Subject:	CHEM
Course Number:	21B
Descriptive Title:	Survey of Organic and Biochemistry
Division:	Natural Sciences
Department:	Chemistry
Course Disciplines:	Chemistry
Catalog Description:	The study of organic chemistry continues with the nomenclature, properties, preparation, reactions and derivatives of carboxylic acids, amines, aldehydes and ketones. Principles of biochemistry are introduced. Descriptions of the structures and biochemical reactions of carbohydrates, lipids, proteins, enzymes and nucleic acids will be analyzed. Catabolic/anabolic pathways as well as the energy consumed or produced by the metabolism of carbohydrates, fats and proteins will be examined. The chemistry of photosynthesis will be studied.
Prerequisite:	Chemistry 21A with a minimum grade of C
Co-requisite:	
Recommended Preparation:	English1 or Eligibility for English 1A or qualification by appropriate assessment
Enrollment Limitation:	
Hours Lecture (per week):	3
Hours Laboratory (per week):	3
Outside Study Hours:	6
Total Hours:	108
Course Units:	4
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Prior to July 1992
Transfer UC:	Yes
Effective Date:	
General Education: ECC	Area 1 - Natural Sciences
Term:	
Other:	
CSU GE:	Area B1 - Physical Universe and its Life Forms: Physical Science, Area B3 - Physical Universe and its Life Forms: Laborator Activity
Term:	

Other:	
IGETC:	Area 5A - Physical Science, Area 5C - course that incorporate a laboratory
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Structures of Reactants for a Reaction** On a written exercise, given the structures of reactants for a reaction, students will be able to write the correct structures of products and identify the reaction type. **SLO #2 Molecular Models and Drawings** Students will be able to create (via molecular models or drawings) accurate representations of compounds. The representations will contain appropriate bonds, lone pairs, and geometry. **SLO #3 Safety Protocol** Students will adhere to safety protocol in the laboratory regarding eye protection. Students will follow the proper procedure regarding wearing goggles in the laboratory, and keeping them on to protect their eyes.
Course Objectives:	1. 1. The student will be able to write a name given a structure and vice-versa for the following: amines, esters, hydrocarbons, carboxylic acids, carboxylic acid derivatives, aldehydes and ketones. 2. The student will be able to state common sources for the following: amines, esters, hydrocarbons, carboxylic acids, carboxylic acid derivatives, aldehydes and ketones. 3. The student will be able to write equations for common equations for common reactions and methods of preparations for following: amines, esters, hydrocarbons, carboxylic acids, carboxylic acid derivatives, aldehydes and ketones. 4. Identify the type of mechanism used in common organic chemistry reactions as either concerted, carbocation or carbanion and illustrate the mechanism for representative reactions studied. 5. The student will be able to draw the chain structures for the following: carbohydrates, lipids, proteins and nucleic acids. 6. The student will be able to write equations for common reactions involving carbohydrates, lipids, proteins and nucleic acids. 7. Explain the Krebs cycle in terms of the structural changes involved in each step of the cycle, the energy produced by the cycle, and the places in the Krebs cycle where other cycles enter or leave the Krebs cycle. 8. Discuss the genetic processes of replication, transcription and translation in terms of the structural changes involved. 9. Analyze the effect of pH, temperature, concentration of substrate and concentration of enzyme on the ability of any enzyme to function normally. 10. Name an enzyme on the basis of its function. 11. Discuss how adenosine triphosphate (ATP) is made in the mitochondrion, the function of reduced nicotinamide adenine dinucleotide (NADH) and

	reduced flavin adenine dinucleotide (FADH) in this process and where the energy is stored in ATP. 12. Analyze carbohydrate, lipid and protein metabolism (catabolism and anabolism) in terms of the structural changes involved in each step of these processes, ATP input and production and function of each process. 13. Demonstrate proficiency in basic laboratory skills, taking and recording observations of chemical systems, recording and interpretation of quantitative experimental data.
Major Topics	I. Review of organic chemistry (3 hours, lecture) A. Nomenclature of hydrocarbons B. Bonding C. Chemical reactions D. Functional groups E. Equilibria F. Acid theories II. Carboxylic Acids and Acid Derivatives, Esters (5 hours, lecture) A. Common and IUPAC nomenclature B. Preparations and reactions of acid derivatives C. Diacids - through glutaric acid D. Reactions: 1. Claisen condensation 2. Decarboxylation of beta-keto acids III. Aldehydes and Ketones (4 hours, lecture) A. Important structural features B. Common and IUPAC nomenclature C. Preparation 1. Hydrolysis of alkenes 2. Oxidation of alcohols D. Reactions 1. Redox 2. Nucleophilic addition of ROH 3. Claisen condensation 4. Aldol condensation IV. Amines and Amides (1.5 hours, lecture) A. Common and IUPAC nomenclature

B. Acid-base reactions of amines
C. Preparation and reactions of amides

V. Introduction to Biochemistry (2 hours, lecture)

A. General characteristics of biomolecules
B. Bioenergetics
C. Electron transport chain - chemiosmotic theory

VI. Carbohydrates (5 hours, lecture)

A. Introduction
B. Monosaccharides

1. Classification
2. Characteristics of each class
3. Ring structures
4. Reactions

C. Disaccharides

1. Important examples - maltose, lactose, cellobiose, sucrose
2. Characteristics of each example

D. Polysaccharides

1. Definition
2. Important examples - starch, glycogen, cellulose
3. Characteristics of each example

E. Tests for Carbohydrate classes

VII. Lipids (4 hours, lecture)

A. Definition
B. Classification and structure

1. Simple - waxes and triacylgycerols
2. Complex - phospholipids and gylcolipids
3. Others - steroids, prostaglandins, fat soluble vitamins

C. Soaps and detergents

VIII. Proteins (5 hours, lecture)

A. Definition
B. Amino Acids - structure, effect of pH, isoelectric point, classification by R groups, reactions
C. Peptide bond

D. Proteins - definition, methods of classification, structural levels, primary structure determination, denaturation

IX. Nucleic Acids (3 hours, lecture)

A. Definition
B. Mononucleotide - structure, linkages
C. Nucleic acids - definition, nomenclature, structural levels
D. RNA - types and functions
E. Genetic processes - replication, transcription, translation
F. Genetic code and Mutations

X. Enzymes (5 hours, lecture)

A. Definition
B. Classification - by hydrolysis, IUB, traditional grouping
C. Special enzymes
D. Factors affecting activity - temperature, pH, concentration of substrate and of enzyme
E. Enzyme inhibition - competitive and non-competitive
F. Theories of how enzymes work - lock and key, induced fit

XI. Carbohydrate Metabolism: Catabolism (4 hours, lecture)

A. Digestion - steps and enzymes involved
B. Glycolysis - structures and enzymes, ATP bookkeeping
C. Krebs cycle (Citric Acid Cycle)

XII. Lipid Metabolism: Catabolism (3 hours, lecture)

A. Digestion - steps and enzymes involved
B. Beta-oxidation cycle - steps, enzymes, structures, ATP bookkeeping
C. Ketosis - definition, dangers of, causes of, steps involved

XIII. Protein Metabolism: Catabolism (3 hours, lecture)

A. Digestion
B. Catabolism of amino acids
C. Urea cycle

XIV. Carbohydrates Metabolism: Anabolism (3.5 hours, lecture)

A. Pentose phosphate shunt
B. Gluconeogenesis
C. Glycogenesis
D. Glycogenolysis

XV. Lipids Metabolism: Anabolism (3 hours, lecture)

A. Synthesis of fatty acids
B. Synthesis of fat

XVI. Laboratory Experiments (54 hours, lab)

Select 8-10 experiments)

A. Laboratory safety in the organic lab
B. Characteristics of organic compounds

1. Nomenclature

2. Structures

3. Drawings

C. Reactions involving Alcohols and Phenols

D. Reactions involving Preparation of Aspirin

E. Reactions involving Aldehydes, Ketones, and Carboxylic acids

F. Introduction to carbohydrates

G. Reactions involving Saponification of Triglycerides

H. Introduction to Proteins

I. Separation of Amino acids

J. Introduction to Enzymes

I. Review of organic chemistry (3 hours, lecture)

A. Nomenclature of hydrocarbons

B. Bonding

C. Chemical reactions

D. Functional groups

E. Equilibria

F. Acid theories

II. Carboxylic Acids and Acid Derivatives, Esters (5 hours, lecture)

A. Common and IUPAC nomenclature
B. Preparations and reactions of acid derivatives
C. Diacids - through glutaric acid
D. Reactions:

1. Claisen condensation

2. Decarboxylation of beta-keto acids

III. Aldehydes and Ketones (4 hours, lecture)

A. Important structural features
B. Common and IUPAC nomenclature
C. Preparation

1. Hydrolysis of alkenes
2. Oxidation of alcohols

D. Reactions

1. Redox
2. Nucleophilic addition of ROH
3. Claisen condensation
4. Aldol condensation

IV. Amines and Amides (1.5 hours, lecture)

A. Common and IUPAC nomenclature
B. Acid-base reactions of amines
C. Preparation and reactions of amides

V. Introduction to Biochemistry (2 hours, lecture)

A. General characteristics of biomolecules
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C. Electron transport chain - chemiosmotic theory

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A. Introduction
B. Monosaccharides

1. Classification
2. Characteristics of each class
3. Ring structures
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C. Disaccharides

1. Important examples - maltose, lactose, cellobiose, sucrose
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1. Simple - waxes and triacylgycerols
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D. Proteins - definition, methods of classification, structural levels, primary structure determination, denaturation

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C. Ketosis - definition, dangers of, causes of, steps involved

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G. Reactions involving Saponification of Triglycerides

H. Introduction to Proteins

I. Separation of Amino acids

J. Introduction to Enzymes

Total Lecture Hours:	54
Total Laboratory Hours:	54
Total Hours:	108
Primary Method of Evaluation	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	The following proteins have the same molecular weight and size. The pI of each is: carboxypeptidase(6.0), pepsin(1.0), growth hormone(6.9) and ovalbumin (4.6). a. State whether each is (+) charged, (-) charged or uncharged at pH = 6.0. b. Draw an electrophoresis diagram of the mixture of the four proteins at pH = 6.0.
Critical Thinking Assignment 1:	In the space provided, describe how the amino acids proline and lysine are related to the disease condition called scurvy.
Critical Thinking Assignment 2:	Write a mechanism for the reaction of butanal with n-propyl alcohol in the presence of hydrogen chloride.
Other Evaluation Methods:	Completion, Essay Exams, Homework Problems, Laboratory Reports, Matching Items, Multiple Choice, Objective Exam, Other Exams, Performance Exams, Quizzes, True/False, Written Homework
Instructional Methods:	Demonstration, Discussion, Lab, Lecture
If other:	
Work Outside of Class:	Answer questions, Problem solving activity, Required reading, Study, Written work (such as essay/composition/report/analysis/research)
If Other:	
Up-To-Date Representative Textbooks:	Seager and Slabaugh. Chemistry for Today: General, Organic and Biochemistry. 9th ed. Thomson, 2018. Peller. Catalyst: Chemistry 21A/B Custom Edition for El Camino College. 3rd ed. Prentice Hall, 2011. Discipline Standard
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	
Requisite:	Prerequisite
Category:	sequential
Requisite course(s): List both prerequisites and corequisites in this box.	Chemistry 21A
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Use the language of general chemistry (vocabulary, nomenclature, formulas and equations) to describe chemical systems and changes (physical and chemical) they undergo.** CHEM 21A - Use the language of general chemistry (vocabulary, nomenclature, formulas and equations) to describe chemical systems and changes (physical and chemical) they undergo.

	Describe the structure of the atom in terms of the arrangement of subatomic particles and electronic configuration. CHEM 21A - Describe the structure of the atom in terms of the arrangement of subatomic particles and electronic configuration. **Utilize the principles of bonding to identify types of bonding, write Lewis structures, predict molecular geometry, bond angles and polarity.** CHEM 21A - Explain the difference between ionic and covalent bonding and write Lewis structures for molecules and polyatomic ions. **Describe the bonding and geometry of carbon compounds in terms of hybridization and type of bonding orbital overlap (pi or sigma).** CHEM 21A - Explain the difference between ionic and covalent bonding and write Lewis structures for molecules and polyatomic ions. CHEM 21A - Predict molecular geometry, bond angles and polarity.CHEM 21A - Analyze the bonding and geometry of carbon compounds in terms of hybridization and type of bonding orbital overlap (pi or sigma). **Solve introductory level quantitative problems applied to chemical systems by using dimensional analysis and algebra.** CHEM 21A - Solve introductory level quantitative problems applied to chemical systems by using dimensional analysis and algebra. These problems include unit conversions, stoichiometry, gas laws, solution concentrations, and pH. **Identify types of intermolecular forces and how they relate to properties.** CHEM 21A - Describe the properties of solids, liquids, gases and solutions and relate them to bonding and intermolecular forces. **Discuss the factors which affect the rate of reactions and apply Le Chatelier's Principle to equilibria.** CHEM 21A - Discuss the factors which affect the rate of reactions and apply Le Chatelier's Principle to equilibria. **Identify types of acids and bases and interpret elementary acid-base equilibria.** CHEM 21A - State the properties and definitions of acids and bases and interpret elementary acid-base equilibria. **Name and write equations for the preparation and important reactions of alkanes, alkenes, alkynes, alcohols and ethers.** CHEM 21A - Determine the nomenclature and write equations for the preparation and important reactions of alkanes, alkenes, alkynes, alcohols and ethers.

	Name common aromatic compounds and describe the structure and resonance of these compounds. CHEM 21A - State the names of common aromatic compounds and describe the structure and resonance of these compounds. **Identify a chiral center in an organic compound.** CHEM 21A - Identify a chiral center in an organic compound, identify the different enantiomers. **Show how selected organic reactions take place by using reaction mechanisms.** CHEM 21A - Devise mechanisms to show how selected organic reactions take place. **For laboratory: Be able to use common laboratory equipment including pipets, burets, balances and burners. Take and record observations of chemical systems and interpret qualitative and quantitative experimental data. Understand the rules and procedures for laboratory safety.** CHEM 21A - Use common laboratory glassware and equipment. CHEM 21A - State and apply the rules and procedures for laboratory safety. CHEM 21A - Demonstrate the ability to use basic laboratory skills such as taking and recording observations of chemical systems and interpreting qualitative and quantitative experimental data.
Requisite:	
Requisite and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	ENGL 1
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Students need well-developed reading skills in order to understand and interpret information in their textbooks and writing skills to develop essays and projects.** ENGL 1- Summarize, analyze, evaluate, and synthesize college-level texts. ENGL 1 -Write a well-reasoned, well-supported expository essay that demonstrates application of the academic writing process.
Requisite:	Eligibility for English 1A or qualification by appropriate assessment
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	**This course involves reading college level textbooks, developing projects, and answering essay questions. A student's success in this class will be enhanced if they have these skills.** Summarize, analyze, evaluate, and synthesize college-level texts. Write a well-reasoned, well-supported expository essay that demonstrates application of the academic writing process.
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Jack L. Wolf

Date:	11/08/1971
Original Board Approval Date:	
Last Reviewed and/or Revised by:	Ana Tontcheva
Date:	09/20/2021
Last Board Approval Date:	12/20/2021 effective FALL 2022