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**BOROUGH OF MANHATTAN COMMUNITY COLLEGE**

The City University of New York  
Department of Science

**Title of Course** Fundamentals of Biochemistry **Class Hours** 3

**Course Code** CHE 125 **Laboratory Hours per Week** 3

**Semester** \_\_\_\_\_ **Credits** 4

**Instructor Information**

**Name** \_\_\_\_\_

**Telephone:** \_\_\_\_\_

**Office:** \_\_\_\_\_

**Email** \_\_\_\_\_

**Course Description**

This course is an introduction to the principles of biochemistry that studies the structure, function, energetics and metabolism of biomolecules. The laboratory emphasizes biochemical techniques.

**Basic Skills Prerequisites:** ACR 094, ENG 088 or ESL 062, and MAT 056.

**Prerequisites:** CHE 120, CHE 122 or departmental approval

<b>Course Student Learning Outcomes (Students will be able to...)</b>	<b>Measurements (means of assessment for student learning outcomes listed in first column)</b>
1. identify and define key terminology in biochemistry	1. Examinations will measure students' ability to biomolecules
2. explain biochemical properties	2. Examinations will measure students' ability to explain primary, secondary, tertiary and quaternary protein structure
3. apply chemical concepts to biochemical properties.	3. Examinations will measure students' ability to apply intermolecular forces in biomolecules
4. compare biochemical properties based on chemical models.	4. Examinations will measure student's ability to compare bonding in biomolecules.
5. categorize chemical properties based organic functional groups	5. Examinations will measure student's ability to categorize lipid functions
6. evaluate the effect of changes in biomolecules on biochemical properties.	6. Examinations will measure student's ability to evaluate metabolic functions

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**Below are the college's general education learning outcomes, the outcomes that are checked in the left-hand column indicate goals that will be covered and assessed in this course.**

	<b>General Education Learning Outcomes</b>	<b>Measurements (means of assessment for general education goals listed in first column)</b>
X	<b>Communication Skills-</b> Students will be able to write, read, listen and speak critically and effectively.	
X	<b>Quantitative Reasoning-</b> Students will be able to use quantitative skills and the concepts and methods of mathematics to solve problems.	Examinations will assess student's ability to mathematical analyze quantitative problems in biochemistry.
X	<b>Scientific Reasoning-</b> Students will be able to apply the concepts and methods of the natural sciences.	Examinations will assess student's ability to interpret biochemical properties based on chemical concepts and models.
<input type="checkbox"/>	<b>Social and Behavioral Sciences-</b> Students will be able to apply the concepts and methods of the social sciences.	
<input type="checkbox"/>	<b>Arts &amp; Humanities-</b> Students will be able to develop knowledge and understanding of the arts and literature through critiques of works of art, music, theatre or literature.	
<input type="checkbox"/>	<b>Information &amp; Technology Literacy-</b> Students will be able to collect, evaluate and interpret information and effectively use information technologies.	
<input type="checkbox"/>	<b>Values-</b> Students will be able to make informed choices based on an understanding of personal values, human diversity, multicultural awareness and social responsibility.	

**Required Textbook**

Pratt and Cornely Essential Biochemistry 4E with Wiley Plus, John Wiley  
ISBN 978-1-119-10499-5

**Required Laboratory Manual**

Bettleheim, Frederick A., and Landesberg, Joseph M., Laboratory Experiments in Biochemistry (CHE 125), BROOKS COLE (Cengage) Belmont CA  
ISBN 978-0-357-43170-2  
ISBN: 978-0-357-43170-7

**Other Resources**

**Use of Technology (if applicable)**

**Evaluation & Requirements of Students**

Examinations 5@12%	60%
Final Examination	12%
Laboratory	20%
Online Homework	8%

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## Outline of Topics

Week	Ch/ Sec	Topics	Sample Calculations	Pages	
<b>The Chemical Basis of Life</b>					
1	1.1	What is Biochemistry		1-2	
	1.2	Biological Molecules		3-6	
		Four Types of Biomolecules		7-9	
		Three Types of Biological Polymers			
	1.3	Energy and Metabolism			
		Enthalpy and Entropy	11#1.1	10-11	
		Free Energy	12#1.2	11-12	
		Spontaneity		12-14	
	<b>Aqueous Chemistry</b>				
		2.3	Acid-Base Chemistry	35#2.1; 38#2.2; 38#2.3; 39#2.4	23-40
	2.4	Tools and Techniques: Buffers	41#2.5	40-42	
	2.5	Acid-Base Balance in Humans		42-45	
<b>Protein Structure</b>					
2	4.1	Amino Acids			
		Twenty Amino Acids (Review)		86-89	
		Peptide Bonds (Review)		90-92	
		Protein Primary Structure (Review)		93-93	
	4.2	Secondary Structure			
		Conformation of the Peptide Group (Review)		94-96	
		Irregular Secondary Structure		06-97	
	4.3	Tertiary Structure			
		Hydrophobic Cores (Review)		97-99	
		Protein Structure Stability (Review)		99-100	
		Other Protein Interactions (Review)		100-101	
		Protein Folding		101-102	
	4.4	Conformation of Proteins		102-103	
		Quaternary Structure			
	4.5	Quaternary Structure (Review)		104-105	
Clinical Connection					
Protein Misfolding and Disease			105-106		
<b>Protein Function</b>					
3	5.1	Myoglobin and Hemoglobin	121#5.1	120-127	
	5.2	Hemoglobin Variants		127-129	

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	5.3	Structural Proteins		130-140
	5.4	Motor Proteins		140-146
		<b>Enzymes</b>		
	6.2	Chemical Catalytic Mechanisms		158-162
	6.3	Unique Properties of Enzyme Catalysts		166-169
	6.4	Chymotrypsin in Context		169-173
	6.5	Blood Coagulation		172-175
		<b>Enzymes Kinetics and Inhibition</b>		
4	7.1	Introduction to Enzyme Kinetics		183-185
	7.2	Michaelis-Menten Equation	186#7.1; 189#7.2 192#7.3	186-194
	7.3	Enzyme Inhibition	197#7.4	194-203
	7.4	Drug Development		204-206
		<b>Lipids and Membranes</b>		
5	8.2	The Lipid Bilayer		222-225
	8.3	Membrane Proteins		225-228
	8.4	Fluid Mosaic Model		228-229
		<b>Membrane Transport</b>		
	9.1	Thermodynamics of Membrane Transport	236#9.1; 239#9.2; 239#9.3	235-240
	9.2	Passive Transport		240-245
	9.3	Active Transport		249-248
	9.4	Membrane Fusion		248-253
		<b>Signaling</b>		
6	10.1	General Features of Signaling Pathways	262#10.1	260-264
	10.2	G Protein Signaling Pathways		265-270
	10.3	Receptor Tyrosine Kinases		270-273
	10.4	Lipid Hormone Signaling		274-275
		<b>Carbohydrates</b>		
7	11.3	Glycoproteins		291-295
		<b>Metabolism and Bioenergetics</b>		

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	12.1	Food and Fuel		301-306
	12.2	Metabolic Pathways		306-314
	12.3	Free Energy Changes in Metabolic Reactions	315#12.1	314-321
		<b>Glucose Metabolism</b>		
8	13.1	Glycolysis		330-344
	13.2	Glycogenesis		344-347
	13.3	Glycogen Synthesis and Degradation		347-349
		<b>Glucose Metabolism</b>		
9	13.4	The Pentose Phosphate Pathway		350-353
	13.5	Disorders of Carbohydrate Metabolism		353-355
		<b>The Citric Acid Cycle</b>		
10	14.1	The Pyruvate Dehydrogenase Reaction		362-365
	14.2	The Eight Reactions of the Citric Acid Cycle		365-372
	14.3	Thermodynamics of the Citric Acid Cycle		372-374
	14.4	Anabolic and Catabolic Functions of the Citric Acid Cycle		374-378
		<b>Oxidative Phosphorylation</b>		
11	15.1	The Thermodynamics of Oxidation-Reduction Reactions	368#15.1; 389#15.2	385-390
	15.2	Mitochondrial Electron Transport		390-399
	15.3	Chemiosmosis		399-401
	15.4	ATP Synthase		401-405
		<b>Lipid Transport</b>		
12	17.1	Lipid Transport		432-434
	17.2	Fatty Acid Oxidation		435-443
	17.3	Fatty Acid Synthesis		443-462
	17.4	Synthesis of Other Lipid		452-459
		<b>Nitrogen Metabolism</b>		
13	18.1	Nitrogen Fixation and Assimilation		454-463
	18.2	Amino Acid Biosynthesis		469-476

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	18.3	Amino Acid Catabolism	476-480
	18.4	Nitrogen Disposal: The Urea Cycle	480-484
	18.5	Nucleotide Metabolism	495-490
<b>Regulation of Mammalian Fuel Metabolism</b>			
14	19.1	Integration of Fuel Metabolism	498-501
	19.2	Hormonal Control of Fuel Metabolism	501-506
	19.3	Disorders of Fuel Metabolism	507-511
	19.4	Cancer Metabolism	511-513
15		Examination Week	

### Laboratory Experiments

1. Column and Paper Chromatography  
Separation of Plant Pigments
2. Preparation of Acetylsalicylic Acid (Aspirin)
3. Isolation of Caffeine from Tea Leaves
4. Fermentation of a Carbohydrate  
Ethanol from Sucrose
5. Extraction and Identification of Fatty Acids  
From Corn Oil
6. Analysis of Lipids
7. Acid Base Properties of Amino Acids
8. Neurotransmitters: An Example of Enzyme Specificity
9. Beer's Law and Standard Curves
10. Tyrosinase Enzyme Kinetics
11. Quantitative Analysis of vitamin C Contained In Foods
12. Viscosity and Secondary Structure of DNA
13. Analysis of Vitamin A in Margarine

### Class Participation

Participation in the academic activity of each course is a significant component of the learning process and plays a major role in determining overall student academic achievement. Academic activities may include, but are not limited to, attending class, submitting assignments, engaging in in-class or online activities, taking exams, and/or participating in group work. Each instructor

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has the right to establish their own class participation policy, and it is each student's responsibility to be familiar with and follow the participation policies for each course.

BMCC is committed to the health and well-being of all students. It is common for everyone to seek assistance at some point in their life, and there are free and confidential services on campus that can help.

**Single Stop** [www.bmcc.cuny.edu/singlestop](http://www.bmcc.cuny.edu/singlestop), room S230, 212-220-8195. If you are having problems with food or housing insecurity, finances, health insurance or anything else that might get in the way of your studies at BMCC, come by the Single Stop Office for advice and assistance. Assistance is also available through the Office of Student Affairs, S350, 212-220-8130.

**Counseling Center** [www.bmcc.cuny.edu/counseling](http://www.bmcc.cuny.edu/counseling), room S343, 212-220-8140. Counselors assist students in addressing psychological and adjustment issues (i.e., depression, anxiety, and relationships) and can help with stress, time management and more. Counselors are available for walk-in visits.

**Office of Compliance and Diversity** [www.bmcc.cuny.edu/aac](http://www.bmcc.cuny.edu/aac), room S701, 212-220-1236. BMCC is committed to promoting a diverse and inclusive learning environment free of unlawful discrimination/harassment, including sexual harassment, where all students are treated fairly. For information about BMCC's policies and resources, or to request additional assistance in this area, please visit or call the office, or email [olevy@bmcc.cuny.edu](mailto:olevy@bmcc.cuny.edu), or [twade@bmcc.cuny.edu](mailto:twade@bmcc.cuny.edu). If you need immediate assistance, please contact BMCC Public safety at 212-220-8080.

**Office of Accessibility** [www.bmcc.cuny.edu/accessibility](http://www.bmcc.cuny.edu/accessibility), room N360 (accessible entrance: 77 Harrison Street), 212-220-8180. This office collaborates with students who have documented disabilities, to coordinate support services, reasonable accommodations, and programs that enable equal access to education and college life. To request an accommodation due to a documented disability, please visit or call the office.

### **BMCC Policy on Plagiarism and Academic Integrity Statement**

Plagiarism is the presentation of someone else's ideas, words or artistic, scientific, or technical work as one's own creation. Using the idea or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations, require citations to the original source. Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism. Students who are unsure how and when to provide documentation are advised to consult with their instructors. The library has guides designed to help students to appropriately identify a cited work. The full policy can be found on BMCC's Web site, [www.bmcc.cuny.edu](http://www.bmcc.cuny.edu). For further information on integrity and behavior, please consult the college bulletin (also available online).