Undergraduate Program in Biochemistry Website

11:115:403: General Biochemistry I

Offered

This is a lecture course which is offered each Fall, and Spring semesters. This course is the first semester of a two-semester integrated survey of biochemistry, the second half being General Biochemistry 404. The typically sequence is 403 in the Fall and 404 in the Spring, however, both courses are offered in the off semester.

Prerequisites and Registration Restrictions

Pre-requisites: 01:160:307-308 Organic Chemistry or 315-316 Honors Organic Chemistry with grades of C or better. For pre-requisite overrides or special permission contact Nalini Kaul at nalinik@sebs.rutgers.edu.

Format

Two 80-minutes interactive lectures per week with asynchronous readings and assignments.

This course will be delivered on a semi-flipped style of teaching. In a traditional classroom, a teacher presents some new information. Students take notes and go home to work through material and complete assignments on their own. In a flipped classroom, students are assignment material before classtime. This may be chapter readings, videos, homework, etc. Then once in class, students complete practical exercises using the material. In a fully flipped modality, there would be no formal instruction during class. This class hybridizes the traditional and flipped models. There will be pre-class material for the students to be introduced or review basic concepts. Then in class, students will do activities to increase understanding of the concepts and the teacher will introduce more complex or advanced material on the topic. Then there will be a homework assignment at the end of the chapter to help with learning.

This class switches around the traditional order of teaching with the purpose of creating a more in depth and supportive environment in the classroom when the teacher is present. This results in students understanding the content at a higher and deeper level than before.

What does this mean for students:

1. Students are expected to complete pre-class assignments, before the class. The pre-class material will vary but may include: readings, videos, quizzes, or review of previous material.

2. Students have the ability to watch video content at their own pace, re-watching, rewinding and pausing when needed.
3. Students have the ability to review material from other classes to refresh knowledge before class.
4. Students should set aside time to complete material before class.
5. Students should set aside time at the end of the chapter to review all material and complete chapter homework.
6. Students are not expected to have full mastery of material before class, but are expect to come to class prepared and ready to work on the material.
    - The goal of this design was to take review and basic concepts out of the class lecture and then use time in class to discuss more difficult or specific use of content.
    - Example: You have learned that proteins are a long chain of amino acids. The pre-work about this will be introducing the structure and properties of amino acids. In class we will talk about specifics of properties and different techniques that use the properties.

Description

This course is the first semester of a two-semester integrated survey of biochemistry. Biochemistry describes in molecular terms the structures, mechanisms, and chemical processes shared by all organisms and provides organizing principles that underlie life in all its diverse forms. Students will gain a fundamental understanding of what makes living systems tick at the molecular level. This includes a comprehensive survey of the chemistry of biological compounds, including proteins, polysaccharides, lipids, and nucleic acids, enzyme kinetics, bioenergetics, organelles, and cellular organization.

Topics covered

Week	Chapter	
1	2	Water, the Solvent of Life
2	3	Amino Acids, Peptides, and Proteins
	4	The Three-Dimensional Structure of Proteins
3	4	The Three-Dimensional Structure of Proteins
	5	Protein Function
4	5	Protein Function

Exam 1: Chapter 1-5

5	6	Enzymes
6	6	Enzymes
7	7	Carbohydrates and Glycobiology
	8	Nucleotides and Nuclei Acids
8	8	Nucleotides and Nuclei Acids
	9	DNA-Based Information Technologies
9	9	DNA-Based Information Technologies

Exam 2: Chapter 6-9

10	10	Lipids
11	11	Biological Membranes and Transport
12	11	Biological Membranes and Transport
13	12	Biochemical Signaling
14	12	Biochemical Signaling

Exam 3: Chapter 10-12

15	13	Introduction to Metabolism
16	**Final**	

Course Book

Lehninger Principles of Biochemistry, 8th Edition David L. Nelson - Michael M. Cox, with access to the Achieve Learning Platform.

Learning Goals

Upon successful completion of this two-semester sequence, students will using the language and reasoning of biochemistry be able to: (greyed sections are the focus of the second semester)

1. Relate the structure and function(s) of the following major classes of cellular components:
    a. Water
    b. Amino acids and proteins
    c. Sugars and polysaccharides
    d. Nucleotides and nucleic acids
    e. Fatty acids and lipids
    f. Membranes and membrane signaling proteins
2. Conceptually map biochemical core concepts:
    a. Levels of proteins structure, motifs, conformational changes, allosteric movements, folding/unfolding
    b. Receptor-ligand affinity
    c. Enzyme mechanisms and inhibition at the active site; substrate and transition state analogs, inhibitors
    d. Membrane chemistry and architecture; active and passive transport
3. Critically assess or Design an experiment using:
    a. Protein purification and analytical separation methods, including column chromatography, isoelectric focusing, and ultracentrifugation
    b. Protein sequencing and analysis, including MALDI and ESI mass spectrometry, Sanger's reagents, proteases, bioinformatics resources
    c. X-ray diffraction as an approach to atomic level structure/function; use of transition state analogs to pinpoint or modulate the active site
    d. FRET as used in high-throughput enzyme assays; FRET sensors
    e. Michaelis-Menten kinetics as an approach to understanding enzyme mechanisms, including the steady state approximation, kcat, Km, kcat/Km parameters;
4. Assess thermodynamic and entropic cost in biological processes
5. Diagram roles and deviations in enzyme-catalyzed reactions and reaction sequences in organism's physiology to:
    a. Obtaining chemical energy
    b. Converting nutrient molecules
    c. Polymerizing monomeric precursors in macromolecules
    d. Synthesizing and degrading biomolecules required for specialized functions.

6. Integrate structural components of DNA, RNA, and protein structure to the processes of DNA replication, transcription and translation.

Examinations

Three 80-minute exams and a three-hour final.

Syllabus

A specific and detailed syllabus will be available during the first class meeting and will be contained within the Learning Management System for that specific term.