Chemistry for Health Sciences | Lecture and Lab
Academic Year 2021-2022

Course Information

Course Numbers	Total Credits	Time Requirement
CHEM351/CHEM351L	**5 (4 Lecture + 1 Lab)**	**90 hrs (Lecture 60hrs + Lab 30hrs)**

Course Details

Recommended Prerequisites

High School Diploma or equivalent; General Education courses are highly recommended

Course Description

Chemistry for Health Sciences is an introductory course, which is 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 10th edition (Connect©) (ISBN: 13: 978-1260148954). An electronic textbook is provided to students on Canvas.

Lab 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.

Course Schedule (Subject to slight modifications by the instructor)

Week	Lecture	Assessment
1	Module 1: Chemistry: Methods and Measurement Module 2: The Structure of the Atom and the Periodic Table Module 3: Structure and Properties of Ionic and Covalent Compounds Module 4: Calculations, Chemical Changes, and the Chemical Equation	Reading Assignment Homework Check Your Understanding Participation
2	Module 5: States of Matter: Gases, Liquids, and Solids Module 6: Solutions Module 7: Energy, Rate, and Equilibrium Module 8: Acids and Bases and Oxidation-Reductions Reactions	Reading Assignment Homework Check Your Understanding Participation
3	Module 9: An Introduction to Organic Chemistry: The Saturated Hydrocarbons Module 10: The Unsaturated Hydrocarbons: Alkenes, Alkynes, and Aromatics Module 11: Alcohols, Phenols, Thiols, and Ethers Module 12: Aldehydes and Ketones Module 13: Carboxylic Acids and Carboxylic Acid Derivatives	Reading Assignment Homework Check Your Understanding Exam I Modules 1-8 Participation
4	Module 14: Amines and Amides Module 15: Carbohydrates Module 16: Lipids and Their Functions in Biochemical Systems Module 17: Protein Building Blocks: The α-Amino Acids Module 18: Enzymes	Reading Assignment Homework Check Your Understanding Exam II Modules 9-14 Participation
5	Module 19: Introduction to Molecular Genetics Module 20: Carbohydrate Metabolism Module 21: Aerobic Respiration and Energy Production Module 22: Fatty Acid Metabolism	Reading Assignment Homework Check Your Understanding Exam III Modules 15-22 Participation

Tentative Grading Procedures

Lecture

Assignment	Total assignments	Weight
Reading assignments	22	10%
Check Your Understanding Quiz	22	25%
Participation	10	10%
Homework	22	15%
Exams	3	40%
Total		100%

Lab Schedule

(Subject to slight modifications by the instructor)

Topic	Assignment
Check-in: Check in/safety	Lab notebook
Experiment 1: Measurement and Significant Figures	Lab notebook
Experiment 2: Separation of Mixtures	Lab notebook
Experiment 3: Families of Elements	Lab notebook
Experiment 4: Reaction Stoichiometry	Lab notebook Quiz 1
Experiment 5: Molecular Structure and Properties	Lab notebook
Experiment 6: Paper Chromatography	Lab notebook
Experiment 7: Alcohols and Phenols	Lab notebook
Experiment 8: Organic Functional Groups	Lab notebook Quiz 2

Tentative Grading Procedures

Lab

Lab

Assessment	Weight (%)
Lab Quizzes	40
Lab Notebook	10
Pre labs	15
Post labs	25
Participation (discussions, worksheets etc)	10
Total	100

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

Academic Integrity

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

Teaching Methods and Activities

In classes with scheduled class time, lecture will be delivered in real time/live by the instructor. You must adhere to the attendance policy set out by the instructor for the class. In asynchronous classes, students will review lecture content in their own time. Due to the individualized nature of the learning, students should expect to spend as much time as needed based on individual attainment of prerequisite knowledge. Check your Canvas course page and student schedule to confirm the modality of the course that you are registered in.

Lecture Outline PowerPoints, Supplemental Videos and Support Materials: The lecture outline is essentially a series of PowerPoint slides on the most important chapter topics that you should review before you begin the Reading Assignment. These slides will also serve as a good reference when completing homework and reviewing for exams. Supplemental videos and support materials contain videos or other items related to some of the most important or interesting topics in the chapter. Some videos show fun applications. Some videos are conceptual, and some videos are designed to help you master the calculations in this course. These are all optional learning materials.

Reading Assignment: Read the assigned sections in the chapter fully and complete any activities embedded in the SMARTBOOK reading assignment. Reading time will vary from module to module.

Homework: Homework problems are reflective of the type questions that will be on the Exams. Remember, there is a difference between completing chemistry related word problems with access to help (book, instructor office hours, tutor, Google, etc.) versus completing problems on your own. It is okay and encouraged to use all available resources to learn how to complete a certain type of chemistry problem. However, the long-term goal should be obtaining the ability to complete Exam problems without any aid. First homework must be done using Proctorio.

Check Your Understanding Quizzes: On Check Your Understanding pages, you will practice the module content you've covered using interactive study tools. These interactive study tools will help you assess your progress and identify areas for improvement. Additionally, interactives give you an opportunity to review and apply information presented in your course and in the online textbook before taking quizzes or high-stakes exams.

Exams: There are three exams in each class. There will be questions that are similar to the learning curves, homework, and formative quizzes. The Exams are all on Canvas. Please pay attention to the due dates. They are final and will not be extended. You must use proctoring methods required by the instructor.

Laboratory

Attire for lab

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.

Evaluation of Experimental Technique: You will be assessed on your general performance and regards for the rules of the laboratory and safety procedures.

Attendance for lab: Punctual attendance at each of your regularly scheduled laboratory and period is required. Additionally, you are required to stay until you and/or your group have completed the experiment. Check out with

your lab instructor before leaving the laboratory after completing the experiment. You are expected to attend every one of your scheduled lab meeting times. However, if you find yourself in a situation where you are unable to attend lab, please email your instructor right away.

Lab Notebook: Students will be required to keep a laboratory notebook, and the instructor will grade notebook entries. The notebook allows you to accurately record experiment procedures and data, so you should write it so that someone else could repeat your experiments and get the same results. Among other things, this includes recording all spectroscopic and analytical data that you obtain from the experiment procedure. Further information about the lab notebook will be provided in class.

Pre-labs: Prelabs contain content questions that are intended to help you prepare for lab procedures. Pre-labs can be found in the lab manual and must be completed before each lab class.

Post-labs: Post-labs, or lab reports will consist of the report sheet(s), answers to post-lab questions and sometimes Excel plots of data analysis when appropriate. While the lab activity may be group-based, you must complete lab reports on your own (lab reports are not group assignments).

Laboratory Quizzes: Quizzes will be given the week after your experiment and its modality will be indicated by the Professor. These quizzes will be closely based on the pre-labs and lab reports.

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.