

CHEM 0002B - INTRODUCTION TO CHEMISTRY II

Catalog Description

Prerequisite: Completion of CHEM 2A with grade of "C" or better

Advisory: Eligibility for ENGL 1A

Hours: 126 (72 lecture, 54 laboratory)

Description: Designed to meet the requirements for certain nursing, dental hygiene, physical therapy, agriculture, and forestry programs (Organic and Biochemistry). A study of the major classes of organic compounds, including nomenclature structure, properties, and isomerism. Emphasizes the chemistry and metabolism of carbohydrates, lipids, and proteins, including nucleo-protein and enzymes through related lecture and laboratory exercises. (C-ID CHEM 102) (CSU, UC-with unit limitation)

Course Student Learning Outcomes

- CSLO #1: Demonstrate proficiency in solving problems and analyzing data related to functional groups in organic chemistry.
- CSLO #2: Demonstrate proficiency in solving problems and analyzing data related to biochemical molecules.
- CSLO #3: Apply biochemical principles to metabolism.
- CSLO #4: Demonstrate proficiency in scientific communication.

Effective Term

Fall 2022

Course Type

Credit - Degree-applicable

Contact Hours

126

Outside of Class Hours

144

Total Student Learning Hours

270

Course Objectives

On written examinations, on laboratory exercises, or in laboratory experiments students will:

Lecture Objectives:

1. compare and contrast the properties of organic and inorganic compounds;
2. determine the geometry, shape, and polarity of an organic molecule;
3. diagram the structures and provide names for alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, thiols, aldehydes, ketones, carboxylic acids, salts of acids, esters, anhydrides, amines, amides;
4. identify esters;
5. diagram isomers of organic compounds;
6. describe the physical properties and chemical properties for alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, thiols, aldehydes, ketones, carboxylic acids, salts of acids, esters, anhydrides,

amines, amides, aldehydes, ketones, carboxylic acids, salts of acids, esters, anhydrides, amines, amides;

7. explain the characteristics required for a molecule to exhibit cis-trans isomerism; identify and name cis-trans isomers;

8. identify important alcohols and ethers and their use;

9. write chemical reactions for alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, thiols, aldehydes, ketones, carboxylic acids, listing all reactants and catalyst, if necessary, and predict products for each type of reaction;

10. write the chemical reactions for the synthesis and hydrolysis of hemiacetals, acetals, esters, anhydrides, and amides;

11. identify the general structure and function of important alkaloid drugs;

12. draw the basic structure of an amino acid; identify amino acids as polar, nonpolar, acidic, or basic;

13. draw the structure of a short polypeptide and identify the peptide bonds;

14. name and describe the four levels of protein structure and the intermolecular force(s) stabilizing each level;

15. compare and contrast the structure and functions of globular and fibrous proteins;

16. describe denaturation and explain how denaturing agents act at the molecular level to denature a protein;

17. explain amino acid utilization in the body;

18. describe the structure, properties, and role of enzymes;

19. explain the factors that affect enzyme activity;

20. explain the biological mechanisms for activating and regulating enzymes;

21. discuss how enzymes are used in medical diagnosis and treatment;

22. explain the concept of stereoisomerism and its occurrence and significance in nature; sketch structures for the optical isomers of a compound;

23. identify the structures of the most common monosaccharides;

24. compare the occurrence in nature, the structural components, and type of bonding found in disaccharides and polysaccharides;

25. identify a carbohydrate as reducing or nonreducing;

26. identify the criteria that categorizes a substance as a lipid;

27. compare and contrast the structural characteristics and physical properties of a solid fat and a liquid fat;

28. diagram a generalized structure showing the components and type of bonds found in triglycerides, waxes, phosphoglycerides, sphingolipids, and glycolipids; explain the role of each of these compounds in biological systems;

29. list the types of compounds containing the steroid ring system; explain the physiological role of each type of compound in biological systems;

30. write a saponification reaction and sketch the structure of a soap;

31. compare and contrast the role of soap and bile as emulsifying agents in terms of structure, mode of action, and function;

32. describe the structure of the cell membrane;

33. explain the mechanism by which metabolites are transported across the cell membrane;

34. identify the structural features of eicosanoids; discuss the function of prostaglandins, leukotrienes, thromboxanes;

35. describe the mechanism for lipid transport and storage in biological systems, including the synthesis, structure, and function of chylomicrons, HDL, LDL, VLDL;

36. describe the pathways by which carbohydrates, lipids, and proteins are metabolized and the location of each of these pathways in the cell, including glycogenesis, glycolysis, Krebs cycle, B-oxidation, and urea cycle;

37. explain why acetyl CoA is considered a central molecule in metabolism;
38. explain the mechanism and purpose of the electron transport system and oxidative phosphorylation;
39. determine the number of high-energy ATPs generated from the metabolism of a given carbohydrate or fat;
40. explain the conditions under which ketoacidosis occurs and the resulting impact on physiological systems;
41. describe the anabolic processes of gluconeogenesis, glycogenesis, and fatty acid synthesis;
42. explain the link between DNA and heredity;
43. describe the structural components and type of bonds found in DNA and RNA;
44. explain the genetic code;
45. describe the three types of RNA and the function of each in biological systems;
46. explain the steps involved in the processes of DNA replication, RNA transcription, and translation;
47. explain the mechanisms for regulation of genetic expression;
49. explain the different types of mutation;
50. perform research on a topic using library or internet resources and integrate the information into a written report to be presented to the class.

Laboratory Objectives:

1. Perform laboratory experiments to reinforce the concepts, to teach basic laboratory techniques, and to prepare for more advanced laboratory work in chemistry, if applicable;
2. Demonstrate proficiency in using computers for the collection, analysis, and graphical display of data;
3. Diagram the structures and provide names for alkanes, alkenes, alkynes, aromatic compounds, alcohols, and ethers; given a chemical formula, draw isomers of that compound;
4. Construct a Lewis structure for any organic molecule and determine the shape, polarity, intermolecular forces, and properties of that molecule;
5. Apply the technique of liquid-liquid extraction in isolating an organic substance;
6. Using a melting point apparatus, determine the melting point and purity of an organic substance;
7. Identify functional groups using qualitative analysis and investigate their chemical properties;
8. Construct and identify chiral compounds; distinguish between enantiomers, diastereomers, and meso compounds;
9. Identify different types of carbohydrates using qualitative analysis and investigate their chemical properties;
10. Ferment sugars to produce ethanol; apply the technique of distillation to isolate ethanol;
11. Synthesize two esters of salicylic acid: aspirin and oil of wintergreen;
12. Apply the technique of thin-layer chromatography to separate compounds in over the counter medications;
13. Investigate physical and chemical properties of fats and oils;
14. Synthesize soap and explore its properties;
15. Isolate and identify amino acids using paper chromatography; investigate the properties of amino acids and proteins;
16. Analyze the effects of enzyme concentration, temperature, pH, and inhibitors on enzyme activity;
17. Use gel electrophoresis to separate compounds; develop the technique of micropipetting;
18. Identify unknown DNA using gel electrophoresis and determine the number of base pairs using a standard curve;
19. Extract DNA from a fruit or vegetable;

20. Describe the systems which control acid-base balance in the blood; explain the function of the lungs and kidneys in maintaining constant blood pH;
21. Exhibit cooperative and individual skills in the collection and analysis of data;
22. Develop clear, cogent reporting of experimental observations, analysis and conclusions using the scientific method.

General Education Information

- Approved College Associate Degree GE Applicability
 - AA/AS - Physical Sciences
 - AS - Physical Science Lab
- CSU GE Applicability (Recommended-requires CSU approval)
 - CSUGE - B1 Physical Science
 - CSUGE - B3 Lab Activity
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)
 - IGETC - 5A Physical Science
 - IGETC - 5C Laboratory Science

Articulation Information

- CSU Transferable
- UC Transferable

Methods of Evaluation

- Essay Examinations
 - Example: Students will take quizzes and exams that will have essay questions. Example 1: Compare and contrast glycolysis and gluconeogenesis (lecture course objectives 36, 41). Students will be required to discuss the similarities and differences between the two pathways. Students will be graded on a traditional grading scale based on the correct number of similarities and differences they discuss in their response. Example 2: Compare and contrast the activation/inhibition of carbohydrate and lipid metabolic pathways in response to the release of insulin and/or glucagon (course lecture objective 36). Students will be required to discuss the effect of each hormone on carbohydrate and lipid metabolism. Students will be graded on a traditional grading scale based on the number of correct effects they discuss in their response.
- Objective Examinations
 - Example: Students will take quizzes and examinations utilizing a variety of objective questions like true or false and multiple choice. Standard grading. Example Questions (lecture course objectives 23, 24) 1. Ribose is an aldose. True or False? 2. Which of the following is a reducing sugar? a. sucrose b. glycogen c. starch d. glucose
- Problem Solving Examinations
 - Example: Students will solve problems by completing organic reactions. (lecture course objectives 9,10). Students will be graded based on their work to show all possible unique products, adding a catalyst, if needed. Example questions 1. Draw the structure of all products formed in the reaction of butane with bromine. Be sure to include any catalysts. 2. Draw the products of the hydrolysis of methyl acetate. Be sure to include any catalysts.
- Projects
 - Example: Students will choose a topic related to organic or biochemistry and apply information they learn in class to the

topic. (lecture objective 50) Example: 1. Students will write a 3-5 page summary of their topic. 2. Students will prepare a 3-5 minute oral presentation of their topic to the class at the end of the semester. Students are graded based on the accuracy of the information, proper use of sources, the clarity of their report and presentation.

- Reports
 - Example: In the course lab manual, students will collect data, calculate results and answer additional questions regarding the topics demonstrated in the lab like determining the purity of ethanol collected during the distillation (lab objective 10) or calculating the percent recovery of caffeine (lab objective 5) . Students will be graded based on the accuracy and discussion of their results. Example 1. Using the density of the alcohol sample, determine the percentage of ethanol in your sample. 2. Using the mass of caffeine in the original caffeine tablet and the mass of caffeine collected, determine the percent recovery.
- Skill Demonstrations
 - Example: Students will utilize lab equipment to obtain precise and accurate data and results. Example: 1. Isolation of Caffeine (Lab objective 1, 5, 6). Students will isolate caffeine from a caffeine tablet, using techniques of liquid extraction. Students will also determine the purity of their caffeine by taking melting points. Rubric grading. 2. Identification of Functional Groups (Lab objective 1,7). Students will test for different functional groups using a series of different reactions.

Repeatable

No

Methods of Instruction

- Laboratory
- Lecture/Discussion
- Distance Learning

Lab:

1. Instructor organizes laboratory experiments and demonstrations that reinforce metabolic concepts. Instructor guides students in data collection and analysis and preparation of laboratory reports..
2. Instructor organizes laboratory experiments and demonstrations that reinforce concepts of carbohydrates. Instructor guides students in data collection and analysis and preparation of laboratory reports.

Lecture:

1. Instructor presents information regarding concepts of metabolism. Students are expected to read the text and work on practice problems related to metabolism. During the presentation students are expected to ask questions and work on example problems individually or in small groups.

Distance Learning

1. The topic of carbohydrates will be presented using text and/or video presentations. Students will then review example problems and then solve problems on carbohydrates using online homework portals and/or online worksheets on LMS. A discussion board is provided to allow students to interact and discuss problem solving strategies with each other.

Typical Out of Class Assignments Reading Assignments

1. Read a section from the textbook or other printed material on proteins. Be prepared to participate in class discussion and to complete assigned problems. 2. Read the experiment on isolation of caffeine and be prepared to perform and answer questions on the experiment.

Writing, Problem Solving or Performance

1. Collect data, analyze data, and prepare a written laboratory report on the isolation of caffeine experiment. 2. On a worksheet, write a chemical reaction for the preparation of methyl acetate.

Other (Term projects, research papers, portfolios, etc.)

Perform research on a topic using library or internet resources. Integrate the information with chemistry concepts and synthesize a written report to be presented to the class.

Required Materials

- General, Organic, and Biological Chemistry
 - Author: Stoker
 - Publisher: Cengage Learning
 - Publication Date: 2015
 - Text Edition: 7th
 - Classic Textbook?:
 - OER Link:
 - OER:
- Lab Manual for Stokers General, Organic, and Biological Chemistry
 - Author: Stoker
 - Publisher: Cengage Learning
 - Publication Date: 2015
 - Text Edition: 7th
 - Classic Textbook?:
 - OER Link:
 - OER:
- Chemistry: An Introduction to General, Organic, and Biological Chemistry
 - Author: Timberlake
 - Publisher: Pearson
 - Publication Date: 2017
 - Text Edition: 13th
 - Classic Textbook?:
 - OER Link:
 - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.