

Cell Physiology & Biophysics

PET5936 | Class # 23864 | 3 Credits | Spring 2024

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Course Info

INSTRUCTOR

Terence E. Ryan, Ph.D.
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Preferred Method of Contact: **email**

OFFICE HOURS

office hours are by appointment

MEETING TIME/LOCATION

FLG 225 - Monday periods 6-8 (12:50P – 3:50P)

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

Textbook: Alberts et al. ESSENTIAL CELL BIOLOGY ISBN: 978-1-324-03348-6; 6th Edition: Publisher: W. W. NORTON & COMPANY ©2023 (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-linked 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 & 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 instructor or TA 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 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>.

A student experiencing an illness should visit the UF Student Health Care Center or their preferred healthcare provider to seek medical advice and obtain documentation. If you have an illness, family emergency or death, please contact the Dean of Students Office (www.dso.ufl.edu) and follow the DSO Care Team procedures for documentation and submission of a request for make-up assignment (<https://care.dso.ufl.edu/instructor-notifications/>). The DSO will contact the instructor. Do not provide any documentation to the instructor regarding illness or family emergency. This is your personal and protected information. The DSO is qualified to receive and verify the documents you provide. The instructor will follow the recommendations from the DSO.

ACCOMMODATING STUDENTS WITH DISABILITIES

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center by visiting their Get Started page at <https://disability.ufl.edu/students/get-started/>. 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 <https://gatorevals.aa.ufl.edu/students/>. 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 <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

Getting Help

HEALTH & 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/>

Civility, Accessibility, and Community Resources

This is a science-based course, which should ideally be objective in its presentation, interpretation, and valid for everyone. However, much of science is subjective and is historically built on a small subset of privileged voices. I acknowledge that the readings for this course were authored by white men and women. Furthermore, the course relies heavily on findings from experiments mostly conducted by white men. The interpretation and presentation are modified, as feasible, by the instructor. I will make an effort to acknowledge whenever possible the contribution that people from several races, sexes, and backgrounds have given to the field. However, I admit that it is possible that there may be both overt and covert biases in the material due to the lens with which it was written, even though the material is primarily of a scientific nature. Integrating a diverse set of experiences is important for a more comprehensive understanding of science. Please contact me (in person or electronically) or submit anonymous feedback if you have any suggestions to improve the quality of the course materials.

Furthermore, I would like to create a learning environment for my students that supports a diversity of thoughts, perspectives and experiences, and honors your identities (including race, gender, class, sexuality, religion, ability, etc.) To help accomplish this:

- If you have a name and/or set of pronouns that differ from those that appear in your official UF records, let me know as indicated above.
- If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with me. I want to be a resource for you. Remember that you can also submit anonymous feedback (which will lead to me making a general announcement to the class, if necessary to address your concerns).
- If you prefer to speak with someone outside of the course, see the list of contacts below.
- I am continuing to learn about diverse perspectives and identities, and still adapting to the cultural differences between countries and regions. If something was said in class (by anyone) that made you feel uncomfortable, please talk to me about it. Again, anonymous feedback is always an option.

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 studies. 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 %.

More detailed information regarding current UF grading policies can be found here:

<https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>. Any requests for additional extra credit or special exceptions to these grading policies will be interpreted as an honor code violation (i.e., asking for preferential treatment) and will be handled accordingly.

Weekly Course Schedule

WEEKLY SCHEDULE (updates and/or changes will be announced via CANVAS)

Week	Dates	Lecture Topic (required reading pages)	Reading assignments
1	Jan 8	Introduction to the Class:	<i>No material, only a brief introduction</i>
2	Jan 15	No Class – Martin Luther King Jr. Holiday	
3	Jan 22	Chemical components of the cell and cell membranes	<i>Chapter 2</i>
3	Jan 29	Membrane transport and Membrane Potentials	<i>Chapters 11-12</i>
4	Feb 5	DNA, Chromosomes, Replication, RNA	<i>Chapters 5-7</i>
5	Feb 12	Control and Gene Expression	<i>Chapter 8</i>
6	Feb 19	Protein structure and the basic machinery of protein synthesis	<i>Chapter 4</i>
7	Feb 26	MIDTERM EXAM	

8	Mar 4	Introduction to Cell signaling and how cells “think”	<i>Chapter 16</i>
9	Mar 11	No Class – Spring Break!	
10	Mar 18	The cytoskeleton, molecular motors and how they are regulated	<i>Chapter 17</i>
11	Mar 25	The life and death of a cell and how it is regulated	<i>Assigned Articles on Canvas</i>
12	April 1	Redox biology	<i>Assigned Articles on Canvas</i>
13	April 8	Bioenergetics and mitochondrial function	<i>Assigned Articles on Canvas</i>
14	April 15	Make up time and carry over material	
15	April 22	FINAL EXAM	

SUCCESS AND STUDY TIPS

The instructor encourages 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.

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