Brooklyn College
Department of Chemistry

CHEM. 4571 - W12 (20429)

Days and Times	Room	Instructo
We 12:45PM-2:15PM	Online	Richard Ma

Biochemistry I Lectures (Lecture)

Prof. Richard S. Magliozzo
Office Hours: Wednesdays immediately after class (2:15-3:15 pm); Friday mornings, 10-11:30.
e-mail: rmaglioz@brooklyn.cuny.edu

Important Dates: Please check on your own at the following site and also re-check often.
https://www.brooklyn.cuny.edu/web/about/administration/enrollment/registrar/bulletins/fall20/calendar.php

Note that we do not meet on Wed. Oct. 14 (Monday classes) or Wed. Nov. 25 (Friday classes).
I will update this document when necessary because dates for lectures and exams may change.

If you will observe a religious holiday during the course and can't take a quiz or exam on that day, you must notify me at the start of the semester in order to receive an accommodation.
If you are allowed test-taking or other accommodations, please also notify me now.

Course goals: to learn the foundations upon which modern biochemistry is understood, including the properties of water, amino acids, carbohydrates, lipids, proteins, nucleic acids, and the structure of macromolecules; hemoglobin structure and function; the basics of enzyme kinetics and function; and an introduction to metabolism.

Text: *Biochemistry*, 4th Edition, by Mathews, van Holde & Ahern (3rd Edition also OK); additionally: *Biochemistry*, by L. Stryer, W.H. Freeman & Co. (available free on *PubMed*- you need to search by topic/keywords); Biochemistry texts by other authors may be substituted but lecture material usually follows Mathews closely. I can lend one or two copies if I am allowed into my campus office.
Supplementary Text *Biochemical Calculations,* 2nd Edition, I.H. Segel, John Wiley & Sons. (optional but very useful to help learn problem solving; I will hand out some problems from this book):

I recommend using the Internet for searching other sources of information relevant to the course material as a tool for study but NOT just Wikipedia unless you look into the citations. Youtube videos from reliable sources on some of the processes we will discuss can also be useful.

Lecture slides/notes and assignments will be posted on *Blackboard*. All exams will be on Blackboard and **if you don't have a reliable Internet connection, notify me immediately**.

You will need a reliable Internet connection and a laptop/PC running Blackboard in the CHROME browser AND a smart phone for you to take exams with fair outcomes for all.

Send me an email when you have read through the whole syllabus to acknowledge this and to ask any questions.

Course Outline

The course is organized into "modules" that cover certain subject areas and use sections or whole chapters in the text. For example, the first module is about Coronavirus and will lead into the topics of non-covalent interactions, nucleic acid structure and function, protein structure and function and possibly a short segment on drugs and their targets.

We will cover most of the material in Chapters 1-6, (9?), 7, 11, 13, 14, 15 (in Mathews) in various formats; lectures at the regular class meeting times will be used mostly to discuss and review assigned material including annotated/audio lecture slides rather than a typical Powerpoint lecture. In certain cases at the start of the semester however, more typical lectures/Powerpoint slides will be shared. Please keep up with the assignments, readings, problem sets, etc. because time flies when you are having fun.

Occasional required assignments: 1) do the Review Quiz and please catch up on the "math" you need for that including an understanding of $\log_{10}$, **ln** and exponential functions, and some algebra; we will come across problems that are easy to solve with 2 simultaneous equations, for example; 2) find (using PubMed) recent original research articles related to material covered in class and when assignment is posted. summarize one or two, in one paragraph. You can login to the BC library to access full text of published articles- learn how to do this ASAP. These will NOT be graded but your submission of the title and abstract along with your summary will be accounted for as a required assignment. You will receive a grade of *INC* if these assignments are not handed in; 3) calculate and hand in a titration curve including an example of the calculations, for a weak acid with strong base and weak base with strong acid, when we cover that topic in class. Details when the assignment is posted; 4) Create your own set of test questions to share with the class to help with studying. I will also be posting old exam questions.

Grading/Exam Schedule (tentative) Dates subject to change: Exam I: Sept. 30; Exam II: Nov. 4; Final Exam Dec. 16. I may give some shorter quizzes on other dates as announced in advance.
Exams will have T/F, multiple choice, fill-in type questions to test your factual and conceptual understanding. *I may use individual live questioning if too many problems arise with remote testing procedures or issues about cheating arise.*

No "extra projects" for grading will be solicited or accepted. *NO make-up exams will be allowed. If you miss one exam, your semester average will be based upon the other two exam grades. You will not get a grade in the course if you miss two exams or the final exam*. The overall class exam average (usually around 68%) will establish a grade of "C" for the course.

Final grades will be calculated as the average of three exam grades (usually weighted 33% each but sometimes more weight given to the cumulative final if it improves averages) and may include quiz grades. Points for assignments/exercises will be announced when those are posted.

Lecture schedule (tentative and subject to change):

Module 1; Session 1.
Coronavirus- structure and function at the molecular level to introduce concepts and facts about nucleic acids, proteins and enzymes, immunology, vaccines. Various resources will be used.

Sessions **2-3**: What is biochemistry? Elements, molecules, macromolecules in biological systems. Non-covalent interactions and properties of molecules; Coulombic interaction energy; water, acid-base chemistry (ionic equilibria); pH and buffers (preparation, properties); blood pH regulation; buffer "capacity"; solubility of macromolecules; acid/base titrations. Tools of Biochemistry 2A. QUIZ.

Learning goals: gain understanding of the identity and properties of chemicals in biological systems; gain understanding of the various types of electrostatic (non-covalent) interactions between chemical species; improve skills for calculation of the composition of solutions of acids/bases and buffer solutions; interpret titration curve data.

Assignments: Week 2:choose a weak acid (such as formic acid, acetic acid, benzoic acid) and calculate/plot a titration curve for a 0.1 M solution of this acid with strong base using Excel. Do the same for a weak base (ammonia, TRIS) titrated with strong acid. Complete the Problem Set posted on Blackboard.

Sessions **4-6**: Review of thermodynamic principles useful in biochemistry; 1st and 2nd Laws; chemical equilibrium (isomerization example, omitted from Mathews 4th Edition); Gibbs' Free Energy; "high-energy" phosphate compounds; coupled reactions involving phosphoryl transfer; OMIT section on redox reactions.

Learning goals: gain understanding of the thermodynamics of processes occurring under constant V or constant P; gain understanding of chemical equilibria for typical reactions and coupled reactions; Gain understanding of the application of free energy equation to biochemical reactions.

Sessions **7-9**: Nucleic Acids; chemical/structural properties of nucleic bases; structural elements of monomers; base pairing/hydrogen bonding; polymerization; thermodynamics of polymerization; DNA, RNA structures/functions; commercial synthesis of DNA; sequencing and genome projects; basic molecular biology

(PCR, restriction enzymes); genes to proteins (transcription and translation, ribosomes). Tools of Biochemistry 4A, 4B.

Learning goals: gain understanding of how structural features of nucleic acids govern functional properties; learn basic chemical properties of nucleic acid subunits and macromolecules including hypochromicity; examine and understand features of enzymatic replication of DNA. Gain understanding of DNA synthesis including phosphoramidite reactions; gain understanding of modern sequencing methodologies; gain insights into ribosome structure, function and mechanism of protein biosynthesis. Tools of Biochemistry 5A, B.

Sessions **10-12**: Amino acids; structures, functional groups, acid/base properties (titrations); peptide bond; proteases; peptides and proteins; protein overexpression; protein structural analysis.

Learning goals: learn the structural/functional classification of the 20 amino acids; learn the three-letter code names (and single letter codes for extra credit at some point on exams); predict the overall charge on peptides as a function of pH, predict pI values.

Session **13**: 3-D structure of proteins; Ramachandran plots; secondary, tertiary, quaternary structure; examples of structural proteins, examples of globular proteins; collagen biosynthesis, post-translational modification; protein folding; structural predictions.

Learning goals: learn details of the geometry of the peptide bond, the α-helix, and β-sheet; interpret Ramachandran plots; learn the features of various structural proteins; learn the structural features of globular proteins; understand the thermodynamics of protein folding and the hydrophobic effect.

Session **14**: Myoglobin and hemoglobin structure and function; physiology of oxygen transport and storage; % saturation, p_{50} ($p_{1/2}$) and Keq for oxygen binding; cooperativity; Hill plot; allosteric effectors;

Learning goals: gain a quantitative understanding of ligand binding; gain an understanding of the mechanisms of allosteric effects in hemoglobin.

Session **15**. Enzymology (<u>demonstration/exercise done at home and data reported to the class for analysis</u>); Michaelis-Menten kinetic model; meaning of parameters K_M and V_{max}. Kinetics data collection and analysis. Introduction to metabolism- glycolysis

Learning goals: understand the development of the Michaelis-Menten equation from basic principles; gain an understanding of the relationship between *in vitro* measurements and their physiological relevance.

NOTE THE FOLLOWING: The faculty and administration of Brooklyn College support an environment free from cheating and plagiarism. Each student is responsible for being aware of what constitutes cheating and plagiarism and for avoiding both. The complete text of the CUNY Academic Integrity Policy and the Brooklyn College procedure for policy implementation can be found at www.brooklyn.cuny.edu/bc/policies. <u>If a faculty member suspects a violation of academic integrity and, upon investigation, confirms that violation, or if the student admits the violation, the faculty member MUST report the violation.</u>