Chemistry for Health Sciences | Lecture and Lab

Academic Year 2020-2021

Course Information

Course Numbers	Total Credits	Time Requirement
CHEM351/CHEM3511L	**5 (4 Lecture + 1 Lab)**	**90 hrs (Lecture 60hrs + Lab 30hrs)**

Course Details

Recommended Prerequisites

High School Diploma or equivalent; College algebra is highly recommended

Course Description

Chemistry for Health Sciences is an introductory course designed exclusively for Health Sciences for Pre-Nursing majors. Basic concepts in general, organic and biological chemistry are covered. The course is designed to show the centrality of chemistry between the physical and life sciences. Topics covered will include measurement and unit conversion, atomic and molecular structure of matter, solutions, acid/base chemistry, organic chemistry and structure of proteins, carbohydrates, and fats. Laboratory portion of the course provides firsthand experiences that inform, illustrate, expand, and reinforce major concepts discussed in lecture.

Lecture and Laboratory Communication

A website will be set up on Canvas by your instructor.
Log in with your Username and password: **https://scuhs.instructure.com**

Faculty Information

Refer to the Canvas course webpage for this information.

Class Meeting Times

Refer to Canvas course webpage for this information.

Instructional Materials

Required Text(s): General, Organic, and Biochemistry by Katherine J. Denniston 9th edition (Connect©) (ISBN: 13: 978-007802154). An electronic textbook is provided to students on Canvas.

Lab: SCU Chemistry for Health Sciences Lab Manual (available on Canvas).

Provided materials: Flame resistant Lab Coat/Apron, Nitrile gloves, Safety Goggles. Only approved safety goggles must be worn. Approved safety goggles will be provided by lab instructor during the first lab session. Goggles are required during all lab sessions. No goggles, no experiment.

Required Attire: Close-toed shoes, professional attire and lab coats are mandatory during all lab hours. Gloves, goggles and additional safety equipment will be required per experiment.

Scientific Calculator: Graphics or text-memory calculators are not allowed for use during quizzes or exams in the lab. If you bring one you will have to take your quiz without a calculator. You are encouraged to obtain a scientific calculator with exponents and logarithms immediately, rather than the day before a quiz or an exam. It is

important to be comfortable with the calculator that you are using, rather than to be struggling to locate the keys for certain mathematical operations. For example, a TI-30X IIS is acceptable.

Course Purpose

Student Learning Outcomes

At the conclusion of this course, a successful student should be able to:

1. Demonstrate thorough knowledge and understanding of the fundamental principles and core concepts of Chemistry for Health Sciences. (CLO 1-113)
2. Apply their knowledge to appraise scientific and technical literature in the field of General Chemistry (CLO 1-57)
3. Apply major concepts of chemical reactivity of organic compounds to solve problem (CLO 58-86)
4. Students will explain/describe the synthesis of proteins, lipids, nucleic acids, and carbohydrates and their role in metabolic pathways (CLO 87-113).
5. Demonstrate competency in laboratory safety and in routine biological laboratory skills. (CLO 1-113)

Course Learning Objectives: Please refer to the appendix for a full list of course objectives.

SOUTHERN CALIFORNIA UNIVERSITY OF HEALTH SCIENCES

Course Schedule

(subject to slight modifications by the instructor)

Day	Lecture	Assessment
1	Methods and Measurement The Structure of the Atom and the Periodic Table Structure and Properties of Ionic and Covalent Compound	Class Participation
2	Calculations, Chemical Changes, and the Chemical Equation States of Matter: Gases, Liquids, and Solids	Class participation
3	Solutions Energy, Rate, and Equilibrium	Exam 1
4	Acids and Bases An Introduction to Organic Chemistry: The Saturated Hydrocarbons	Class participation
5	The Unsaturated Hydrocarbons: Alkenes, Alkynes, and Aromatics Alcohols, Phenols, Thiols, and Ethers Aldehydes and Ketones	Exam 2
6	Carboxylic Acids and Carboxylic Acid Derivatives Amines and Amides Carbohydrates	Class participation
7	Lipids and Their Functions in Biochemical Systems Protein Building Blocks: The α-Amino Acids Enzymes	Exam 3
8	Introduction to Molecular Genetics Carbohydrate Metabolism	Class participation
9	Aerobic Respiration and Energy Production Fatty Acid Metabolism	Class participation
10	Review	Exam 4

Tentative Grading Procedures

Lecture

Assessment	Points	Weight (%)
Exam 1	125	15
Exam 2	125	15
Exam 3	125	15
Exam 4	125	15
Participation (in class mini quizzes/activities)	100	12
Homework	220	27
Total	820	100%

Lab Schedule

(subject to slight modifications by the instructor)

Day	Laboratory	Assessment
1	Check-in: Check in/safety/Worksheet	Lab notebook
2	Experiment 1: Measurement and Significant Figures	Lab notebook
3	Experiment 2: Separation of Mixtures	Quiz 1
4	Experiment 3: Families of Elements	Lab notebook
5	Experiment 4: Reaction Stoichiometry	Quiz 2 Lab notebook
6	Experiment 5: **Lewis and VSEPR**	Lab notebook
7	Experiment 6: Paper Chromatography: Separation of Metals	Quiz 3 Lab notebook
8	Experiment 7: Alcohols and Phenols	Lab notebook
9	Experiment 8: Organic Functional Groups	Lab notebook
10	Check-out	Quiz 4

Tentative Grading Procedures

Lab

Assessment	Points
Lab Quizzes (4 x 50 points)	200
Lab Notebook (8 x 20 points)	160
Participation	5
Worksheet	20
Total	385

Lab Notebook:

- Pre-Lab: 40% of Total Assignment points (includes title, purpose, hypothesis, materials, procedure, pre-lab questions and worksheets)
- Post Lab: 50% of Total Assignment points (includes data, observations, calculations, post lab questions and conclusion)
- Neatness, grammar and clarity: 10% of Total assignment points

Grading scale:

Please note letter grades will be assigned only at the end of the trimester.

A = 90% to 100%

B = 80% - less than 90%

C = 70% - less than 80%

D = 60% - less than 70%

F = less than 60%

W = Withdrawal

Grading procedures:

The format of this assessment may include multiple choice, short answer, labelling, fill-in-the-blank, or calculation examinations. Participation points are required and will be assigned by the instructor as the course progresses through your general performance and regards for the rules of the laboratory and safety procedures.

Academic Integrity

Visit SCU's **Academic Integrity** page to review policies for professionalism and academic integrity.

Teaching Methods and Activities

The course requires a significant time commitment from students. This commitment is both in terms of reading lecture outlines prior to reading the chapters, as well as reviewing the material.

Required Attire

Close-toed shoes, professional attire and lab coats are mandatory during all lab hours. No shorts, heels, or flip-flops will be allowed in the laboratory; hair longer than shoulder-length must be pulled back and held with a clip or hair tie. Gloves, goggles and additional safety equipment will be required per experiment.

Classroom Expectations

Please be professional, prompt, prepared, and polite at all times.

The professor will adhere to all policies as found in the Student Handbook. Cellular phones must be kept on silent during class and lab times. Students may not use a phone as a calculator. As a safety precaution, no food or drinks are allowed inside the lab, but there will be a designated break for eating and drinking outside of the lab.

Best Practices for Studying Chemistry for Health Sciences

- Read before and read after each class. Skim the chapter before it is covered in lecture to become comfortable with some of the terms associated with each topic. Review each chapter after it is covered in class to enhance your understanding of what was covered in class.
- Participate during class by taking notes during class and looking over them afterwards. Don't skip class, arrive late, or leave early. Ask questions for clarification when you don't understand the material.
- Stay on top of the homework and assignments. Do the assigned problems as close to the time as when the topic is covered in the class to increase the depth of your understanding of specific concepts and will help you learn the material more efficiently and effectively.
- Do not wait until the night before the homework is due to start the assignment. You will get more out of it if you take the time to really learn the concepts and review the material without being rushed.
- Find a group of students to study with. Seek out students dedicated to doing well in the course. This makes studying more fun and helps you learn the material better by teaching what you know and learning from your peers what you don't know. Explaining these concepts to others will help you learn the material even better.
- Stay focused by finding an environment where you can study with few distractions.

University Policies

Accommodations

As a learning-centered community, Southern California University of Health Sciences recognizes that all students should be afforded the opportunity to achieve their academic and individual potential. The University recognizes and supports the standards set forth in Section 504 of the Rehabilitation Act and the American with Disabilities Act (ADA). In accordance with its mission and federal and applicable state laws, the University is committed to making reasonable accommodations for qualified applicants for admission and enrolled students with disabilities. A student who needs accommodation(s) due to a disability should contact the Academic Support Office located in the Learning Resource Center.

Faculty and Dr./Patient Relationships

SCU faculty are highly skilled. However, per University Policy, health care is offered to students through the University Health System only. Neither preclinical nor clinical faculty can provide advice, assessment, treatment, or other elements that would be considered part of a Doctor-Patient relationship outside of a clinical setting established for that purpose.

Learning Activities

Students are expected to spend at least two hours for each lecture hour of course time per week in activities and assessments outside the classroom. Examples of activities include, but are not limited to: writing papers; reading articles or text; small group work; presentations; completing assignments; preparation for assessments; online activities and other activities that do not include direct instructor interaction and involvement.

All university policies apply to this course and all others. For full policy information please consult the university SCU Policy Manual. For a quick reference guide to the following policies: make-up examination, F-challenge examination, grade posting, results of failing grades, student support information, syllabus amendments, special needs, student conduct, and attendance, please consult the academic policies document housed on the **Online Student Services .**

SOUTHERN CALIFORNIA UNIVERSITY OF HEALTH SCIENCES

Appendix A: Course Learning Objectives

At the conclusion of this course, a successful student should be proficient in:

Chemistry: Methods and Measurement

1. Explain the relationship between chemistry, matter, and energy.
2. Discuss the approach to science, the scientific method, and distinguish among the terms *hypothesis, theory,* and *scientific law.*
3. Distinguish between data and results.
4. Describe the properties of the solid, liquid, and gaseous states.
5. Classify matter according to its composition.
6. Provide specific examples of physical and chemical properties and physical and chemical changes.
7. Distinguish between intensive and extensive properties.
8. Identify the major units of measure in the English and metric systems.
9. Report data and calculate results using scientific notation and the proper number of significant figures.
10. Distinguish between *accuracy* and *precision* and their representations: *error* and *deviation.*
11. Convert between units of the English and metric systems.
12. Know the three common temperature scales and convert values from one scale to another.
13. Use density, mass, and volume in problem solving, and calculate the specific gravity of a substance from its density.

The Structure of the Atom and the Periodic Table

14. Describe the properties of protons, neutrons, and electrons.
15. Interpret atomic symbols, and calculate the number of protons, neutrons, and electrons for atoms.
16. Distinguish between the term's *atom* and *isotope and* use isotope notations and natural abundance values to calculate atomic masses.
17. Summarize the history of the development of atomic theory, beginning with Dalton.
18. Describe the role of spectroscopy and the importance of electromagnetic radiation in the development of atomic theory.
19. State the basic postulates of Bohr's theory, its utility, and its limitations.
20. Recognize the important subdivisions of the periodic table: periods, groups (families), metals, and nonmetals.
21. Identify and use the specific information about an element that can be obtained from the periodic table.
22. Describe the relationship between the electronic structure of an element and its position in the periodic table.
23. Write electron configurations, shorthand electron configurations, and orbital diagrams for atoms and ions.
24. Discuss the octet rule and use it to predict the charges and the numbers of protons and electrons in cations and anions formed from neutral atoms.
25. Utilize the periodic table trends to estimate the relative sizes of atoms and ions, as well as relative magnitudes of ionization energy and electron affinity.

Structure and Properties of Ionic and Covalent Compounds

26. Draw Lewis symbols for representative elements and their respective ions.
27. Classify compounds as having ionic, polar covalent, or nonpolar covalent bonds.
28. Write the formula of a compound when provided with the name or elemental composition of the compound.

29. Name inorganic compounds using standard naming conventions, and recall the common names of frequently used substances.
30. Predict differences in physical state, melting and boiling points, solid-state structure, and solution chemistry that result from differences in bonding.
31. Draw Lewis structures for covalent compounds and polyatomic ions.
32. Explain how the presence or absence of multiple bonding relates to bond length, bond energy, and stability.
33. Use Lewis structures to predict the geometry of molecules.
34. Describe the role that molecular geometry plays in determining the polarity of compounds.
35. Use polarity to determine solubility and predict the melting and boiling points of compounds.

Calculations, Chemical Changes, and the Chemical Equation

36. Calculate the mass of an atom using the atomic mass unit.
37. Use the relationship between Avogadro's number and the mole to perform calculations.
38. Determine molar mass and demonstrate how it is used in mole and mass conversion calculations.
39. Use chemical formulas to calculate the formula mass and molar mass of a compound.
40. Describe the functions served by the chemical equation, the basis for chemical calculations.
41. Classify chemical reactions by type: combination, decomposition, or replacement.
42. Balance chemical equations given the identity of products and reactants.
43. Write net ionic equations and use solubility rules to predict the formation of a precipitate.
44. Distinguish between an acid and a base.
45. Write oxidation and reduction half-reactions and identify oxidizing agents and reducing agents.
46. Compare and contrast voltaic and electrolytic cells.
47. Describe examples of redox processes.
48. Use a chemical equation and a given number of moles or mass of a reactant or product to calculate the number of moles or mass of a reactant or product.
49. Calculate theoretical and percent yields

States of Matter: Gases, Liquids, and Solids

50. Perform conversions between units of pressure.
51. Describe the major points of the kinetic molecular theory of gases.
52. Explain the relationship between the kinetic molecular theory and the physical properties of measurable quantities of gases.
53. Describe the behavior of gases expressed by the gas laws: Boyle's law, Charles's law, combined gas law, Avogadro's law, the ideal gas law, and Dalton's law.
54. Use gas law equations to calculate conditions and changes in conditions of gases.
55. Use molar volume and standard temperature and pressure (STP) to perform calculations.
56. Discuss the limitations to the ideal gas model as it applies to real gases.
57. Describe properties of the liquid state in terms of the properties of the individual molecules that comprise the liquid.
58. Describe the processes of melting, boiling, evaporation, condensation, and sublimation.
59. Describe the dipolar attractions known collectively as van der Waals forces.
60. Describe hydrogen bonding and its relationship to boiling and melting temperatures.
61. Relate the properties of the various classes of solids (ionic, covalent, molecular, and metallic) to the structure of these solids.

Solutions

62. Distinguish among the terms *solution, solute,* and *solvent.*
63. Describe the properties and composition of various kinds of solutions.
64. Explain which factors influence the degree of solubility, and use trends to make predictions.
65. Describe the relationship between solubility and equilibrium.
66. Use Henry's law to calculate equilibrium solubility values for gases.
67. Calculate solution concentration in mass/volume percent, mass/mass percent, parts per thousand, and parts per million.
68. Determine the quantity of solute or solution from the concentration of solution.
69. Calculate the molarity of solution from mass or moles of solute.
70. Perform dilution calculations.
71. Describe and explain concentration-dependent solution properties.
72. Perform calculations involving colligative properties.
73. Describe why the chemical and physical properties of water make it a truly unique solvent.
74. Interconvert molar concentration of ions and milliequivalents/liter.
75. Explain the role of electrolytes in blood and their relationship to the process of dialysis.

Energy, Rate, and Equilibrium

76. Correlate the terms *endothermic* and *exothermic* with heat flow between a *system* and its *surroundings.*
77. Explain what is meant by *enthalpy, entropy,* and *free energy* and demonstrate their implications.
78. Describe experiments that yield thermochemical information and use experimental data to calculate the quantity of energy involved in reactions.
79. Describe the concept of reaction rate and the role of kinetics in chemical and physical change.
80. Describe the importance of *activation energy* and the *activated complex* in determining reaction rate.
81. Predict the way reactant structure, concentration, temperature, and catalysis affect the rate of a chemical reaction.
82. Write rate laws and use these equations to calculate the effect of concentration on rate.
83. Recognize and describe equilibrium situations.
84. Write equilibrium constant expressions and use these expressions to calculate equilibrium constants or equilibrium concentrations.
85. Use LeChatelier's principle to predict changes in equilibrium position.

Acids and Bases

86. Classify compounds with acid-base properties as acids, bases, or amphiprotic.
87. Write equations illustrating the role of water in acid-base reactions.
88. Identify conjugate acid-base pairs.
89. Describe the relationship between acid and base strength and dissociation.
90. Use the ion product constant for water to solve for hydronium and hydroxide ion concentrations.
91. Calculate pH from solution concentration data.
92. Calculate hydronium and/or hydroxide ion concentration from pH data.
93. Describe the meaning and utility of neutralization reactions.
94. Use titration data to determine the molar concentration of an unknown solution.
95. Demonstrate the reactions and dissociation of polyprotic substances.
96. Describe the effects of adding acid or base to a buffer system.
97. Calculate the pH of buffer solutions

98. Explain the role of buffers in the control of blood pH under various conditions.

ORGANIC CHEMISTRY

An Introduction to Organic Chemistry: The Saturated Hydrocarbons

99. Compare and contrast organic and inorganic compounds.
100. Recognize structures that represent each of the families of organic compounds.
101. Write the names and draw the structures of the common functional groups that characterize the families of organic compounds.
102. Write condensed, structural, and line formulas for saturated hydrocarbons.
103. Describe the relationship between the structure and physical properties of saturated hydrocarbons.
104. Use the basic rules of the IUPAC nomenclature system to name alkanes and substituted alkanes.
105. From the IUPAC name of an alkane or substituted alkane, be able to draw the structure.
106. Draw constitutional (structural) isomers of simple organic compounds.
107. Write the names and draw the structures of simple cycloalkanes.
108. Draw *cis*- and *trans*-isomers of cycloalkanes.
109. Describe conformations of alkanes.
110. Draw the chair and boat conformations of cyclohexane.
111. Write balanced equations for combustion reactions of alkanes.
112. Write balanced equations for halogenation reactions of alkanes.

The Unsaturated Hydrocarbons: Alkenes, Alkynes, and Aromatics

113. Describe the physical properties of alkenes and alkynes.
114. Draw the structures and write the IUPAC names for simple alkenes and alkynes.
115. Write the names and draw the structures of simple geometric isomers of alkenes.
116. Write equations predicting the products of addition reactions of alkenes and alkynes: hydrogenation, halogenation, hydration, and hydrohalogenation.
117. Apply Markovnikov's rule to predict the major and minor products of the hydration and hydrohalogenation reactions of unsymmetrical alkenes.
118. Write equations representing the formation of addition polymers of alkenes.
119. Draw the structures and write the names of common aromatic hydrocarbons.
120. Write equations for substitution reactions involving benzene.
121. Describe heterocyclic aromatic compounds and list several biological molecules in which they are found.

Alcohols, Phenols, Thiols, and Ethers

122. Classify alcohols as primary, secondary, or tertiary.
123. Rank selected alcohols by relative water solubility, boiling points, or melting points.
124. Write the names and draw the structures for common alcohols.
125. Discuss the biological, medical, or environmental significance of several alcohols.
126. Write equations representing the preparation of alcohols by the hydration of an alkene.
127. Write equations representing the preparation of alcohols by hydrogenation (reduction) of aldehydes or ketones.
128. Write equations showing the dehydration of an alcohol.
129. Write equations representing the oxidation of alcohols.
130. Discuss the role of oxidation and reduction reactions in the chemistry of living systems.
131. Discuss the use of phenols as germicides.
132. Write names and draw structures for common ethers and discuss their use in medicine.

133. Write equations representing the condensation reaction between two alcohol molecules to form an ether.
134. Write names and draw structures for simple thiols and discuss their biological significance.

Aldehydes and Ketones

135. Draw the structures and discuss the physical properties of aldehydes and ketones.
136. From the structures, write the common and IUPAC names of aldehydes and ketones.
137. List several aldehydes and ketones that are of natural, commercial, health, and environmental interest and describe their significance.
138. Write equations for the preparation of aldehydes and ketones by the oxidation of alcohols.
139. Write equations representing the oxidation of carbonyl compounds.
140. Write equations representing the reduction of carbonyl compounds.
141. Write equations for the preparation of hemiacetals and acetals.
142. Draw the keto and enol forms of aldehydes and ketones.

Carboxylic Acids and Carboxylic Acid Derivatives

143. Write structures and describe the physical properties of carboxylic acids.
144. Determine the common and IUPAC names of carboxylic acids.
145. Describe the biological, medical, or environmental significance of several carboxylic acids.
146. Write equations that show the synthesis of a carboxylic acid.
147. Write equations representing acid-base reactions of carboxylic acids.
148. Write equations representing the preparation of an ester.
149. Write structures and describe the physical properties of esters.
150. Determine the common and IUPAC names of esters.
151. Write equations representing the hydrolysis of an ester.
152. Define the term *saponification,* and describe how soap works in the emulsification of grease and oil.
153. Determine the common and IUPAC names of acid chlorides.
154. Determine the common and IUPAC names of acid anhydrides.
155. Write equations representing the synthesis of acid anhydrides.
156. Discuss the significance of thioesters and phosphoesters in biological systems.

Amines and Amides

157. Classify amines as primary, secondary, or tertiary.
158. Describe the physical properties of amines.
159. Draw and name simple amines using systematic and common nomenclature systems.
160. Write equations representing the synthesis of amines.
161. Write equations showing the basicity and neutralization of amines.
162. Describe the structure of quaternary ammonium salts and discuss their use as antiseptics and disinfectants.
163. Discuss the biological significance of heterocyclic amines.
164. Describe the physical properties of amides.
165. Draw the structure and write the common and IUPAC names of amides.
166. Write equations representing the preparation of amides.
167. Write equations showing the hydrolysis of amides.
168. Draw the general structure of an amino acid.
169. Draw and discuss the structure of a peptide bond.
170. Describe the function of neurotransmitters

BIOCHEMISTRY

Carbohydrates

171. List the functions of proteins.
172. Draw the general structure of an amino acid, and classify amino acids based on their R groups.
173. Describe the primary structure of proteins and draw the structure of the peptide bond.
174. Draw the structures of small peptides and name them.
175. Describe the types of secondary structure of a protein.
176. Discuss the forces that maintain secondary structure.
177. Describe the structure and functions of fibrous proteins.
178. Describe the tertiary and quaternary structure of a protein.
179. List the R group interactions that maintain protein conformation.
180. List examples of proteins that require prosthetic groups and explain the way in which they function.
181. Discuss the importance of the three-dimensional structure of a protein to its function.
182. Describe the roles of hemoglobin and myoglobin.
183. Describe how extremes of pH and temperature cause denaturation of proteins.
184. Explain the difference between essential and nonessential amino acids.

Enzymes

185. Classify enzymes according to the type of reaction catalyzed and the type of specificity.
186. Give examples of the correlation between an enzyme's common name and its function.
187. Describe the effect that enzymes have on the activation energy of a reaction.
188. Explain the effect of substrate concentration on enzyme-catalyzed reactions.
189. Discuss the role of the active site and the importance of enzyme specificity.
190. Describe the difference between the lock-and-key model and the induced fit model of enzyme-substrate complex formation.
191. Discuss the roles of cofactors and coenzymes in enzyme activity.
192. Explain how pH and temperature affect the rate of an enzyme-catalyzed reaction.
193. Describe the mechanisms used by cells to regulate enzyme activity.
194. Discuss the mechanisms by which certain chemicals inhibit enzyme activity.
195. Discuss the role of the enzyme chymotrypsin and other serine proteases.
196. Provide examples of medical uses of enzymes.

Introduction to Molecular Genetics

197. Draw the general structure of DNA and RNA nucleotides.
198. Describe the structure of DNA and compare it with RNA.
199. Explain DNA replication.
200. List three classes of RNA molecules and describe their functions.
201. Explain the process of transcription.
202. List and explain the three types of post-transcriptional modifications of eukaryotic mRNA.
203. List and explain the three types of post-transcriptional modifications of eukaryotic mRNA.
204. Describe the essential elements of the genetic code and develop a "feel" for its elegance.
205. Describe the process of translation.
206. Define mutation and understand how mutations cause cancer and cell death.
207. Describe the tools used in the study of DNA and in genetic engineering.
208. Describe the process of polymerase chain reaction, and discuss potential uses of the process.
209. Discuss strategies for genome analysis and DNA sequencing.

Carbohydrate Metabolism

210. Discuss the importance of ATP in cellular energy transfer processes.
211. Describe the three stages of catabolism of dietary proteins, carbohydrates, and lipids.
212. Discuss glycolysis in terms of its two major segments.
213. Looking at an equation representing any of the chemical reactions that occur in glycolysis, describe the kind of reaction that is occurring and the significance of that reaction to the pathway.
214. Describe the mechanism of regulation of the rate of glycolysis. Discuss particular examples of that regulation.
215. Discuss the practical and metabolic roles of fermentation reactions.
216. List several products of the pentose phosphate pathway that are required for biosynthesis.
217. Compare glycolysis and gluconeogenesis.
218. Summarize the regulation of blood glucose levels by glycogenesis and glycogenolysis.

Aerobic Respiration and Energy Production

219. Name the regions of the mitochondria and the function of each region.
220. Describe the reaction that results in the conversion of pyruvate to acetyl CoA, describing the location of the reaction and the components of the pyruvate dehydrogenase complex.
221. Summarize the reactions of aerobic respiration.
222. Looking at an equation representing any of the chemical reactions that occur in the citric acid cycle, describe the kind of reaction that is occurring and the significance of that reaction to the pathway
223. Explain the mechanisms for the control of the citric acid cycle.
224. Describe the process of oxidative phosphorylation.
225. Describe the conversion of amino acids to molecules that can enter the citric acid cycle.
226. Explain the importance of the urea cycle and describe its essential steps.
227. Discuss the cause and effect of hyperammonemia.
228. Summarize the role of the citric acid cycle in catabolism and anabolism.

Fatty Acid Metabolism

229. Summarize the digestion and storage of lipids.
230. Describe the degradation of fatty acids by β-oxidation.
231. Explain the role of acetyl CoA in fatty acid metabolism.
232. Understand the role of ketone body production in β-oxidation
233. Compare β-oxidation of fatty acids and fatty acid biosynthesis.
234. Describe the regulation of lipid metabolism in relation to the liver, adipose tissue, muscle tissue, and the brain.
235. Summarize the antagonistic effects of glucagon and insulin.