

BIOL150 : Introduction to Biochemistry and Molecular Biology

General Information

Author:	<ul style="list-style-type: none">Karoline Rostamiani
Course Code (CB01) :	BIOL150
Course Title (CB02) :	Introduction to Biochemistry and Molecular Biology
Department:	BIOL
Proposal Start:	Spring 2025
TOP Code (CB03) :	(0401.00) Biology, General
CIP Code:	(26.0101) Biology/Biological Sciences, General.
SAM Code (CB09) :	Non-Occupational
Distance Education Approved:	No
Will this course be taught asynchronously?:	No
Course Control Number (CB00) :	CCC000647441
Curriculum Committee Approval Date:	06/12/2024
Board of Trustees Approval Date:	10/09/2024
Last Cyclical Review Date:	06/12/2024
Course Description and Course Note:	BIOL 150 introduces students to the study of molecular composition, structure, and functions of macromolecules. This course is designed to examine the relationship between protein structure and metabolic pathways, and how it contributes to genetic diseases. Concepts in molecular biology such as gene regulation, replication, transcription, and translation are discussed. This course is appropriate for students pursuing careers in the allied health medical fields.
Justification:	New Course
Academic Career:	<ul style="list-style-type: none">Credit
Mode of Delivery:	No value
Author:	<ul style="list-style-type: none">Karoline Rostamiani
Course Family:	No value

Academic Senate Discipline

Primary Discipline:	<ul style="list-style-type: none">Biological Sciences
Alternate Discipline:	No value
Alternate Discipline:	No value

Course Development

Basic Skill Status (CB08)

Course is not a basic skills course.

Allow Students to Gain Credit by Exam/Challenge

Course Special Class Status (CB13)

Course is not a special class.

Pre-Collegiate Level (CB21)

Not applicable.

Grading Basis

- Grade with Pass / No-Pass Option

Course Support Course Status (CB26)

No value

General Education and C-ID

General Education Status (CB25)

Not Applicable

Transferability

Transferable to both UC and CSU

Transferability Status

Approved

Cal-GETC

Area 5A: Physical Science

Area 5B: Biological Science

Area 5C: Laboratory

Area

Physical Science

Biological Science

Laboratory

Status

Pending

Pending

Pending

Approval Date

No value

No value

No value

Comparable Course

No Comparable Course defined.

Units and Hours

Summary

Minimum Credit Units (CB07) 5

Maximum Credit Units (CB06) 5

Total Course In-Class (Contact Hours) 162

Total Course Out-of-Class Hours 108

Total Student Learning Hours 270

Credit / Non-Credit Options

Course Type (CB04)

Credit - Degree Applicable

Noncredit Course Category (CB22)

Credit Course.

Noncredit Special Characteristics

No Value

Course Classification Code (CB11)

Credit Course.

Variable Credit Course

Funding Agency Category (CB23)

Not Applicable.

Cooperative Work Experience Education

Status (CB10)

Weekly Student Hours

	In Class	Out of Class
Lecture Hours	3	6
Laboratory Hours	6	0
Studio Hours	0	0

Course Student Hours

Course Duration (Weeks) 18

Hours per unit divisor 54

Course In-Class (Contact) Hours

Lecture 54

Laboratory 108

Studio 0

Total 162

Course Out-of-Class Hours

Lecture 108

Laboratory 0

Studio 0

Total 108

Time Commitment Notes for Students

No value

Units and Hours - Weekly Specialty Hours

Activity Name	Type	In Class	Out of Class
No Value	No Value	No Value	No Value

Pre-requisites, Co-requisites, Anti-requisites and Advisories

Prerequisite

BIOL122 - Introduction To Biology

Objectives

- Describe the structure of atoms, the properties of water and structure and function of biological macromolecules; describe the flow of information from DNA to protein.
- Describe the flow of information from DNA to protein.
- Describe the mechanisms of evolution including natural selection.
- Describe basic ecological principles and the impact of humans on the environment.
- Identify the defining characteristics of major groups of organisms.
- Compare prokaryotic and eukaryotic cells, and describe the structure and function of eukaryotic organelles.
- Describe the principles of inheritance and solve basic Mendelian genetics problems.
- Describe basic principles of mammalian physiology.

OR

Prerequisite

BIOL120 - Human Anatomy

Objectives

- Identify major structures in the 11 systems of the human body.
 - Identify the basic features of cells and their organization as tissues.
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OR

Prerequisite

BIOL101 - General Biology I

Objectives

- Identify the properties of lipids, carbohydrates, proteins, and nucleic acids.
 - Describe the structure of prokaryotic and eukaryotic cells.
 - Explain cell respiration and photosynthesis.
 - Describe and identify the different stages in mitosis.
 - Describe the relationships between meiosis and Mendelian genetics.
 - Solve Mendelian genetics problems, including autosomal, X-linked genes and dihybrid crosses.
 - Describe the processes of DNA replication, transcription, and translation.
 - Explain the basic mechanisms of gene regulation in prokaryotes and eukaryotes.
 - Demonstrate proper use of laboratory equipment including the microscope, spectrophotometer, and micropipettes.
 - Demonstrate proficiency with data collection, analysis, and graphical representation.
-

OR

Prerequisite

BIOL112 - Microbiology

Objectives

- Explain a general understanding of the taxonomy and major characteristics of the various microorganisms.
 - Illustrate general knowledge of the physical and chemical structure of prokaryotes and eukaryotes.
 - Describe the biochemical processes of the cell, including cell respiration, DNA replication, genetic recombination, transcription, translation, and cellular transport.
 - Examine the physical and chemical methods and mechanisms used to control microbial growth.
-

AND**Advisory**

ENGL101 - Introduction to College Reading and Composition

Objectives

- Read, analyze, and evaluate a variety of primarily non-fiction readings for content, context, and rhetorical merit with consideration of tone, audience, and purpose.
 - Develop varied and flexible strategies for generating, drafting, and revising essays.
 - Write timed, in-class essays exhibiting acceptable college-level control of mechanics, organization, development, and coherence.
 - Integrate the ideas of others through paraphrasing, summarizing, and quoting without plagiarism.
 - Find, evaluate, analyze, and interpret primary and secondary sources, incorporating them into written essays using appropriate documentation format.
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AND**Prerequisite**

CHEM105 - Organic Chemistry A

Objectives

- Classify organic compounds by structure which is the framework of organic chemistry.
 - Precisely describe the principles of organic chemical reactions through techniques of lecture, laboratory problem solving and computer-simulated experiments.
 - Have a working knowledge of the laboratory methods and specialized instruments typically used in organic chemistry.
 - Keep accurate laboratory records.
 - Read and evaluate scientific material of significance to them as citizens.
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OR

Prerequisite

CHEM121 - Fundamentals of College Chemistry (Organic and Biochemistry)

Objectives

- Identify basic equipment and know its function or use, know and perform basic organic laboratory techniques such as filtration, crystallization, extraction, and TLC in laboratory.
- Identify or draw the structural formulas and for the reaction, predict products, provide organic structures and their IUPAC names, given the IUPAC names for organic reactants.
- Differentiate physical and chemical properties of organic functional families and correlate them with the structure.
- Identify the functions of biomolecules in biological systems and their metabolic pathways.

Entry Standards

Entry Standards

Analyze experimental data.

Demonstrate proper use of laboratory equipment and chemicals.

Describe important biological molecules as well as cellular structure and function.

Course Limitations

Cross Listed or Equivalent Course

Specifications

Methods of Instruction

Methods of Instruction

Lecture

Methods of Instruction

Laboratory

Methods of Instruction

Demonstrations

Methods of Instruction	Collaborative Learning			
Methods of Instruction	Multimedia			
Methods of Instruction	Presentations			
Methods of Instruction	Discussion			
Out of Class Assignments				
<ul style="list-style-type: none"> • Written laboratory protocols that include experiment title, purpose, material, procedures, and expected results for each laboratory experiment • Homework assignments (e.g. biochemistry calculations, scientific article reviews and written reports) 				
Methods of Evaluation	Rationale			
Exam/Quiz/Test	Written exams			
Activity (answering journal prompt, group activity)	Scientific journal discussions			
Report	Report laboratory results in scientific written format			
Writing Assignment	Written protocols for each laboratory			
Exam/Quiz/Test	Quizzes			
Exam/Quiz/Test	Laboratory practicum exams			
Textbook Rationale				
No Value				
Textbooks				
Author	Title	Publisher	Date	ISBN
David L. Nelson	Lehninger Principles of Biochemistry 8th Edition	W.H. Freeman	January 1, 2021	978-1319228002
Shafat Ahmad Latoo, Mohammad Asif Shah	Laboratory Guide: Concepts and Protocols for Practical Courses in Biochemistry and Molecular Biology 1st Edition	Nova Science Pub Inc	September 1, 2022	978-1685078621

Rooma Devi, Aman Chauhan,
Simmi Kharb, Chandra Shekhar
Pundir

Clinical Biochemistry: A
Laboratory Guide 1st Edition

Jenny Stanford
Publishing

October 5, 2023

978-9814968751

Other Instructional Materials (i.e. OER, handouts)

No Value

Materials Fee

Lab fee

Learning Outcomes and Objectives

Course Objectives

Discuss chemical properties of macromolecules.

Summarize DNA replication, transcription, translation and gene modifications.

Explain the key metabolic processes.

Read, understand, and discuss scientific literature.

Correlate DNA mutations and protein structure and function to their role in genetic diseases.

Analyze data and report results in oral and written format.

Present peer reviewed scientific articles.

Solve quantitative biochemistry problems.

Discuss enzyme kinetics.

Evaluate experimental data, develop hypotheses, and design experiments to test hypotheses.

Explain concepts in biochemistry such as DNA replication, protein structures, protein folding, and protein functions.

SLOs

Discuss chemical and physical laws pertaining to biology. Expected Outcome Performance: 70.0

Discuss the different levels of biological organizations in biochemistry. Expected Outcome Performance: 70.0

Demonstrate proficiency in basic molecular biology and biochemistry techniques such as polymerase chain reaction, protein purification, and chromatography. Expected Outcome Performance: 70.0

Additional SLO Information

Does this proposal include revisions that might improve student attainment of course learning outcomes?

No

Is this proposal submitted in response to learning outcomes assessment data?

No

If yes was selected in either of the above questions for learning outcomes, explain and attach evidence of discussions about learning outcomes.

No Value

SLO Evidence

No Value

Course Content

Lecture Content

Foundations of Biochemistry (2 hours)

- History of biochemistry
- Origin of life
- Cellular foundations
- Cells and organelles
- Chemical foundations
- Physical foundation
- Genetic foundations
- Evolutionary foundations

Water Structure and Catalysis (2 hours)

- Properties of water
- Ionization of water
- Weak acids and weak bases
- Buffers and their functions

Amino Acids, Peptides, and Proteins (4 hours)

- Amino acid structures
- Disulfide bridge
- Biosynthesis of amino acids
- Peptides and proteins
- Protein bonds
- Covalent structure of proteins
- Peptide bonds and ionization

Structure of Proteins (2 hours)

- Primary structures
- Secondary structures
- Tertiary structures
- Quaternary structures
- Protein denaturing

Protein Folding and Function (3 hours)

- Role of proteins in metabolic pathways
- Binding interactions
- Protein denaturing and renaturing
- Protein misfolding
- Heat shock proteins
- Hemoglobin
- Chaperones

Enzymes (4 hours)

- Introduction to enzymes
- Classification of enzymes
- Characteristics of enzymes
- Substrate binding mechanism
- Enzyme functions
- Enzyme kinetics
- Biosynthesis of enzymes
- Mechanisms of enzyme activity
- Regulation of enzyme activity
- Regulatory enzymes
- Cofactors
- Coenzymes
- Catalysis
- Lock and key mechanism
- Syncatalytic mechanism
- Michaelis-Menten equation
- Enzyme inhibitors
- Role of enzymes in metabolic pathways and diseases

Carbohydrates (3 hours)

- Chemistry of carbohydrates
- Carbohydrate nomenclature
- Monosaccharides
- Disaccharides
- Polysaccharides
- Functions of carbohydrates inside cells
- Working with carbohydrates
- Glycoproteins
- Complex carbohydrates

Nucleotides and Nucleic Acids (3 hours)

- Nucleotide structure
- Nucleic acid structure
- Nucleic acid chemistry
- Biosynthesis of nucleotides
- Degradation of nucleotides
- Eukaryotic chromosome structure
- DNA replication
- Transcription
- Translation

Lipids (2 hours)

- Lipid nomenclature
- Saturated fatty acids
- Unsaturated fatty acids
- Triglycerides
- Fatty acid biosynthesis
- Triglycerol biosynthesis
- Cholesterol biosynthesis

- Complex lipids
- Lipids in plasma membranes
- Fatty acid transportation in cell and the body
- Role of lipids as cofactors and signaling molecules

Membranes and Transport (1 hour)

- Architecture of membranes
- Fluid mosaic model
- Membrane protein structures
- Protein channels
- Active transport
- Passive transport

Vitamins and Minerals (1.5 hours)

- Fat-soluble vitamins
- Water soluble vitamins
- Co-enzymes
- Role of vitamins in metabolic pathways and diseases

Protein Synthesis and Turnover (2.5 hours)

- The genetic code
- Protein synthesis machinery
- Protein synthesis process

Regulation of Gene Expression (3 hours)

- Mechanisms of gene expression
- Transcription factors

Metabolic Pathways (4 hours)

- Characteristics of metabolic pathways
- Reactions in metabolism
- Thermodynamics in metabolism

Carbohydrate Metabolism (3.5 hours)

- Glycolysis
- Krebs cycle
- Oxidative phosphorylation
- Glycogen metabolism
- Gluconeogenesis
- Glycogen storage and diseases
- Pyruvate metabolism

Lipid Metabolism (2 hours)

- Fatty acid oxidation
- Ketone metabolism
- Fatty acid catabolism

Nucleic Acid Metabolism (3 hours)

- Pyrimidine metabolism
- Purine metabolism
- DNA synthesis
- RNA synthesis

Amino Acid and Polypeptide Metabolism (3.5 hours)

- Protein catabolism
- Amino acid metabolism
- Translation

Photosynthesis (1 hour)

- Chloroplast
- Light reaction
- Dark reaction
- C4 plants
- Photorespiration

Biotechnology (4 hours)

- DNA cloning
- Genomic libraries

- Polymerase chain reaction
- Genomes to proteomes

Total Hours: 54

Laboratory/Studio Content

General Laboratory Principles (5 hours)

- Laboratory Safety
- Precise volumetric measurements
- Mixing liquids
- Laboratory balances
- Methods of sterilization
- Centrifuges
- Balances
- Pipettor use

Units, Solutions, Dialysis (6 hours)

- Metric system
- Preparation of solutions
- Solution preparation calculations
- Principle of dialysis

Acid-Base Equilibria, pH, Buffer Systems (6 hours)

- Measurement of pH
- Calculation of pKa values
- Calculation of isoelectric point of protein
- Buffer dilutions
- Buffer preparation
- Osmotic effects on pH

Spectrophotometry (5 hours)

- Spectrophotometry
- Spectrophotometric determination of total DNA and RNA
- Estimation of pKa Value

Identification of Proteins (7 hours)

- Identification of albumin
- Identification of casein
- Bicinchoninic acid assay (BAC)

Protein Purification (20 hours)

- Protein expression
- Protein isolation
- Ammonium sulfate precipitation
- Column chromatography
- Sodium dodecyl-sulfate polyacrylamide gel electrophoresis (SDS- PAGE)
- Enzyme-linked immunosorbent assay (ELISA)
- Lowry protein assay

Protein Sequence Determination (3 hours)

- GeneX
- DNA translator
- ExPASy
- Blast

Chromatography (8 hours)

- Thin layer chromatography (TLC)
- Paper chromatography
- Affinity chromatography
- Gel filtration chromatography
- Column chromatography
- Separation of amino acids
- Identification of amino acids

Enzymatic Hydrolysis (3 hours)

- Hydrolysis of starch

Enzyme Kinetics (8 hours)

- Phosphatase assay
- Michaelis-Menten kinetics
- Mechanisms of enzyme inhibition
- Competitive inhibitors
- Allosteric inhibitors
- Effects of enzyme concentration

Protein-Ligand Interaction (3 hours)

- Reaction kinetics
- Determining binding constant

Recombinant DNA Technologies (20 hours)

- Genomic DNA purification
- Plasmid cloning
- Transformation
- Plasmid miniprep
- Restriction digest
- Site-directed mutagenesis
- Polymerase chain reaction

Gel electrophoresis (7 hours)

- Principles of gel electrophoresis
- Polyacrylamide gel electrophoresis (PAGE)
- Native PAGE
- Agarose gel
- Two-dimensional electrophoresis

Bioinformatics (7 hours)

- Proteomics
- Primary sequence and three-dimensional structure

Total hours: 108**Additional Information**

Is this course proposed for GCC Major or General Education Graduation requirement? If yes, indicate which requirement in the two areas provided below.

Yes

GCC Major Requirements

No Value

GCC General Education Graduation Requirements

Natural Sciences

Repeatability

Not Repeatable

Justification (if repeatable was chosen above)

No Value

Resources

Did you contact your departmental library liaison?

No

If yes, who is your departmental library liaison?

No Value

Did you contact the DEIA liaison?

No

Were there any DEIA changes made to this outline?

No Value

If yes, in what areas were these changes made:

No Value

Will any additional resources be needed for this course? (Click all that apply)

- New Equipment

If additional resources are needed, add a brief description and cost in the box provided.

- Thermocycler- It will be used for polymerase chain reaction experiments (\$3,500.00)
- Polyacrylamide gel electrophoresis (PAGE) equipment will be used for protein analysis (\$800.00)