common generalized cell signaling pathways that are reutilized in many ways to regulate cell function, including G-protein-liked responses, enzyme linked receptor systems, catalytic dimerization, MAPK signaling, stress activated signaling, etc.

Introduction to Redox Biology and Oxygen transport.

22. Be able to identify how oxidation-reduction reactions in the cell are often extremely important in cell function and how these can be destructive if out of homeostasis.
23. Be able to identify the most common oxidants found in cells and how these are usually handled by the most common antioxidant pathways.
24. Be able to describe the origins of the discovery of nitric oxide and what primary redox and signaling roles NO plays in the cell. Identify common reactions of NO with common oxidants and the consequences of these reactions.
25. Be able to describe how O₂ diffuses into the cell, what barriers there are for diffusion and how the cell has evolved to overcome those barriers using NO, myoglobin, reactive oxygen and other mechanisms.
26. Be able to recognize the sources of reactive oxygen formation in the mitochondria and how these contribute to biomedical challenges to the cell.

The life and death of a cell

27. Be able to identify the primary signaling mechanisms involved in the process of cell replication and growth.
28. Be able to describe how cells manage to die, when the need to die (apoptosis) and when this system is not working (necrosis).

29. Be able to identify the fundamental signaling processes that lead to apoptosis and how these are identified in the laboratory.
30. Be able to describe the basic elements of the cell cycle that lead from stasis to cell division and how cells become stable in “senescence.”

COURSE AND UNIVERSITY POLICIES:

ATTENDANCE POLICY: It is expected in graduate level courses that students will always be in attendance. However, because of outside activities expected of graduate students, illness, etc. there are often unexpected absences. It is expected that if you cannot attend class for any reason you will contact the lead instructor regarding your reasons for absence. There is a 30% class participation grade. Students missing class without excuse will receive a proportional reduction in their grade for this component of the course.

PERSONAL CONDUCT POLICY: Students are expected to exhibit behaviors that reflect highly upon themselves and our 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 Honor Code (<http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obliged to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult the lead instructor, Dr. Ryan, in this class.

EXAM MAKE-UP POLICY: There is one midterm and one final exam in the class. Students who have to miss an exam must contact the instructor at least 12 hours prior to the exam. How the make-up exam will be handled will be through negotiation with the lead instructor. 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 at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.”

ACCOMMODATING STUDENTS WITH DISABILITIES: Students requesting accommodation for disabilities must first register with the Dean of Students Office (<http://www.dso.ufl.edu/drc/>). The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when

requesting accommodation. You must submit this documentation prior to submitting assignments or taking the quizzes or exams. Accommodations are not retroactive, therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations. The instructors will do anything needed to accommodate disabilities.

COURSE EVALUATIONS: Students are highly encouraged to evaluate the course instructor(s) using GatorEvals. Students can complete their evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>.

GETTING HELP:

In case you feel you need help in any way, a number of University programs are available. Talk to the lead course instructor if you would like assistance in finding the right mechanism for your needs.

Health and Wellness

- U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575
- Counseling and Wellness Center: <https://counseling.ufl.edu/>, 352-392-1575
- Sexual Assault Recovery Services (SARS) - Student Health Care Center, 392-1161
- University Police Department, 392-1111 (or 9-1-1 for emergencies)
<http://www.police.ufl.edu/>

Academic Resources

- E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>
- Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling. <https://career.ufl.edu/>
- Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.
- Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <http://teachingcenter.ufl.edu/>
- Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <http://writing.ufl.edu/writing-studio/>
- Student Complaints On-Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/> On-Line Students Complaints: <http://distance.ufl.edu/student-complaint-process/>

GRADING:

Evaluation Components	Points Per Component	Approximate % of Total Grade
Lecture and Course material Exams (2)	35 points ea	70%
Class Participation	30 points ~2 pts per week)	30%

Lecture and learning material Exams – Exams will be designed to fit within a single class period and will consist of between 25-35 questions, including varying amounts of either standard multiple choice-type questions and particularly essay questions. Undergraduates taking the class are likely to receive different exams. Student are expected to be responsible for both the lecture material and the assigned reading material. An emphasis will be placed on thinking and understanding and less on memorization. The final will not be comprehensive but will cover all material presented since the last exam.

Homework – Students will be assigned specific reading assignments aligned with the course schedule and learning objectives. The instructors may provide some additional self quizzes or assessments to further prepare the students for the exams.

Class participation assessment – Students basically start with full credit (30 points) at the beginning of the semester and are expected to participate in each week's class period. This will take various forms, depending on the topic being studied. Students who are unprepared to participate or do not show up for class will lose 2 points in this grade each week. Students who are unusually prepared and do a truly outstanding job may receive additional points at the instructor's discretion.

GRADING SCALE:

We will utilize a modified overall grading scale for the final grade of the class:

90-100% A

80-89.99% B

70-79.99% C

60-69.99% D

<60 E

Your final grade will be determined by rounding your final score to the closest integer %.

WEEKLY COURSE SCHEDULE:

Note: Preliminary, subject to change with notification

Terence Ryan (TR)

Thomas Clanton (TC)

Week	Dates	Lecture Topic (required reading pages)	Reading assignments
1	Jan 7	Introduction to the Class: (TR) Chemical components of the cell and cell membranes (TR) Membrane transport and Membrane Potentials (TC)	To be announced weekly
2	Jan 14	Bioenergetics and mitochondrial function (TR)	
3	Jan 21	Protein structure and the basic machinery of protein synthesis (TC)	
4	Jan 28	Basic methods of cell biology research (TR)	
5	Feb 4	The cytoskeleton, molecular motors and how they are regulated (TC)	
6	Feb 11	Review and carry over material (TR and TC)	
7	Feb 18	MIDTERM EXAM	
8	Feb 25	Introduction to Cell signaling and how cells "think" (TR)	
9	Mar 3	SPRING BREAK NO CLASS	
10	Mar 10	Introduction to REDOX biology (TC)	
11	Mar 17	Mitochondrial redox biology (TR)	
12	Mar 24	The life and death of a cell and how it is regulated (TC).	
13	Mar 31	Autophagy, mitophagy and regulation of mitochondrial content (TR)	

14	Apr 7	EXPERIMENTAL BIOLOGY - Lectures and activities available online in CANVAS No formal class Oxygen transport in skeletal muscle (TC)	
15	Apr 14	Make up time and carry over material (TR and TC)	
16	Apr 21	Review and preparation for final (TR and TC)	
Final Exam – Thursday April 30, 7:30am-9:30 AM			

SUCCESS AND STUDY TIPS:

The instructors encourage you to learn to UNDERSTAND the material by listening, reviewing the lectures and performing the reading. Take the extra time to understand underlying mechanisms and worry less about memorizing. Terms are important because they are holding places for new concepts but they can always be looked up or googled. Concepts are harder to master and more important for this class.

We hope to make the class exciting and accessible and will appreciate getting feedback as we go.