Lecture Contact Hours: 64-72; Homework Hours: 128-144; Total Student Learning Hours: 192-216
Laboratory Contact Hours: 48-54; Homework Hours: 0; Total Student Learning Hours: 48-54

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

CHEMISTRY 102 – INTRODUCTION TO GENERAL, ORGANIC AND BIOLOGICAL CHEMISTRY

4 hours lecture, 3 hours laboratory, 5 units

Catalog Description
A one-semester course covering the basic principles of general, organic and biochemistry as needed to understand the biochemistry, physiology and pharmacology of the human body. Intended for students planning to transfer to a California State University nursing program. *Students with a grade of "C" or better in CHEM 115 or 116 (offered at Grossmont College) are not eligible for this class.*

Prerequisite
Appropriate mathematics placement

Entrance Skills
Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:
1) Perform basic arithmetic operations: addition, subtraction, multiplication and division using positive and negative numbers.
2) Perform calculations involving fractions, decimals and exponents. Understand and express numbers in scientific (exponential) notation.
3) Understand and calculate percent. Convert percentages into decimal form and vice versa.
4) Calculate arithmetic average.
5) Use a scientific calculator to perform the types of calculations described above in items 1-4.
6) Solve linear algebraic equations; solve word problems involving linear equations.
7) Understand and determine the magnitudes of angles in units of degrees.
8) Recognize plane geometric figures such as triangles and squares; differentiate among the terms linear, planar and three-dimensional.
9) Perform calculations and solve equations involving ratio and proportion techniques.
10) Graphing of data in a rectangular coordinate system.
11) Understand and interpret graphs of linear functions.
12) Perform dimensional analysis and interpret the result

Course Content
1) Atoms and Elements
2) Compounds and their Bonds
3) Measurements
4) Chemical Reactions and Quantities
5) Chemical Kinetics
    a. Nuclear Radiation
6) Gases
7) Solutions
8) Acids and Bases
9) Organic Compounds
    a. Hydrocarbons
    b. Stereochemistry
    c. Functional Groups
10) Carbohydrates

11) Metabolic Pathways and Energy Production
    a. Digestion
    b. Coenzymes in Metabolic Pathways
    c. Glycolysis
    d. Citric Acid Cycle
12) Lipids
13) Metabolic Pathways and Energy Production
    a. Oxidation of Fatty Acids
14) Amino Acids, Proteins and Enzymes
15) Nucleic Acids
    a. Protein Synthesis
16) The Chemistry of Drugs

Course Objectives

Students will be able to:

1) Demonstrate their knowledge of the principles of general chemistry and their applicability to the field of health care by:
    a. Recognizing the difference between ionic and covalent compounds and writing their names and formulas.
    b. Identifying and employing units of measurement and concentration.
    c. Calculating medication dosages and IV drip rates utilizing dimensional analysis and ratio and proportion while carrying the proper number of significant figures.
    d. Describing the concepts of pH, buffers, acids and bases and calculating pH.
    e. Describing the properties of gases and solving problems utilizing gas laws.
2) Demonstrate their knowledge of organic chemistry by:
    a. Recognizing the most common organic functional groups.
    b. Describing how properties of functional groups dictate the chemical and physical properties of organic compounds.
    c. Writing names and structures of the major classes of organic compounds.
    d. Identifying the classes of organic molecules that play important roles in human health.
3) Demonstrate their knowledge of biochemistry with respect to the major classes of biomolecules (carbohydrates, lipids, proteins, nucleic acids) by:
    a. Describing their chemical and physical properties.
    b. Describing their major metabolic and catabolic pathways.
4) Identify and describe the structure and function of drugs in relation to the biochemistry of the human body, nutrition, and the pathophysiology of diseases.
5) Demonstrate the ability to combine their knowledge of general, organic and biochemistry to describe and analyze relevant issues in the field of health care.
6) In the laboratory:
    a. Observe qualitative phenomena and measure quantitative properties of inorganic substances undergoing physical or chemical changes.
        1. Use glassware and laboratory equipment to make measurements with proper precision including mass, volume and density.
        2. Separate mixtures using chemical techniques including dissolution of solutes, dialysis and filtration; understand characteristics of separation techniques and Tyndall effect.
        3. Observe various classes of chemical reactions and products of each; collection of reaction data to determine experimental yield.
        4. Draw conclusions about the behavior of acid, base and buffer solutions.
        5. Investigate molecular structure using model kits.
    b. Observe and record physical and chemical properties of the major classes of organic compounds and biomolecules.
        1. Investigate chirality including the differences between constitutional isomers and stereoisomers and to further distinguish the differences between stereoisomers categorizing them as either enantiomers or diastereomers using molecular model kits.

2. Observe the physical and chemical properties of alkanes, alcohols, phenols, thiols, carboxylic acids, esters, amines and amides.
3. Perform oxidation reactions to distinguish between primary, secondary and tertiary alcohols.
4. Perform a variety of reactions including esterification, amidation, hydrolysis and saponification.
5. Observe properties of carbohydrates and distinguish between mono-, di- and polysaccharides, aldoses and ketoses as well as reducing and non-reducing sugars using chemical tests.
6. Observe physical properties of lipids and proteins such as color, solubility, and state.
7. Distinguish between mono-, di-, tri-peptide or protein using chemical tests.
8. Observe the effects of denaturing agents on proteins and unknown samples.
9. Perform gel electrophoresis to match DNA samples in a case study laboratory.
10. Determine the effects of enzyme activity in the digestion of carbohydrates, lipids, and proteins by changing parameters such as pH, temperature, time, and concentration of substrate and enzyme.

c. Analyze and evaluate both qualitative and quantitative observations by applying the theoretical principles being studied.

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

1) Exams consisting of the following question types–definitions, short essay, qualitative problems, quantitative problems–that measure students' ability to explain and apply the basic chemical concepts.
2) Laboratory activities that evaluate students' ability to observe the properties of a wide range of chemical substances, to apply competent observational skills, and to demonstrate proper collection and recording of data.
3) Written laboratory reports that measure students' ability to interpret and analyze both qualitative and quantitative data.
4) Lab practical that assesses students' abilities to perform basic laboratory techniques, take measurements and make predictions based on lab procedures and data collected.

Special Materials Required of Student

Scientific calculator, laboratory notebook, safety glasses

Minimum Instructional Facilities

1) Standard classroom with generous writing board space, wall-size periodic table, demonstration table with sink and gas tap
2) Standard laboratory facility

Method of Instruction

1) Lectures are designed to explain basic concepts; ideas are introduced by presentation of data or generation of data through lecture demonstration. Analysis and explanations of data elicited from students by frequent and persistent questions. Applications to the real world are incorporated as much as possible.
2) Laboratories correlated with lectures are designed to allow students to make observations of chemical phenomena. Students work in pairs for most experiments. Lab reports and class discussion require students to explain their laboratory observations employing the concepts discussed in lectures.

3) Textbook and supplementary materials are required reading and are essential to successful solution of homework problems, performance of laboratory experiments and performance on quizzes and exams.
4) Students are strongly encouraged to form study groups as well as seek help through peer tutoring and instructor office hours.

Out-of-Class Assignments

1) Reading and homework problems
2) Lab reports
3) Specialized project involving selected topics in chemistry, as required; this project may require the use of research on the internet, at the library, or other resources.

Texts and References

1) Required (representative examples):
   a. Timberlake, Karen. *General, Organic and Biological Chemistry*, Structures of Life, 6th edition. Pearson, 2019. ISBN-13: 978-0134730684
   b. LeBlanc & Villarreal, *Chem 102 Lab Manual*. Morton Publishing, 2019.
2) Supplemental: None

Student Learning Outcomes

Upon successful completion of this course, students will be able to:

1) Describe fundamental chemistry concepts such as the nature of matter, atomic structure, and chemical bonding, balance chemical reactions, and perform chemical calculations.
2) Recognize functional groups of organic compounds and predict their reactivity based on chemical and physical properties.
3) Explain the structure and function of biological systems based on their physical and chemical properties and how they participate in metabolic and catabolic pathways.
4) In the laboratory, perform a variety of experimental techniques in the chemistry laboratory to collect, analyze and interpret data.