LINFIELD COLLEGE

CHEMISTRY 440 **BIOCHEMISTRY (5 credits)** **Fall 2009**

Syllabus and Tentative Lecture Schedule

Instructor: Robert Wolcott Office: Mur 120 Office hours: M-Th 1-2 PM
Email: rwolcott@linfield.edu telephone: (503 883) 2265 Lecture MWF 9:00 – 10:00

The purpose of this course is to introduce the basic principles governing the operation of living systems. Early lectures describe the nature and properties of common "building block" molecules. This information is then applied to investigate the chemical reactions and energy transactions used to form complex macromolecular structures. An ancillary goal is to show how fundamental principles learned in general, organic and physical chemistry, as well as concepts taught in a variety of biology courses, can all be applied to reach an understanding of how living systems operate.

The work of the course involves active participation in lectures and laboratory exercises. The lectures provide the opportunity to learn and discuss facts, concepts and relationships. Laboratory exercises apply information presented in lecture to real situations, and give experience in a variety of techniques suited to investigation of properties of living systems. Students are expected to contribute in both lecture and lab by asking questions and making pertinent comments.

Examinations test for the ability not only to reproduce memorized facts and concepts, but also to apply them to unfamiliar situations and to discover good solutions to problems. **Lab reports are expected to show that the student understands the significance of a given experiment within the overall context of the course, and is able to clearly communicate the purpose, results and significance of the work performed.**

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Web Site: http://www.linfield.edu/chem/ (Click on Current Course Offerings)
Text: Lehninger Principles of Biochemistry, 5th edition, Freeman, 2008.

The following schedule is TENTATIVE and subject to change.

Date		Topic	Reading
Sep	2,4	Overview, including basic thermodynamics	1
	9	Properties of water, ionic equilibria	2
	11,14,16	Amino acids, peptides & proteins, analytical methods	3
	18,21	Proteins: 3D structure	4
	23	Proteins: biological functions	5
Sep/Oct	25,28,30,2,5	Enzymes: capabilities, kinetics and regulation of activity	6
	7	Overview of carbohydrates *(skim text)*	7
	9	**HOUR EXAM, CHAPTERS 1-6**	
	12	Overview of lipids *(skim text)*	10
	14,16	Membranes and transport phenomena	11
	19	Bioenergetics and reaction types	13
	21	Introduction to metabolism	---
	23,26,28,30	Glycolysis, gluconeogenesis, 6-P-gluconate path	14
Nov	2,4	Principles of metabolic regulation	15
	6	**HOUR EXAM, CHAPTERS 7,10,11,13-15**	
	9,11,13	Citric acid cycle	16
	16,18,20	Oxidative phosphorylation	19
Nov/Dec	30,2	Photosynthesis	19,20
	4	Fatty acid catabolism	17
	7	**HOUR EXAM, CHAPTERS 16, 19,20**	
	9	Fatty acid synthesis	21
	11,14	Overview of amino acid metabolism; possibly nucleotide metabolism	TBA

Final exam (cumulative, unlimited time): Wednesday, Dec 16, 8:00 AM or by mutually acceptable arrangement.
Computation of course grade: 3 exams @ 100, final @ 200, lab @ 125 (normalized) = 625 pt total.
Approximate dividing lines between letter grades (% of total possible points): A 85 B 72 C 52 D

Chem 440 **Laboratory Schedule** **Fall 2009**

Mur 106, Fridays 1-4 PM

Date		Experiment (protocols on course web site)	Credit
Sep	4	Check in, orientation, and calibration of pipetters (bring notebook)	
	11	Preparation of a buffer OR Colorimetry	10
	18	Colorimetry OR Preparation of a buffer	10
	25	Gel filtration chromatography	10
Oct	2	Isolation of lysozyme	
	9	pH optimum of lysozyme	20
	16	Kinetics of chymotrypsin	20
Oct	**23**	*** **(proposal due for individual experiment)** ***	
	23	Isolation of lactate dehydrogenase	
	30	Kinetics of lactate dehydrogenase	20
Nov	6	**Research for individual experiment**	
	13	**(research/prepare/perform individual experiment)**	
	20	**(research/prepare/perform individual experiment)**	
Dec	4	**Finish individual experiment**	20
	11	Check out	

Individual experiment: You need to plan, prepare needed reagents/equipment, and perform an experiment selected from those listed below during the last three weeks. In most cases I can point you to a good source. **A written proposal outlining this experiment (*goal, needed special reagents/equipment/techniques*) must be submitted no later than Oct. 23.** A detailed assignment for this will be handed out later. In it I will ask you to tell exactly how you will prepare and use buffers and other needed reagents, grow bacteria or obtain needed tissues, harvest and process them, use specialized equipment, document your results, *etc*. It is essential to plan ahead and leave yourself "margin" because what seems clear or trivial in a protocol often becomes mysterious or just plain doesn't work when you are at a lab bench. You may need to arrange specialized help that fits someone else's schedule. You will need sufficient lead time to verify that needed equipment and reagents are available (perhaps order them if they are not) and learn how to use them.

Individual experiment possibilities (if you have a different pet project, let's discuss it ***before*** the deadline above):

1. Analysis of an unknown dipeptide
2. Binding constant of phenol red to BSA
3. Stereospecificity of tyrosinase binding to D- and L-DOPA and estimate of catalytic efficiency
4. Enzymatic and nonenzymatic kinetics of sucrose hydrolysis
5. Electrochemical determination of vitamin C in various foods

GENERAL LAB INFORMATION: All reagents should be left where you and others would expect to find them. Please keep the lab clean. OPTICAL CUVETS are plastic and scratch easily, so please wipe them only with Kimwipes, wash only with water or detergent (no organic solvents), and store wrapped in Kimwipes. Glass and quartz cuvets are VERY expensive - please use extra care with these.

LEARN PROPER PIPETTING TECHNIQUE. Some reagents are toxic. In addition, sloppy technique always results in poor or useless data.

Locate and know how to use fire equipment.

Many experiments are long. If you don't come to lab prepared, you won't have time to finish. **Prepare your lab notebook before coming to lab so that you need only fill in data during the experiment.**

LAB NOTEBOOK: Please use a notebook that makes "carbon copy" pages. These copy pages must be stapled to your lab reports. See next page for detailed information on laboratory reports.

Disability Statement: *Students with documented disabilities who may need accommodations, who have any emergency medical information the instructor should know of, or who need special arrangements in the event of evacuation, should make an appointment with the instructor as early as possible, no later than the first week of the term.*

Academic Honesty: *I adhere to the Academic Honesty Policy published in the Linfield College Catalog, and I expect you to do so as well.*

LABORATORY REPORTS - please read carefully:

Reports are due as you enter lab one week after you finish the experiment. Scores for late reports are reduced by 10% of their maximum credit (*i.e.*, a report worth 10 points could only score 9 maximum if submitted late). Reports must be **double-spaced** and written in the accepted format for scientific papers (as taught in Organic Chem at Linfield). An appendix should always be included that shows how you calculated each numeric result (label each example clearly). *Do not use the word "lab" anywhere in your report unless you are talking about a room.* Lab notebook "copy" pages must be attached. **Write from the point of view of scientific significance, not "how to do it" (process).** Further details:

a. I expect you to use correct English grammar and spelling, and to rid the report of typographical mistakes before submission. Such technical errors will be circled but not identified - it is up to you to identify and correct what is wrong.

b. Revisions are a fact of life in the real world. Expect to be asked to revise one or more reports. I urge you to write a draft of your report, proofread it, then have it critiqued by someone who has completed the course and/or whom you know to be a good scientific report writer. Ask the reviewer to mark BUT NOT CORRECT technical errors, awkward sentences, and confusing passages. If you are asked to critique a classmate's report, please don't correct anything, just flag problems that you see. Each of us learns by re-thinking and re-writing. I record the score of the most recent revision.

c. **Introduction:** Briefly develop necessary theoretical background. Be sure that the goals of the experiment are clearly stated.
Materials and methods: don't give all the gory details. Assume that your reader knows his way around a lab. Outline the main steps you followed. Normally, different concentrations of substances used, or different pH values, will be evident from Tables or Figures and should NOT be detailed in the text. **Do** name specialized reagents or supplies used. Explain the purpose of unusual operations. Operations designed to meet specific goals of the experiment should be grouped under suitable subheadings. For example, an enzyme experiment might include subheadings of isolation, characterization, and activity assay.
Results and Data: judiciously choose what data to present. Subheadings related to experiment goals are useful here. Raw data can usually be processed in your notebook. Don't present repetitive data that you distill down to a plot or a single number - just present the plot or number (with units!). If you present a plot, do NOT include the table of data from which it was made. You (or I) can go back to your lab notebook to look up the numbers if necessary.
Discussion: recall goals one by one and, for each, show how results are related to that goal.

d. ***All numeric results, all axis labels on graphs, and all rows/columns in tables must include proper units and the proper number of significant figures!!!*** These are persistent problems that should never occur by this time in your scientific training.

e. **Figures** must be numbered (separately from Tables) in the order they appear in the report; each must be introduced (*i.e.*, before it is presented) by a sentence that tells the reader what to look for in it.
- The *dependent variable* (the quantity you measure) belongs on the vertical axis; the *independent variable* (the quantity you manipulate or select) belongs on the horizontal axis.
- Axis scales should be adjusted so that the plotted data occupy nearly all of the plot area. In other words, there should not be a lot of empty space above, below, to the left or to the right of what you plot.
- Decide for each different plot whether it makes most sense to show data points without connecting them, to connect them, or not to connect but add a theoretical "best fit" line.
- The professionally acceptable designation for a graph, plot or chart is "Figure 2", not "graph #2".
- *If you use software to make a plot, please **turn off the "plot area color"** so that it is not shaded.*
- Each Figure must have *beneath it* a short legend that tells the reader how to interpret what is shown.

  Example **Figure 3: Rates of hydrolysis as a function of pH. Each assay contained 5 nM esterase and 3 mM p-nitrophenyl acetate in 0.1 M Na phosphate buffer of the indicated pH. Production of p-nitrophenol was monitored at 400 nm.**

f. **Tables** must be numbered (separately from Figures) in the order they appear in the report; each must be introduced by a sentence that tells the reader what to look for in it.
- If you don't have enough data for at least 3 rows and 3 columns, do not use a Table (describe in text)
- "Causes" (independent variables) should be in left-hand columns; "Effects" (dependent) in right-hand columns
- Each Table must have *above it* a title that describes what the table is about.

  Example **Table 1: Effects of inhibitors on activity of glucose oxidase [a]**

  (A signal [a in this case] can be added to direct attention to a footnote beneath the Table where special conditions may be outlined.)