

PHY315 Biological and Medical Physics

Lectures Tues/Thurs 11:00AM – 12:20PM
Life Science Complex 306

Prof. Alison (Ali) Patteson (she/her/they)

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Course Website: Using Blackboard and this [Dropbox Folder](#) occasionally.

Cookies and Biophysics Time: Thursdays 3–4:30 PM, My office LSC 385, starting 2nd week

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.

Email Policy. Please start your email to me with the subject header “PHY315:” followed by a relevant phase related to the question. If you do not include “PHY315:” in your 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 broader impacts.

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) in-class assignments and group work, (3) broader impacts 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 without any impact on your grade. If you are out for an extended period and miss more in-class assignments, you will need a valid excuse.
- **Broader Impacts Assignments.** We will have five broader impact assignments throughout the semester. These assignments include assigned reading materials, written questions, and an in-class discussion.
- **Final Project.** There will be a creative final project for this course with an associated presentation. More details to come. You will be assessed via a rubric shared in advanced and you will hand in a draft of your project 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%)	Grade*	Grade Points*	Grade*	Grade Points*
In-Class Assignments & Group Work	(20%)	A	92+	C+	78–80
Mini-Projects	(20%)	A–	90–92	C	72–78
Broader Impact Assignments	(20%)	B+	88–90	C–	70–72
		B	82–90	D	64–70
Final Project	(20%)	B–	80–82	F	<64

Instructor's Role. You are my team, and I am your coach. The goal is to learn as much biophysics as we can in the course together. I have made this an active, engaging course because research says that is the best for students to learn. I will do my best to communicate all expectations for the course. The success of this course depends on your input and engagement!

Course Values. This course may be very different from ones you have had before. There are certain values that will help us make this course successful. These values will guide us as individuals and collectively.

Grit. Grit is the ability to show up day after day to work on your craft. Mistakes are okay and are expected. It is like playing Mario. You will lose many times, as you learn to play the game. Studies show that grit is the number one indicator of someone's success. I have only gotten here by continuing, one mistake after another.

Teamwork. The workforce of the future needs to be able work together in collaborative projects with those from diverse background and training. This is true in physics as well. The lone physicist is a myth. We will work together in groups to hone our teamwork skills, and, as studies have shown, improve our learning of the material.

Flexibility. I teach this class in a very dynamic way, so that I can best capture your attention and interest in the material to motivate you to learn biophysics and train you in the multifaceted skills a biophysicist needs to do their job. Aspects of the course are subject to change, given different constraints on our time together and what I can do in preparation each week. I aim to communicate course changes in advance and keep the course organized.

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.

SCHEDULE

This schedule is tentative and subject to change.

An Up-to-date class schedule will be kept in the Course's [Dropbox Folder](#).

		Biophysics Topic	Notes
1	Aug 26	Chapter 1 - Introduction and Viral dynamics	
2	Sept 2	Chapter 2 - Physics and Biology; <i>+Python coding introduction</i>	
3	Sept 9	Chapter 3 - Discrete Randomness <i>Discussion 1 Thurs</i>	
4	Sept 16	Chapter 4 - Discrete Distributions	
5	Sept 23	Chapter 4- Discrete Distributions Continued <i>+Hands on work with micropipettes, cell counting/hemocytometers</i> <i>Discussion 2 Thurs</i>	
6	Sept 30	Guest Lecturer/s, <i>+Hands on work of Luria-Delbruck experiments</i>	Ali away this week for Physics of Cancer Meeting; Guest Lecturer
7	Oct 7	Chapter 5 - Continuous Distributions <i>Discussion 3 Thurs</i> <i>+Introduction to microscopy and image formation</i>	

8	Oct 14	Guest Lecturer Thursday, Dr. Minh Thanh <i>+Traction force microscopy (lecture, experiments)</i>	Fall Break – No class Tuesday the 15 th Ali away Thursday; Giving Seminar at Penn State
9	Oct 21	Chapter 6 – Random Walks on an Energy Landscape <i>+Introduction to Image Analysis and ImageJ/Fiji</i> <i>Discussion 4 Thurs</i>	
10	Oct 28	Chapter 7 Model Selection and Parameter Estimation <i>+Traction force microscopy code</i>	
11	Nov 4	Chapter 8 – Single Particle Reconstruction <i>Discussion 5 Thurs</i>	
12	Nov 11	Chapter 9 – Poisson Processes	
13	Nov 18	<i>Catch-Up Time</i>	Submit a rough draft of final project for feedback
14	Nov 25	THANKSGIVING BREAK	No class
15	Dec 2	Chapter 10– Randomness in Cellular Processes <i>+ Lecture on giving scientific presentations.</i>	
16	Dec 9	Last Class Tuesday – Final Presentations Continued	

*There will at least one special guest speaker for the course. Details TBD.

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 using the QR codes posted around the building.

Class Roster

Name	Email Address
Reeves,Alexis	grreeves@syr.edu
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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)– <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.