

Texas A&M University - Corpus Christi
CHEM 4401 Biochemistry I - Fall 2011
TR 11:00 –12:15 pm BH 104

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Course Description

CHEM 4401 is the first half of a two-semester course that covers the structure and function of the major biomolecules (amino acids, lipids, carbohydrates, proteins, lipids, nucleic acids and polysaccharides) as well as the major metabolic pathways involved in their synthesis and degradation. This course has a laboratory component that covers basic biochemical techniques, the use of various biochemistry databases, and the analysis and preparation of biochemical data.

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

- Identify important biochemical functional groups, the types of bonds (hydrogen, ionic, hydrophobic, etc.) they typically form, and the impact these bonds have on biochemical structure, activity and function.
- Recognize and describe the chemical and physical properties of water, its relationship to ionization constants, the pH of a solution, and its role in the structure and function of proteins, nucleic acids, carbohydrates and lipids.
- Identify the major classes of small biochemical compounds (amino acids, carbohydrates, nucleotides, lipids), compare and contrast their chemical characteristics and biological roles.
- Describe the primary features of protein structure and function, including ligand binding, enzyme catalysis and the regulation of enzyme activity.
- Recognize the primary features of polysaccharide structure and function, and describe their major biological roles.
- Recognize the primary features of nucleic acid (DNA, RNA) structure, compare and contrast their functions and major biological roles.
- Describe the construction and function of biological membranes.
- Identify and describe the basic mechanisms of biological signal transduction.
- Perform basic biochemistry procedures, including: buffer preparation, spectrophotometry, chromatography, enzyme preparation, kinetic analysis and standard bioinformatics techniques.
- Analyze experimental protocols, perform standard biochemical calculations, critique data, and prepare results for oral or written presentation.

Required Texts:

Principles of Biochemistry, 5th Edition (2008) Lehninger, Nelson and Cox.

Biochemistry I and II Laboratory Manual, Milroy and Morvant.

Recommended Texts

Biochemistry I (CHEM 4401) Study Guide, Larkin.

Lecture Format: The CHEM 4401 lecture will be taught using a *peer-centered* format, which requires participation on the part of students. Briefly, the lecture period will be broken up into mini-sections covering specific topics. At the end of a topic, example problems are posed and the class surveyed for the correct answer. If it appears that the concept still requires clarification, students are asked to work with one another for approximately one minute to consider the reasoning for their answer. To facilitate this type of interaction, we will be utilizing a set of answer cards (A,B,C,D) that are included as part of the study guide. **PLEASE BRING THESE CARDS TO EACH CLASS.**

Lecture Exams: There will be three semester examinations in addition to a comprehensive final examination. Examinations will be predominantly multiple choice but may include short answer, brief calculation or structure drawing questions. All answers on exam scantrons are final, so please either fill in your answer choices on your scantron as you proceed, double check your answers on your scantron before you turn it in, or both. If you feel you have a legitimate disagreement with your score on a particular test question, please write Dr. Larkin a note explaining the situation. Provide evidence to support your case. If your argument is sound, then you will be given additional credit. **You must have your note ready by the second lecture after the exams are returned.**

Exam 1	100 pts
Exam 2	100 pts
Exam 3	100 pts
Final Exam	100 pts
Total	400 pts

Exams will take place during regular class time. Please let me know ahead of time if you have a university-approved excuse, if at all possible, so alternate arrangements can be made. **All make-up exams will be short answer to essay-type tests.** We will not “drop” any of the examinations in the calculation of your final grade.

Course Grading: A combined grade for both lecture and laboratory will be given for the course. The lecture component will count for 75% of the grade and the laboratory component for 25%. **This course will not have a curve.** The scale below indicates the minimum course score (out of a possible 100) required to obtain a particular grade.

Grade	Score
A	90
B	80
C	70
D	55
F	<55

The course score is calculated by adding the lecture and laboratory scores:

$$\text{lecture score} : \frac{\text{Exam points}}{400} * 75$$

$$\text{laboratory score} : \frac{(\text{lab reports} + \text{worksheets} + \text{exam points})}{200} * 25$$

As noted above, there are 400 points possible in lecture from the three regular and one final examination. There will be a total of 200 points that can be earned in the laboratory component of the course from lab reports, worksheets, a mid-term exam, a final exam and laboratory performance.

Two examples are provided below that outline the type of final grade one might expect with a laboratory percentage of either 90% or 80%. Each example shows the final outcomes expected when varying levels of lecture points have been earned. The point is to show that a good score needs to be obtained in BOTH lecture AND laboratory in order to obtain a good overall grade for the course. DO NOT expect a good lab score to boost a weak lecture score by a full letter grade.

Total Lecture points earned	Lecture Score	Total Laboratory points earned	Laboratory Score	Course Score (Lecture+Lab Score)	Final Grade
200 (50%)	37.5	180 (90%)	22.5	60.0	D
240 (60%)	45.0	180 (90%)	22.5	67.5	D
280 (70%)	52.5	180 (90%)	22.5	74.5	C
320 (80%)	60.0	180 (90%)	22.5	82.5	B
360 (90%)	67.5	180 (90%)	22.5	90.0	A
200 (50%)	37.5	160 (80%)	20	57.5	D
240 (60%)	45.0	160 (80%)	20	65.0	D
280 (70%)	52.5	160 (80%)	20	72.5	C
320 (80%)	60.0	160 (80%)	20	80.0	B
360 (90%)	67.5	160 (80%)	20	87.5	B

Decorum: The best way to encourage learning is to provide an environment conducive to listening, concentration and discussion. As in any class, students are expected to maintain the highest standards of decorum and to conform to college-level standards of ethics and academic integrity. Most of these involve common sense and courtesy, but please refer to the section on academic policies and regulations in the university catalog for a more thorough description of these expectations.

Please remember that biochemistry is **NOT a “Spectator Sport”**. Keep up with the reading, do end-of chapter problems, come to class, review and annotate your notes and use the study guide. I have produced one as a homework tool that is available at the bookstore (about \$5). It is extensive, so begin early and keep up with the material as we proceed through the semester. An additional, “official” study guide (Osgood and Ocorr) will also be made available on reserve at the library. Forming a study group with 1-2 other students is another strategy many students find helpful.

Note for students with disabilities The Chemistry Program complies with the Americans with Disabilities Act in making reasonable accommodations for qualified students. If you need disability accommodations, or if you suspect that you may have a disability (physical impairment, learning disability, psychiatric disability, etc.), please contact the Services for Students with Disabilities Office (Driftwood 101, ph. 825-5816). It is important that you contact them in a timely fashion as it may take from several days to weeks to review requests and prepare accommodations.

Academic Advising. The College of Science and Technology requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. The Academic Advising Center is located in the college’s office suite in the Center for Instruction. Please choose the advisor who corresponds to your major (or potential major). Contact your advisor directly, or call Tracey Ramirez at (361) 825-6094, to schedule an appointment. Walk-in times may be available at especially busy times of the year (such as the start of a semester). Please call the Advising Center to check availability and ensure a minimal wait.

Grade Appeals. As stated in University Rule 13.02.99.C2, Student Grade Appeals, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Rule 13.02.99.C2, Student Grade Appeals, and University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules Web site at http://www.tamucc.edu/provost/university_rules/index.html. For assistance and/or guidance in the grade appeal process, students may contact the Office of Student Affairs.

Outline and Tentative Schedule

Date		Topic	Reading
			Chapter.section(s)
August	25	Introduction/Foundations	-
August	30	Cells & Organelles	1.1
September	1	Biomolecules/Reactions	1.2-3
September	6	Biomolecules/Reactions	1.2-3
September	8	Biomolecules/Water	2.1
September	13	Water	2.2
September	15	Water	2.3-5
September	20	Exam 1	
September	22	Amino Acids	3.1
September	27	Protein Structure	3.2, 3.4
September	29	Protein Structure	4.1-4
October	4	Protein Function: Ligand Binding	5.1-2
October	6	Protein Function: Ligand Binding	5.2-3
October	11	Enzymes:General function	6.1-2
October	13	Enzymes: Kinetics	6.3
October	18	Enzymes: Mechanisms	6.4
October	20	Enzymes: Regulation	6.5
October	25	Exam 2	
October	27	Carbohydrates	7.1-2
November	1	Carbohydrates	7.3-4
November	3	Carbohydrates/nucleic acids	8.1-2
November	8	Nucleic Acids	8.1-2
November	10	Nucleic Acids	8.3-4
November	15	Lipids	10.1-2
November	17	Lipids	10.3-4
November	22	Exam 3	
November	24	No Class - Thanksgiving Break	
November	29	Membranes	11.1-2
December	1	Membranes	11.3
December	6	Biosignalling	12.1-6
December	8	Final Exam 11-1:30pm	Comprehensive

CHEM 4401 Laboratory

The laboratory component is a hands-on course in biochemistry techniques and the use of important biochemistry databases. The primary objective is to expose the student to a number of procedures commonly used in the biochemistry laboratory and to provide a basis for understanding how biochemical data is obtained, analyzed and presented. Additional objectives include instruction in the theory and principles of biochemistry.

Required Laboratory Materials

Biochemistry I and II Laboratory Manual, Milroy and Morvant (required). Additional assignments will be posted as portable document files (.pdf) to Dr. Larkin's web site prior to lab. You must have Adobe Acrobat reader (available for download from Dr. Larkin's web site) installed on your computer in order to perform a download.

Supplementary instruction material. ALWAYS CHECK Dr. LARKIN'S WEB SITE (www.tamucc.edu/~plarkin/) for any supplementary materials required for each week's lab. Not every experiment is printed in the laboratory manual, and some require additional instructions, etc. Bringing supplementary material to lab is the STUDENT'S RESPONSIBILITY, NOT THE TA's.

Laboratory Notebook (required): A separate (not used for other classes) notebook is required for performing pre-laboratory work, recording observations, etc. Traditional blue, string-bound hard-covered versions are available at the University Bookstore.

Safety Goggles

Lab Coat

Attendance: Students are required to attend all laboratory sessions. Please arrive on time and remain until the laboratory procedure is completed. Check with your instructor before leaving. Absence from laboratory without a university approved excuse and/or prior approval from the instructor will result in a grade of zero for that session. Occasionally a student may be permitted to attend another laboratory section if a conflict arises with their scheduled session, and IF it is cleared with all instructors involved BEFOREHAND, but no make-up lab periods will be held outside of the scheduled sections.

Safety

Safety Lecture: You must be registered for, and complete, one of the Lab Safety Briefings (PSCI 0091) prior to performing experiments in the laboratory.

Eye Safety: When in lab, always wear your safety goggles. A first violation will result in a verbal notification. Subsequent violations may result in the student being asked to leave the laboratory, with a grade of zero for the session. Also, be advised that wearing contact lenses in the laboratory can be harmful to your eyes, even when you wear safety goggles over them.

Clothing: No open toe shoes or shorts (or short dresses) are allowed in the laboratory. A lab coat must be worn at all times.

Keep it Clean: Keeping things clean will keep any chemicals in the lab and not in your home. Always wash your hands just before leaving the lab. Never take samples or glassware out of the lab. **Do not place your coats, backpacks and other personal items on the bench tops or floor in the lab. They can be placed in the cabinets under the benches.** Keep in mind; anything you

bring into the lab should be treated with care at home. Your notebook and lab book may be picking up stuff you spilled on the bench or floor and did not clean up.

Disposal of Chemical Wastes: During the experiments, you will generate several types of waste, which need to be handled properly. Organic wastes should be placed in an appropriately marked container for organic waste. Aqueous waste (such as water layers from extractions) should also be poured into an appropriately marked waste container. Likewise, solid wastes should be placed in an appropriately labeled container. Broken glassware should be placed in the broken glassware container. Never put glass into the regular trashcans.

Ask for Assistance: If you have any questions about the safety of any procedure, please ask your instructor before proceeding.

A few reminders:

- No eating or drinking is allowed in the laboratory
- Know the location of fire extinguishers, eyewash stations, safety showers, fire alarms and Material Data Safety Sheets (MSDS forms)
- If an accident occurs, immediately notify the instructor or TA.

Laboratory Facilities

Your laboratory fees, tuition and tax dollars pay for the instruments and labware in the laboratory. We will teach you how to use all of the necessary equipment for each exercise. To ensure optimal performance of instruments, do not attempt to use any equipment until your instructor gives you direction. If equipment malfunctions, **notify the instructor immediately so we can repair or replace it as soon as possible.**

This laboratory receives heavy use. As a courtesy to your fellow students, all lab teams are expected to clean up their stations after each period. This includes replacing all equipment to their original locations, turning off and covering instruments, cleaning glassware, replacing pipet tips and wiping down lab benches. Each team must check out with their instructor prior to leaving.

Grading:

Your laboratory score will be determined based on points earned from weekly assignments, laboratory reports, laboratory performance, a mid-term and a final exam. There are a total of 200 points that can be earned. Laboratory counts for 25% of your course grade and is calculated as follows:

$$\text{laboratory score} : \frac{(\text{lab reports} + \text{worksheets} + \text{exam points})}{200} * 25$$

All assignments are due at the **beginning** of the next laboratory period. We realize that the average student has a great many academic demands during the semester. Therefore, we offer a special **stress-relief clause**. You may turn in **one** assignment late, for any reason. **Please let your instructor know that you intend to use you're free late in writing at the time the assignment is due.** Your assignment will then be due at the beginning of lab the following week. Any other assignments turned in late will be penalized 10% for each extra day.

Laboratory performance. A portion of your grade (~ 5%) will also depend on laboratory performance. This is not “extra credit”, but a score based on individual student behavior. Points are earned by avoiding behaviors such as:

- Arriving late to class
- Being unprepared for the laboratory
- Performing in a lackluster manner (not paying attention, not taking initiative, etc.)
- Leaving the laboratory before completing the exercise
- Being disrespectful to your instructor or fellow students
- Failing to clean up at the end of the laboratory
- Violating safety regulations
- Plagiarizing another student’s work
- In general, conducting oneself unprofessionally

Remember, **while Dr. Larkin is the coordinator of the biochemistry labs, the Teaching assistant is the instructor.** Each instructor is in charge of his/her laboratory sections including attendance, instruction, laboratory assistance, grading, and handling of missed laboratory periods. Your instructor should be the first person you go to with questions related to the laboratory. Be sure to find out the best way to contact your instructor, their office location and their office hours.

Laboratory Reports

The laboratory reports are based on the format of a technical report that might be submitted to a supervisor at an industrial, government or other public/private organization. Even though students work in teams, lab reports are expected to be the result of individual effort. Thus, while we encourage students to work together in regards to data analysis and interpretation, we also expect individuality in interpretation and style of writing, especially regarding the introduction and discussion sections. ***If we suspect copying or plagiarism neither report will be accepted and a grade of zero will be recorded.***

Laboratory reports are to be typewritten, photocopies taken directly from your laboratory notebooks are **not** acceptable. Reports should meet the key tests of being both legible and understandable. Legible means correct spelling and intelligible, complete sentences. Understandable means complete tables and graphs, with units, legends, column headings and axis titles present and clearly identified. Graphs and tables are to be computer-generated. Many software packages, such as Microsoft Excel and Word have convenient tutorials (“wizards”) for the construction of tables and graphs.

The full lab report should consist of a title page, introduction, procedure, results and discussion.

Title Page:

- Laboratory report title
- Your name
- Your lab partner’s name
- Your section number
- The name of your instructor
- The date

Introduction: Clearly state the aim of the experiment, including the name or type of the main technique or procedure and how the results were checked. Include any background information on the basic principles and theory underlying the particular experimental technique.

Procedure: Include a brief narrative description of the major steps for the particular technique/procedure (“...using primers “X” and “Y” and the Polymerase Chain Reaction”, ...using Gel permeation chromatography with “X” as the chromatography matrix”, etc.). You **do not need to rewrite a step-by-step description** of the procedure from your laboratory manual, but try to summarize the important steps.

Results: This section should include all experimental data and its manipulation in the form of example calculations, photographs, tables, etc. Example calculations should be used instead of separate calculations for each sample. Be sure all experimental data is clearly labeled with column headings, axis titles, figure legends, chart and graph titles, etc. This is where students lose the most points.

Discussion: This section is for showing your understanding of the experiment. Be sure to analyze your results and argue why you can draw certain conclusions. Discuss any expected results compared with your actual results and observations. Draw on the theory and your experience in order to rationalize the outcome of the experiment, especially possible reasons for deviations from the expected results.

Laboratory Notebooks: A well-written laboratory notebook will be an invaluable aid in preparing your reports. However, laboratory notebooks are not intended to look perfect. Use your notebook to write down notes on what you think is happening in a particular exercise, hand-draw rough graphs and jot down observations to aid your analysis or conclusions. In addition, each notebook should contain your name, section number and a table of contents. This makes it much easier to find data, results, procedures, etc. on any given experiment. It also makes it easier for us to return a notebook if it should be left in the laboratory.

Pre-lab: As part of each experiment, we ask that you prepare a pre-lab in your laboratory notebook. This section should provide enough specific information on the procedure (e.g., identity and quantity of materials, times, temperatures, etc.) to enable you to perform the experiment. It should be organized in a summary format and include: title of the experiment, purpose of the experiment, technique(s) or procedure(s) being used, outline of steps, tables for data and sample preparation. Your Pre-lab **will not** be turned in as part of your formal laboratory report

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Biochemistry Laboratory I Schedule

Date (week of)		Lab	Topic	Points
August	24		No Laboratory	
August	29	1	Units, Concentration, Solutions & Dilutions	15
September	5	2	Pipeting & Scales	10
September	12	3	Buffers & pH	17
September	19	4	Photometry	17
September	26	5	Amino Acid Chromatography	17
October	3	6	Protein Structure Analysis	10
October	10	7	Enzyme Activity: Polyphenoloxidase	33
October	17	8	Enzyme Kinetics	-
October	24	9	Protein Quantification/ Mid-term exam	20
October	31	10	Glucose determination	17
November	7	11	Nucleic Acids	17
November	14	12	Chromatographic Lipid Separation	17
November	21		No Laboratory (Thanksgiving Break)	
November	28	13	Lab clean-up, Checkout & Final Exam	10
			Total	200