Course Syllabus, Fall term 2021
Biosc 1810 – Macromolecular Structure and Function
Dr. Tony Schwacha

This course largely focuses on the chemistry of proteins, key biological molecules that provide both the overall structure of an organism as well as carry out all of the chemical reactions needed for life. In particular, we will study protein structure, the details of how proteins facilitate chemical catalysis, how the genetic code is used to make proteins, and how proteins are used in membrane transport. Additionally, we will examine critical methodology used to manipulate and study protein structure and function. Pre-requisites for this course include 2 semesters of Foundations in Biology, General Chemistry, and Organic Chemistry. In addition, the completion of assignments in this course will require that you have access to either a Windows or OS X-based computer and have the necessary skills to install basic software on it. *NOTE: As this is an advanced course intended for hardcore Molecular Biology majors, it will emphasize an experimental research perspective and be conducted insofar as feasible at a near-graduate student level. We will not be spending much time reviewing topics covered in your prior courses. If your academic background is weak or this level of course engagement does not seem like fun to you, you should consider taking Biosc 1000 instead…*

Meetings: Depending upon the COVID situation, lectures will be M/W/F at 1:00-1:50 PM either in Langley A221, or via ZOOM (links on the course Canvas site)

Textbook: Lehninger, *Principles of Biochemistry*, 8th Edition (ISBN:9781319230906). This book will also be used in Biosc 1820 next term. In addition, there are 2 copies of the new 8th addition on reserve for this course in the central STEM library located in Benedum Hall.

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Website: All course information will be provided through Canvas course site linked to your Pitt account.

Head Fella: Dr. Tony Schwacha (schwacha@pitt.edu)
560 Crawford Hall
Phone (412) 624-4307
Office hours: Tuesdays from 4:30-5:30 or by appointment
E-mail is the best way to contact me

UTAs: -Daisy Mandl TCM43@pitt.edu or via GroupMe
-Bethany Hileman BAH105@pitt.edu

Both Daisy and Bethany are proud graduates of my 2020 Biosc 1810 course. They will hold office hours on Tuesdays at 1 PM in Clapp 102 (or via ZOOM if necessary) and are happy to set-up individual meetings by appointment.

Additions as of 090821 – resuming live lectures.

Main issue – As current Pitt policy, *everyone needs to wear a mask while in class and in the building.* If you lack a mask, I will ask you to leave. As a favor to me and your classmates, please obey this rule so I don't need to play policeman.

Building access – As some of you know, most of the doors of the Biology complex remain locked. To attend lecture (Langley A221), enter via the Langley lobby. You will need to scan your Pitt ID

card and must have a mask on. Security guards in the lobby will check and enforce these issues. To reduce congestion and promote better social distancing, please enter lecture in the front of class at the bottom level and leave lecture from the back of class at the top level.

Course issues – We will resume live lectures on Monday September 13th, and it is the University's intention to discontinue remote teaching at this time. However, I currently plan to continue recording lectures and posting the links on our site so that you can access them if you have COVID and need to stay home. Note however that these recordings are NOT meant as a substitute for routinely attending class (see below). For lecture recording I will need to bring a large Department-endorsed webcam to class, and given this additional complication I do not know how well the recording process will work. For at least the foreseeable future, we plan to hold recitations and office hours via ZOOM using the links listed in Canvas.

Prior to COVID, I would usually have the lecture Powerpoint slides pre-printed for you as a handout and distribute them to the class at the start of lecture. However, since I will be lugging around the webcam (as well as my laptop), I will not be able to bring a big pile of lecture handouts to class. As the lecture notes are available on our Canvas site, please print them out before class and bring them with you if you wish to take notes on them.

Attendance issues – This course is designed to function fully in-person beginning September 13. Requests for remote attendance will not be reviewed by myself or the department. If you believe you have a qualifying disability that prevents you from attending in-person instruction this semester, *please contact Disability Resources and Services.* If you are quarantined due to COVID-19, you may temporarily participate remotely by providing documentation. Under either of these circumstances, you may elect to preserve your privacy by not using video and by identifying yourself in Zoom using your initials or an alias that you have shared with me.

Lectures and recitations: As much as possible I plan to record the lectures and post the corresponding links on our Canvas course site. We however plan to hold recitations via ZOOM. All course material and information will be posted on the Canvas site for the course. If the COVID risk level increases and the University falls back to an elevated risk posture, we will revert to a Zoom-based format.

Generally, the Powerpoint presentations will be available on Canvas prior to the corresponding lectures so that you can review the lecture material in advance; however, these notes are intentionally incomplete and it is your responsibility to attend lecture and complete the remaining information. In addition, most meetings will have assigned readings and sample problems either from the book or from handouts provided in Canvas. The answers to the problems are either in the back of the book or will be posted on Canvas. Except for the 2 graded problem sets (more below), the problems posted for each lecture are to help prepare you for quizzes/exams and will NOT be graded or collected.

Daisy and Bethany will be holding recitations on Thursday evenings at 8 PM via ZOOM (I will provide Zoom links in our canvas site). Provisionally, these recitations will go over the week's assigned problems or address questions on lecture material. Recitations are a strongly recommended part of this course and a small part of your grade will be based upon your attendance (more below).

Note: This course rapidly covers an unusually large amount of material. To be successful, you will need to actively expend considerable effort to keep up with the lectures and assigned readings and problems. Continually review your notes, attend office hours as needed, and participate during recitations.

Problem sets. To provide hands-on opportunity to analyze either real scientific data or design recombinant DNA constructs, you will be assigned two graded problems sets. Each of them will require quite a bit of

computer work and you will have 2 weeks to complete each of them. The first problem set will require OS X/Windows software available for free through Pitt (GraphPad Prism), while the second will largely use free software available on the internet. Both problem sets are meant to be challenging. I will be providing you with basic information and the overall goal of these problem sets, but not necessarily with all the little details that you will need for successful completion. You are expected to do a little thinking on your own. To assist you, the problem sets will be a group project, and I will open a Discussion board on Canvas so that you can help one another (The UTAs will also be monitoring the Discussion board and will be assisting as needed). Note that although it will be possible for some of you to complete these assignments by depending upon the kindness and brains of your colleagues, these problem sets are meant as practice for questions that you can expect to see on either the midterm or final exam…

Exams and Grades: Your final grade will be determined by your grades by 3 quizzes, 2 problem sets, a midterm, and a final exam. There will be 4 hourly in-class quizzes that will be administered throughout the course; the lowest of these quizzes will be dropped from your final score. In addition, there are 2 problem sets (on protein/ligand binding, and recombinant DNA techniques) that you will also need to turn in. Seventy percent of you grade will come from the midterm and final exam. The Midterm will cover the first half of the course (the nitty-gritties of protein structure, function, and kinetics). The final is NOT cumulative and will only cover the second half of the course (nucleic acids, the central dogma, lipids and membranes, and bio-signaling).

Note that this course has no options for any extra credit.

However, if your final score teeters between two grades, special consideration will be shown to those who participate in the course. Normally, I set the final grade cutoffs and enforce them with no "rounding". The UTAs will be keeping track of your attendance during recitation and office hours. *For those who attend at least 3 recitations/UTA office hours in the first part of the course (prior to the midterm) as well as 3 such meetings in the second half of the course (prior to the final), should your final grade fall with 2% of the wrong side of a cutoff,* ***I'll round your grade up to the next level.***

Your final grade will be determined by your total points earned for the semester. A total of 500 points are possible using the following criteria:

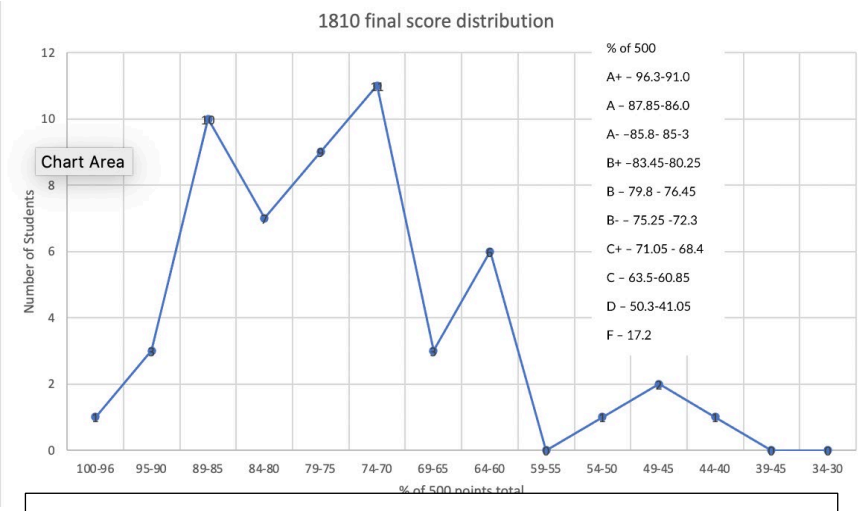
Criteria	**Total Possible**
Top three quiz scores (out of 4 total)	75 points total
2 problem sets	80 points total
Midterm	170 points
Final exam	175 points
Total	**500 points**

The following grading scale will be used:

92—100%	A
90—91%	A-
88—89%	B+
82—87%	B
80—81%	B-

78—79%	C+
72—77%	C
70—71%	C-
68—69%	D+
62—67%	D
60—61%	D-
59% and below	F

I do not have a set percentage for an A+, though I do sometimes give the grade. *If needed, I will move grade boundaries down ("curve").* **Any curve will only help you and will not penalize you compared to the straight grading scale.**



Note that the grades for 2020 were rather heavily curved.

Tests and Test Details: Quizzes and exams will be conducted *during the scheduled lecture time* (an alternative time maybe arranged if you have a very good excuse). You may request a regrade of any portion of a test by submitting it to me, along with a clear explanation of the relevant problem and your justification for the regrade, within three days from when you receive your test grade. Please be aware that your entire test may be reevaluated and any question that was graded incorrectly (in your favor) may also be regraded resulting in points deducted from your total.

As the lowest quiz grade is dropped, there are NO MAKE-UPS FOR THE QUIZZES AND NO OPTIONS FOR EXTRA CREDIT. If you miss a quiz, it will be counted as your lowest quiz grade and be dropped. If you miss more than 1 quiz, you will receive a "0" that will be averaged into the rest of your quiz grade. In contrast, there will be a make-up Midterm and Final exam for those with an excused absence (written proof from your doctor). If the final exam is missed, you will receive a "G" grade that will be converted into a letter grade once the make-up final is completed.

Internet and Computers: For this course in general and to complete the two problem sets in particular, it is absolutely essential that you have a working computer that is WiFi/internet capable and is compatible with Apple or Windows applications. In addition, it is expected that you are able to access posted course information on Canvas, have the ability to download and fill in Word documents, convert them to PDFs, and upload them using appropriate links in the course Canvas site.

Standard University Disclaimers:

Academic Integrity. Cheating/plagiarism will not be tolerated. Students suspected of violating the University of Pittsburgh Policy on Academic Integrity, noted below (**), will be required to participate in the outlined procedural process as initiated by the instructor. A minimum sanction of a zero score for a quiz, exam, or paper will be imposed.

** The integrity of the academic process requires fair and impartial evaluation on the part of faculty and honest academic conduct on the part of students. To this end, students are expected to conduct themselves at a high level of responsibility in the fulfillment of the course of their study. It is the corresponding responsibility of faculty to make clear to students those standards by which students will be evaluated, and the resources permissible for use by students during the course of their study and evaluation. The educational process is perceived as a joint faculty-student enterprise that will perforce involve professional judgment by faculty and may involve—without penalty—reasoned exception by students to the data or views offered by faculty. Senate Committee on Tenure and Academic Freedom, February 1974

Disability Resources. If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Office of Disability Resources and Services, 140 William Pitt Union, 412-648-7890/412-624-3346 (Fax), *as early as possible in the term*. Disability Resources and Services will verify your disability and determine reasonable accommodations for this course. For more information, visit www.studentaffairs.pitt.edu/drsabout.

E-mail Communication. Each student is issued a University e-mail address (username@pitt.edu) upon admittance. This e-mail address may be used by the University for official communication with students. *Students are expected to read e-mail sent to this account on a regular basis.* Failure to read and react to University communications in a timely manner does not absolve the student from knowing and complying with the content of the communications. The University provides an e-mail forwarding service that allows students to read their e-mail via other service providers (e.g., Hotmail, AOL, Yahoo). Students that choose to forward their e-mail from their pitt.edu address to another address do so at their own risk. If e-mail is lost as a result of forwarding, it does not absolve the student from responding to official communications sent to their University e-mail address. To forward e-mail sent to your University account, go to http://accounts.pitt.edu, log into your account, click on **Edit Forwarding Addresses**, and follow the instructions on the page. Be sure to log out of your account when you have finished. (For the full E-mail Communication Policy, go to www.bc.pitt.edu/policies/policy/09/09-10-01.html.)

Biosci 1810 Tentative Course Schedule Fall 2021

Week 1 – Proteins: an introduction			Lecture readings/problems
F	8/27	Term overview – Key course concepts	Chap. 1.2 and 1.3: problems 1-7,1-8,1-11,1-12,1-14,1-15, 1-23
Week 2 –water, weak interactions, pH and buffers amino acids, and protein primary structure			
M	8/30	Water, Weak interactions, acids/bases and buffers	Chap 2.1- 2.3/problems 2-4, 2-6, 2-10, 2-11, 2-12, 2-13, 2-15
W	9/1	Solving buffer problems with the Henderson-Hasselbalch equation	Chap 2.3 /problems 2-16, 2-20, 2-21, 2-22, 2-23, 2-24, 2-25, 2-26, 2-27, 2-32, 2-35
F	9/3	Amino acids and peptides, protein primary structure & determination	Chap. 3.1-3.4/problems 3-3, 3-5, 3-8, 3-13, 3-20, 3-22, 3-26
Week 3 – Protein purification and higher order structure			
M	9/6	Labor Day – no class	
W	9/8	Protein purification	Chap 3.3, 3.4/problems 3-6, 3-10, 3-12, 3-14, 3-15, 3-16, 3-17, 3-18, 3-19, 3-25
F	9/10	Protein secondary, tertiary, and quaternary structure	Chap 4.1-4.4/problems 4-1, 4-2, 4-4, 4-5, 4-7, 4-8, 4-11, 4-12, 4-18
Week 4 – Proteins: protein folding and structure determination I			
M	9/13	Protein folding and modification	Chap. 4.4, no problems
W	9/15	Basic structure determination – X-ray crystallography and electron microscopy	Chap 4.5/ 4-15, 4-16
F	9/17		Quiz 1 (lectures 8/27-9/13)
Week 5 – Ligand binding and cooperativity			
M	9/20	Protein cooperativity and ligand binding – hemoglobin and myoglobin	Chap 5.1/ problems 5-1, 5-2, 5-3, 5-4, 5-5, 5-7, 5-8, 5-9, 5-10, 5-11
W	9/22	Immunoglobulins and motor proteins	Chap. 5.2, 5.3/Problems 5-12, 5-13, 5-14, 5-15, 5-16
F	9/24	protein-ligand assays and analysis	Problem set 1
Week 6 – protein kinetics and active site function			
M	9/27	Working protein binding problems	Review session
W	9/29	Catalytic power and specificity of enzymes	Chap. 6.1, 6.2/problems 6-1, 6-2, 6-3, 6-4, 6-5, 6-6
F	10/1	Enzyme kinetics – Michaelis-Menten, steady state, kcat, Km, kcat/Km	Chap. 6.3/problems 6-7, 6-8, 6-9, 6-10, 6-11, 6-14, 6-16 **Problem set 1 DUE 5 PM**
Week 7 – Inhibition, protein reaction mechanisms and regulation			
M	10/4	Reversible inhibition, transition state analogs, competitive and uncompetitive	Chap 6.3 /Problems 6-12, 6-13, 6-15, 6-18, 6-20
W	10/6	Examples of enzymatic reactions	Chap. 6.4/ problems 6-19, 6-25
F	10/8	Regulatory enzymes and allostery	Chap. 6.5/ no problems
Week 8 – More kinetics			
M	10/11	Working kinetic problems	Review session
W	10/13		Quiz 2 (lectures 9/29-10/11)
F	10/15	Fall break no class	
Week 9 – prep for Midterm Exam			

M	10/18	Protein structure determination II	Everything in class, no problems
W	10/20	Review for midterm	
F	10/22	**Midterm Exam**	**Lectures 8/27-10/18**
Week 10 – nucleic acids I Structure/Function			
M	10/25	Basics – monomer and polymer	Chap. 8.1- 8.3/ problems 8-1, 8-2, 8-3, 8-5, 8-6, 8-7, 8-11, 8-12
W	10/27	Nucleic acid/protein interactions	Chap. 24.3, 28.1 (pp. 1060-1065)/ problem 24-9
F	10/29	Basic cloning and engineering I	Chap. 8.3, 9.1 9.2, problem 8-13, 9-1, 9-2, 9-3, 9-4, 9-5, 9-6, 9-8
Week 11 – nucleic acids II NA technology, central dogma			
M	11/1	Basic cloning and engineering II	problem set 2
W	11/3	Genomics/next generation DNA sequencing	Chap. 8.3 (pp. 302-303, 306-310), 9.2, 9.3/ 8-16, 8-18, 8-19, 9-11, 9-17, 9-18
F	11/5	Transcription and its regulation	Chap. 26.1, 28.1/problems 26-1, 26-2, 26-5, 26-9, 26-16 **Problem set 2 DUE 5 PM**
Week 12 – The Central Dogma and system engineering			
M	11/8	Translation and protein degradation	Chap. 27.1, 27.2, 27.3/problems 27-1, 27-3, 27-4, 27-17, 27-18
W	11/10	Transport across the nuclear membrane	All in class, no problems
F	11/12	System engineering approaches	Box 27-2 (1025-1027), no problems
Week 13 – Lipids			
M	11/15	Storage and membrane lipids	Chap. 10.1, 10.2/problems 10-1, 10-2, 10-3, 10-4, 10-7, 10-8, 10-12, 10-14, 10-16
W	11/17	Review session for quiz 3	
F	11/19		Quiz 3
M-F	11/22-11/26	Thanksgiving break	
Week 14 – Membrane transport			
M	11/29	Membrane structure and dynamics	Chap. 11.1-11.2 /problems 11-1, 11-4, 11-5, 11-6, 11-10, 11-11, 11-12, 11-14, 11-15
W	12/1	Membrane transport	Chap. 11.3/ problems 11-15, 11-16, 11-17, 11-19, 11-20, 11-21, 11-22, 11-23, 11-24, 11-26
F	12/3	Membrane protein purification	No problems
Week 15 – Bio-signaling			
M	12/6	Signal transduction, G-proteins	Chap. 12.1, 12.2, 12-3/ problems 12-1, 12-2, 12-3, 12-4, 12-9, 12-10, 12-11, 12-14
W	12/8	Receptor-mediated signal transduction	Chap. 12.4, 12.7/no problems
F	12/10	LAST DAY OF CLASS	Quiz 4
	TBD	**Review Final Exam**	
	TBD	**Final Exam**	
		Grades due on 12/20	