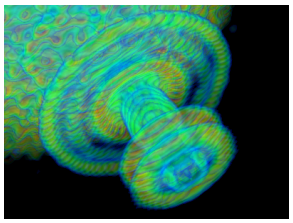

Physics 490/590: Biophysics

Winter 2021

- Instructor: Jay Nadeau, 370 Science Research and Teaching Center, nadeau@pdx.edu, 503-725-8929
- Course Website: https://d2l.pdx.edu/

Course Description
PH 490/590 is a biophysics course designed to introduce physical scientists to the principles and techniques of biophysics. The first section will focus on the key molecules involved in biophysics (proteins, nucleic acids) and the basics of cell biology. Later sections will focus on the thermodynamics and statistical mechanics of biological processes and quantitative descriptions of key phenomena such as Brownian motion, diffusion, action potential firing, and transport.
Prerequisite: Mth 251 (Calculus I); PHY211/221
Zoom meetings: TR 2:00-3:50 pm
Dates: January – March, 2021
Book: The required textbook for this course is ***Biological Physics*** by Philip Nelson. This text is available as a low-cost Student Edition and it is highly recommended that you buy a print copy.

Homework: There is weekly assigned homework. Homework questions will be taken from the book and other sources. All homework will be assigned at the beginning, so if you wish to turn them in early, you're free to do so.

In-class student presentations: Please pick a topic that interests you from the material in the class, and find a paper in the scientific literature on the topic. Sign up for a presentation slot (see Course Schedule). As an alternative to presenting a paper, you may perform a simulation using a specific biophysics software package and present the software and your simulation to the class (example: map a plasmid and clone a gene *in silico*; do a genome search for a specific gene or class of genes; model a reaction; model a protein/ligand interaction; many more).

Exams: None.

Lectures and Zoom meetings: There will be recommended lectures to watch off-line. When we meet on Zoom during class hours, we'll focus on solving problems. After the meeting you will turn in your solution. If you choose not to attend, you will still be asked to turn in a solution to the problem. The problems will be given in advance, so if you find that day's problem easy, you can skip attending. We will also have student presentations during the last 5 weeks of class or so (depending upon number of students).

Grading
The grade of each exam and the course will follow this scale
A: 89-110%
A-: 85-88%
B+: 82-84%
B: 75-81%
B-: 70-74%
C+: 67-69%
C: 60-66%
C-: 55-59%;
D: 40-54%
F <40%

Calculating grades
Grade is calculated as Homework (65%)+ in-class presentation (35%)

POLICY STATEMENTS
Academic Honesty: "Academic honesty is a cornerstone of any meaningful education and a reflection of each student's maturity and integrity. The Code of Student Conduct and Responsibility, which applies to all students, prohibits all forms of academic cheating, fraud, and dishonesty. These acts include, but are not limited to: plagiarism, buying and selling of course assignments and research papers, performing academic assignments (including tests and examinations) for other persons, unauthorized disclosure and receipt of academic information, and other practices commonly understood to be academically dishonest" – Portland State University Bulletin, General Catalog Issue, Vol. 50, 2016-2017.
Title IX – Portland State is committed to providing an environment free of all forms of prohibited discrimination and sexual harassment (sexual assault, domestic and dating violence, and gender or sex-based harassment and stalking). If you have experienced any form of gender or sex-based discrimination or harassment, know that help and support are available. PSU has staff members trained to support survivors in navigating campus life, accessing health and counseling services, providing academic and on-housing accommodations, helping with legal protective orders, and more. Information about PSU's support services on campus, including confidential services and reporting options, can be found on PSU's Sexual Misconduct Prevention and Response website at: http://www.pdx.edu/sexual-assault/get-help or you may call a confidential IPV Advocate at 503-725-5672. Please be aware that all PSU faculty members and instructors are required to report information of an incident that may constitute prohibited discrimination, including sexual harassment and sexual violence. This means that if you tell me about a situation of sexual harassment or sexual violence that may have violated university policy or student code of conduct, I have to share the information with my supervisor or the University's Title IX Coordinator or the Office of Affirmative Action. For more information about Title IX please complete the required student module Creating a Safe Campus in your D2L.

Disability Accommodations at PSU – PSU values diversity and inclusion; we are committed to fostering mutual respect and full participation for all students. My goal is to create a learning environment that is equitable, useable, inclusive, and welcoming. If any aspects of instruction or course design result in barriers to your inclusion or learning, please notify me. The Disability Resource Center (DRC) provides reasonable accommodations for students who encounter barriers in the learning environment. If you have, or think you may have, a disability that may affect your work in this class and feel you need accommodations, contact the Disability Resource Center to schedule an appointment and initiate a conversation about reasonable accommodations. The DRC is located in 116 Smith Memorial Student Union, 503-725-4150, drc@pdx.edu, https://www.pdx.edu/drc.

Course Schedule (subject to change as announced in class and on d2l)

Week	Dates	Topics, Readings, Assignments, Deadlines
1	**1/05/21** **1/07/21**	**Day 1**: The building blocks of biology (Text Chapter 2) https://www.youtube.com/watch?v=9Q2ZX48gc7I&list=PLp0hSY2uBeP_0TWW3UhKqf_AKGodTSuIb Zoom meeting: PyMol and other tools for building molecules **Day 2**: Building blocks continued https://www.youtube.com/watch?v=mo4pjLgDZV4 Zoom meeting: more PyMol, DNA cloning software
2	**1/12/21** **1/14/21**	**Day 3**: Introduction to biological thermodynamics (Text Chapter 1) https://www.youtube.com/watch?v=Ntdqft89_e4 Zoom meeting: work through problem 1.3 **Day 4**: Entropy and internal energy (Chapter 1) https://www.youtube.com/watch?v=RrVq7Yduz2g&list=PLA62087102CC93765&index=3 Zoom meeting: Dimensional analysis problem **Homework 1 due: Chapter 2**
3	**1/19/21** **1/21/21**	**Day 5**: Statistics and thermodynamics (Chapter 3) https://www.youtube.com/watch?v=xgUCzL3TD1g&list=PLA62087102CC93765&index=25 **Day 6**: Zoom meeting: Problem 3.2 Boltzmann distribution/structure of DNA (Chapter 3) https://www.youtube.com/watch?v=0GNNW553IVY&t=2619s Zoom meeting: DNA combinatorics **Homework 2 due: Chapter 1**
4	**1/26/21** **1/28/21**	**Day 7**: Diffusion and random walks (Chapter 4) **https://www.youtube.com/watch?v=2CKSuAZV7AQ&list=PLFn7fvIP7CbMun4daH24AZzX3r7ETT6aD&index=20** Zoom meeting: problem 4.1 **Day 8**: Diffusion in biological problems (Chapter 4) https://www.youtube.com/watch?v=j5IWC4Bpfqk Nernst equation: What is a membrane potential? https://www.youtube.com/watch?v=vYcAHameIGw Zoom meeting: Problem 4.2 **Homework 3 due: Chapter 3**
5	**2/2/21** **2/4/21**	**Day 9**: Life at low Reynolds number (Chapter 5) https://www.youtube.com/watch?v=gZk2bMaqs1E Zoom meeting: Problem 5.2 **Day 10**: Microbial motility: flagella and swimming patterns (Chapter 5) https://www.youtube.com/watch?v=TuXFwKrWQg8 Zoom meeting: Problem 5.4 **Homework 4 due: Chapter 4**
6	**2/09/21**	**Day 11**: Entropy in thermodynamics and stat mech (Chapter 6) Note: the recommended lectures are part of Kardar's excellent Stat Mech course. If you

Week	Dates	Topics, Readings, Assignments, Deadlines
		like stat mech, watch all the lectures. These are among the best lectures I have ever heard. https://www.youtube.com/watch?v=EQB2Pw0lWRU Zoom meeting: Problem 6.2
	2/11/21	**Day 12**: Helmholtz free energy and thermodynamic relations (Chapter 6) https://www.youtube.com/watch?v=JaEqS1ozlHY Zoom meeting: Entropy problem **Homework 5 due: Chapter 5**
7	**2/16/21**	**Day 13**: Partition function and 2-state systems (Chapter 6) https://www.youtube.com/watch?v=2BJYXuZZK3c Zoom meeting: Problem 6.5
	2/18/21	**Day 14**: Osmotic pressure and flow (Chapter 7) https://www.youtube.com/watch?v=qsFzIv3PHz8&t=974s Zoom meeting: Problem 7.3 **Homework 6 due: Chapter 6**
8	**2/23/21**	**Day 15**: Electrostatic interactions (Chapter 7) https://www.youtube.com/watch?v=Z5tZlfSwHrk Zoom meeting: Problem 7.7
	2/25/21	**Day 16**: Water (Chapter 7) Zoom meeting: Problem 7.6 **Homework 7 due: Chapters 6-7**
9	**3/2/21**	**Day 17**: Neurons and action potentials (Chapter 12) https://www.youtube.com/watch?v=HZh0A-lWSmY https://www.youtube.com/watch?v=oa6rvUJlg7o Zoom meeting: Problem 12.1
	3/4/21	**Day 18**: Hodgkin-Huxley equations (Chapter 12) https://www.youtube.com/watch?v=88tKZLGOr3M Zoom meeting: Problem 12.8 **Homework 8 due: Chapter 7**
10	**3/09/21** **3/11/21**	Day 19: Student presentations Day 20: Student presentations **Homework 9 due: Chapter 12**
Final Exam		None