PHY315 Biological and Medical Physics

Lectures Tues/Thurs 11:00AM - 12:20PM
Physics Building 208

Prof. Alison (Ali) Patteson (she/her/they)
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Course Website: Using Blackboard and this Dropbox Folder.
Office Hours:
Thursdays 2-3 PM, My office 209 Physics
Fridays 3-4 PM, Coffee and Cookie Time, My office 209 Physics

Course Description. Biological physics is a rapidly growing field of physics that encompasses research at the interface of physics of and biology. Biological physics is comprised of many different research topics, including the structure of DNA to the treatment of cancer and the understanding of viral infections. Central to biophysics is an understanding of statistical mechanics, transport processes, and soft matter physics, which will be introduced in this course. Hands-on projects and problem-based active learning techniques will be used to gain an understanding of key concepts. This course will also further develop foundational thinking and methods that are fundamental to interdisciplinary science and hone student's critical reasoning and science communication skills.

Prerequisite. PHY212 or PHY216

Learning Outcomes:

After completing this course, students will be able to

- Apply key principles in evaluating and analyzing biophysical scenarios using both a conceptual understanding and calculations
- Devise, implement, and refine an experiment to assess biophysics questions using appropriate statistical and computational methods to interpret the data and draw valid scientific conclusions.
- Effectively communicate biophysics content through both written reports and oral presentation
- Critically review and communicate scholarly research and data in the biophysics field.

Textbook. This course will be based largely on the textbook "Physical Models of Living Systems", 2nd edition, by Philip Nelson. **You will need to purchase or rent the textbook** for this course. The e-book is available from Amazon for $9.99. Note that this fixed-format book works best on a big screen, e.g. Kindle app for a laptop or desktop computer.

Course content will be drawn from this book and supplemented with other readings and assignments throughout the semester. We will use a secondary textbook "Biological Physics: Energy Information, Life", by Philip Nelson. The e-book is available for $9.99 from Amazon. Its ISBN number is 978-0-578-69547-1.

Email Policy. Please start you email to me with the subject header "PHY315:" followed by a relevant phase related to the question. If you do not include "PHY315:" in you title, I may miss your email.

Class Format. The class will meet in-person during the scheduled class time Tues-Thurs 11 AM-12:30 PM. You will have **pre-reading assignments** about every week with questions to be completed before class lectures. There will be additional time in class reserved for **in-class assignments**, which include activities such as group work, problem sets, discussions, and presentations for you to earn points. You may need time outside of class to finish these assignments. There will be additional readings and discussions on biological and medical physics and its societal impacts. This will be an active learning class, the quality of which depends on your engagement and participation.

Assessment & Grading. You will be assessed in a variety of ways in this course. The main types of activities will be: (1) pre-class reading assignments, (2) class assignments and group work, (3) societal impact assignments and (4) a final project.

Pre-class Reading Assignments. I will read your pre-class assignments and use them to seed discussions in class, so your work needs to be submitted on time! Pre-class assignments will be based 50% on putting in a reasonable effort and 50% on accuracy. I will drop the two lowest pre-class assignment scores.

In-Class Assignments and Group Work. In class, you will work in groups on assigned problem sets. Any problems not completed during class will be assigned as homework and due within 1-1.5 weeks at the start of class Thursdays. Remember to work together in class and outside of class to complete the problems. You can miss up to 2 in-class group assignments due to anything. If you are out for an extended period and miss more in-class assignments, you will need a valid excuse.

Societal Impact Assignments. We will have six societal impact assignments throughout the semester. These assignments include assigned reading materials, written questions, and an in-class discussion.

Final Project. The final project will consist of 10–15-minute presentation on a biological or medical physicist of your choice. You will choose the physicist by the midpoint of the course. You will be assessed via a rubric shared in advanced and you will hand in a draft of your presentation for feedback before final presentations.

Gaining Points: I want you to learn the material, not just go through the motions. Thus, you can earn up to an additional 50% credit on any written assignment submitted before the end of the semester. (Limit 1 regrade opportunity per assignment).

The tentative distribution of points used in determining your final grade will be:

Pre-Reading Assignments	(20%)
In-Class Assignments & Group Work	(40%)
Societal Impact Assignments	(20%)
Final Project	(20%)

Grade*	Grade Points*	Grade*	Grade Points*
A	92+	C+	78-80
A-	90-92	C	72-78
B+	88-90	C-	70-72
B	82-90	D	64-70
B-	80-82	F	<64

Working with peers on assignments. I strongly encourage collaboration and discussion amongst yourselves in completing assignments. Each group will develop its own group work rubric and you will be grading each other on group work as a component of your grade. Studies show that students who study in groups together learn better and earn higher grades than those who work alone. However, all submitted work and final written answers must be your own. We may impose a grade sanction up to course failure for any instance of academic dishonesty. Syracuse University's Academic Integrity Policy governs general expectations for students and is incorporated into this syllabus for reference.

Biological and Medical Physics and Societal Impact Assignments

Our six **societal impact assignments** will focus on:

1. We first read articles on topics such as drug development and the patent process (what happens when there is a patent dispute) (Ledford 2017),
2. Why drugs are so expensive (Vincent Rajkumar 2020),
3. How the rise of misinformation is creating hurdles to public health (Ball and Maxmen 2020).
4. We also examine examples of high-profile retractions of scientific literature, exploring instances of the mistreatment of graduate students in academia (Check Hayden 2008).
5. Articles about the spread of misinformation and the research conducted to monitor and combat false information on social media platforms (Ball and Maxmen 2020).
6. How the pandemic has disproportionately affected the careers of women and minorities in the sciences and erased so much of the progress in equity that had been gained in the past three decades (Woolston 2020).

SCHEDULE

This schedule is tentative and subject to change.
An Up-to-date class schedule will be kept here.

		Biophysics Topic	Notes
1	Aug 28	Chapter 1 - Introduction and Viral dynamics	
2	Sept 4	Chapter 2 – Physics and Biology; *+Python coding introduction*	
3	Sept 11	Chapter 3 – Randomness in Biology	Ali at conference in Banff; Substitute instructor Tuesday/Thursday
4	Sept 18	Chapter 4 – Discrete Distributions *Discussion 1*	
5	Sept 25	Chapter 5 – Continuous Distributions *Discussion 2*	
7	Oct 2	Chapter 6 – Random Walks on an Energy Landscape *Discussion 3*	
8	Oct 9	Chapter 7 – Model Selection and Parameter Estimation	**Fall Break** – No class Tuesday the 10th Topics for final presentations submitted
9	Oct 16	Chapter 8 – Single Particle Reconstruction + *+Hands on project with image analysis of colloids*	Ali Visiting University of San Diego Friday Oct 20

10	Oct 23	Chapter 9 - Poisson Processes	Ali Visiting Rice University, Tuesday Oct 24
11	Oct 30	Chapter 10 – Randomness in Cellular Processes *Discussion 4*	
12	Nov 6	Chapter 11 – Negative Feedback Control *Discussion 5*	November 9 – Ali at Cornell
13	Nov 13	Chapter 11 – Negative Feedback Control *Discussion 6*	Submit a rough draft of presentation/project for feedback
14	Nov 20	THANKSGIVING BREAK	No class
15	Nov 27	*+Traction force microscopy*	Dec 1 – Ali in Boston to speak at Harvard
16	Dec 4	No Class Tuesday – Work on Final Project Final Presentations Started Thursdays	Ali in Boston for ASCB Tuesday
17	Dec 11	Last Class Tuesday - Final Presentations Continued	

Inclusion, Equality, and Dignity

Everyone in this class is an equally-valued member of this university and our community. We expect you to treat your classmates as honored colleagues in the collective endeavor we are all involved in: to understand the natural world and use that understanding to improve our society.

In particular, bias against anyone in our class because of their gender or how they express it, their sexual orientation, their religion, their national origin, their race or ethnicity, or a disability they may have will not be tolerated. If you are the target of this sort of bias or if you witness it, please report it directly to me and I will take swift action. If you don't feel comfortable talking to me, you may report it anonymously to the Physics Department at https://docs.google.com/forms/d/e/1FAIpQLScNduLL1hc9fJu5MRaKjajJFnlTDiDio0xvqprn9kCXDpS2Cg/viewform .

SU Physics Department Diversity and Inclusion Statement. Our mission is to drive discovery in physics and its related fields, to educate the next generation of physicists, and to convey the excitement and importance of scientific discovery to the community at large. Our capacity to advance this mission hinges critically on a diverse and inclusive physics community--a community in which every individual, regardless of gender, gender identity, sexual orientation, race, ethnicity, socio-economic status, veteran status, disability, nationality, political or religious views, or position within the department, is treated with dignity and respect, and their contributions are valued. We acknowledge that a history of unequal access has homogenized our field, thus limiting the scope of

discovery and education. We, therefore, commit to increasing the numbers of underrepresented faculty, students, and staff in our department and to enhance inclusivity by insuring equal access to opportunities and resources and fostering a welcoming and positive workplace culture so that every physics department member can fully realize their potential and contribute to the success of our mission.

Syracuse University's academic integrity policy. Syracuse University's academic integrity policy reflects the high value that we, as a university community, place on honesty in academic work. The policy defines our expectations for academic honesty and holds students accountable for the integrity of all work they submit. Students should understand that it is their responsibility to learn about course-specific expectations, as well as about university-wide academic integrity expectations. The university policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same written work in more than one class without receiving written authorization in advance from both instructors. The presumptive penalty for a first instance of academic dishonesty by an undergraduate student is course failure, accompanied by a transcript notation indicating that the failure resulted from a violation of academic integrity policy. The presumptive penalty for a first instance of academic dishonesty by a graduate student is suspension or expulsion. SU students are required to read an online summary of the university's academic integrity expectations and provide an electronic signature agreeing to abide by them twice a year during pre-term check-in on MySlice. For more information and the complete policy, see http://class.syr.edu/academic-integrity/.

Disability-Related Academic Adjustments. If you believe that you need academic adjustments (accommodations) for a disability, please contact the Office of Disability Services (ODS), visit the ODS website– http://disabilityservices.syr.edu, located in Room 309 of 804 University Avenue, or call (315) 443-4498 or TDD: (315) 443-1371 for an appointment to discuss your needs and the process for requesting academic adjustments. ODS is responsible for coordinating disability-related academic adjustments and will issue students with documented Disabilities Accommodation Authorization Letters, as appropriate. Since academic adjustments may require early planning and generally are not provided retroactively, please contact ODS as soon as possible.

Equal opportunity, inclusion and resolution services. The Code of Ethical Conduct is a statement of principles guiding the activities of all faculty, staff, and students. It provides, in part, that we: Respect the rights and dignity of all persons and recognize that discrimination or harassment in any form undermines the fundamental principles of the University; and Support a respectful environment through our own actions, encourage respectful behavior in others, and speak out against hatred and bias. Additional information can be found at www.syr.edu/hcd/equal-opportunity.html. If you have any concerns about these matters, write to the Office of Equal Opportunity, Inclusion and Resolution Services at titleix@syr.edu.

Religious observances policy. SU religious observances notification and policy, found at http://hendricks.syr.edu/spiritual-life/index.html, recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holidays according to their tradition. Under the policy, students are provided an opportunity to make up any examination, study, or work requirements that may be missed due to a religious observance provided they notify their instructors before the end of the second week of classes for regular session classes and by the submission deadline for flexibly formatted classes. For fall and spring semesters, an online notification process is available for students in MySlice /

StudentServices / Enrollment / MyReligiousObservances / Add a Notification. Instructors may access a list of their students who have submitted a notification in My Slice Faculty Center.

Class Roster

Last Name	**First Name**	**Email**
Collard De Beaufort	Jonathan	jcollard
Drew	Charles	crdrew
Gorczynski	Skylar	sagorczy
Majewski	Payton	pjmajews
Martin	Ariana	amarti38
Perry	Adam	aperry09
Sarabia	Lucas	lrsarabi
Short	Maximus	mbshort
Wu	Xiaoti	xwu110
Yuen	Jackson	jyyuen