GROSSMONT COLLEGE

Official Course Outline

CHEMISTRY 117 – INTRODUCTORY BIOCHEMISTRY

1. Course Number Course Title Semester Units Semester Hours

CHEM 117 Introductory Biochemistry 3 3 hours lecture: 48-54 hours

96-108 outside-of-class hours

144-162 total hours

2. Prerequisites

A “C” or higher or “Pass” in Chemistry 116 or Chemistry 102 or Chemistry 241 or equivalent.

Corequisite

None

Recommended Preparation

None

3. Catalog Description

This course is an introduction to the chemistry of biochemical reactions and biochemical molecules. Topics include acid/base chemistry, thermodynamics, cell biology, amino acids and proteins, enzymes, lipids, membranes and transport, carbohydrates, metabolism, nucleic acids, and information transfer. This course is designed for students majoring in nutrition, allied health, nursing, and the chemical or life sciences.

4. Course Objectives

The student will:

1. Apply principles of acid/base chemistry to biological molecules.
2. Apply thermodynamic principles to biochemical processes.
3. Label the parts of prokaryotic and eukaryotic cells and explain how each part is involved in biochemical processes.
4. Classify the amino acids as polar, nonpolar, acids, or basic; show how they combine to form peptides and their structure at various pH’s.
5. Describe protein structure and relative it to function.
6. Explain common biochemical laboratory techniques.
7. Describe catalysis and relate it to enzyme structure.
8. Describe and illustrate the various types of lipids and their roles in an organism.
9. Diagram the fluid mosaic model of cell membranes and describe its role in regulation of particle flow.
10. Compare and contrast different methods for transferring information across a cell membrane.
11. Describe the structures and roles of various monosaccharides and polysaccharides.
12. Diagram and explain important metabolic pathways such as glycolysis, Kreb’s cycle, oxidative phosphorylation, beta-oxidation, and glycogenolysis, in terms of structure and energy production.
13. Discuss how the metabolic pathways are related and regulated.
14. Describe the structures of both DNA and RNA and how they are related to function.
15. Diagram and explain DNA replication, transcription, and translation including the processes.
16. Apply biochemical principles to explain current real work issues in medicine, biology, and/or nutrition.

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5. Instructional Facilities

* 1. Standard classroom
  2. Wall mounted Periodic Chart.
  3. Facilities for lecture demonstrations, including a lecture table with gas, air, water, vacuum and sink.

6. Special Materials Required of Student

None

7. Course Content

The following topics are included in the framework of the course but are not intended as limits on content. The order of presentation and relative emphasis will vary with each instructor.

a. Acid-base chemistry

1) Definitions

2) Equilibrium/Le Chatelier's Principle

3) pH

4) Titration curves

5) Reactions

6) Relation to structure

7) G. Henderson-Hasselbach equation

8) Buffers

b. Thermodynamics

1) Enthalpy

2) Entropy

3) Free energy

4) Energy diagrams

5) Spontaneity

6) Catalysis

7) Gibbs Helmholtz equation

c. Cell biology

1) Prokaryotes vs. eukaryotes

2) Geography of eukaryotes

i. Plasma membrane

ii. Nucleus

iii. Endoplasmic reticulum

iv. Golgi

v. Mitochondria

vi. Chloroplasts

vii. Lysosomes

viii. Microtrabecular lattice

3) Compartmentalization

d. Proteins

1). Amino acids

i.. Classification

ii. Relation of structure to pH

2) Peptides

i. Planarity of peptide bond

ii. Sequences

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7. Course Content (Continued)

3) Structure

i. Primary

a. Sequence determination

b. Synthesis

ii. Secondary

a. Alpha-helix

b. Beta-sheet

c. Collagen

iii. Tertiary

a. Stabilization

b. Myoglobin

iv. Quaternary

a. Subunit interaction

b. Hemoglobin

4) Techniques

1. Chromatography

2. Sodium dodecyl sulfate polyacrylamide gel electrophoresis

3. Crystallography

4. Nuclear magnetic resonance (NMR) spectroscopy

E. Protein function

1. Myoglobin

2. Hemoglobin

V. Enzymes

A. Specificity

B. Mechanisms of action

C. Kinetics

D. Regulation

VI. Lipids

A. Triacyl glycerols

B. Phospholipids

C. Sphingolipids

D. Cholesterol

E. Other lipids

VII. Membranes

A. Fluid mosaic model

B. Regulation of particle/information flow

1. Endo/exocytosis

2. Diffusion

3. Active transport

4. Signal transduction

VIII. Carbohydrates

A. Monosaccharides

1. Glucose

2. Fructose

3. Anomers

B. Disaccharides

C. Polysaccharides

1. Cellulose

2. Starch

3. Peptidoglycan

D. Glycoproteins

IX. Metabolism

A. Energetic principles

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7. Course Content (Continued)

B. Carrier molecules

1. Nicotinamide adenine dinucleotide (NAD)

2. Flavin adenine dinucleotide (FAD)

3. Adenosine triphosphate (ATP)

C. Reaction coupling

X. Glycolysis

A. Pathway

B. Energy yield

C. Regulation

XI. Fates of pyruvate

XII. Tricarboxylic acid (TCA) cycle

A. Pathway

B. Energy yield

C. Regulation

XIII. Oxidative phosphorylation

A. Chemiosmotic theory

B. ATP synthesis

XIV. Beta-oxidation

A. Pathway

B. ATP yield

XV. Glycogenolysis

XVI. Nucleic acids

A. Nucleotides

B. DNA structure and types

C. RNA

1. mRNA

2. tRNA

3. rRNA

XVII. Information pathways

A. DNA replication

B. Transcription

1. Process

2. RNA processing

C. Translation

1. Process

2. Genetic code

D. Mutations

XVIII. Applications of biochemistry

A. Medicine/drug design

B. Nutrition and diet

C. Disease

8. Method of Instruction

a. Lectures are designed to explain basic concepts. Applications to the real world are incorporated as much as possible.

b. Students routinely perform group work on problem sets and in-class presentations.

c. Guest lectures

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9. Methods of Evaluating Student Performance

1. Written exams and final exam.
2. Essays/presentations on topics such as experimental results, descriptive chemistry or current issues in chemistry.
3. Homework.
4. Computer drills.

10. Outside Class Assignments

1. Essays/presentations on topics such as experimental results, descriptive chemistry or current issues in chemistry.
2. Homework, both text and computer based.
3. Short essays.
4. The textbook is required reading and essential to successful solution of homework problems performance on quizzes and exams.

11. Texts

a. Required Text(s):

(1) Appling, Dean R., Spencer J. Anthony-Cahill, and Christopher K. Mathews. *Biochemistry: Concepts and Connections,* 1st Global ed. Pearson, 2016.

(2) Campbell, Mary K., Shawn O. Farrell, and Owen M. McDougal. *Biochemistry*, 9th ed. Cengage Learning, 2018.

(3) Tymoczko, John L., Jeremy M. Berg, and Lubert Stryer. *Biochemistry: A Short Course*, 3rd ed. W. H. Freeman, 2015.

b. Supplementary texts and workbooks:

None

Addendum: Student Learning Outcomes

Upon completion of this course, our students will be able to do the following:

* 1. Demonstrate a working knowledge of the language of biochemistry.
  2. Employ the concept of biochemistry to predict both chemical and physical properties of a biological molecule.
  3. Apply the concept of structure and function to predict properties of biomolecules.

Date approved by the Governing Board: December 13, 2019