

University of Guelph, BIOC*2580 Introductory Biochemistry, Summer 2010

INTRODUCTION © 2010 D. Josephy and E. Wijekoon

Instructors:

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Lectures: Mon., Wedn., Fri. 9:30-10:20; Room: MCLN 107 Please try to attend all of the lectures. A detailed schedule of the lecture topics for each class is attached at the end of this handout.

Office Hours: No scheduled office hours will be held. Please make an appointment by e-mail. We welcome receiving your comments and questions by e-mail, and we will try to answer queries within one working day (Monday to Friday).

Laboratories: Mon., Tues., and Wedn. 14:30-17:20; SC 3110

The laboratory is an important component of the course and is scheduled to coordinate with the lecture topics. Attendance for the full time period of each laboratory is compulsory. The lab. schedule for the semester is given later in this outline. All lab. questions should be addressed to the lab. coordinator:

Jaspreet Kaur SC 3115 ext. 58220 jkaur@uoguelph.ca

Courselink: A Courselink web page is available for the course. Please check it from time to time. We will not be using an on-line discussion forum. If questions arise, please make an appointment to see one of the instructors, or contact us by e-mail. Please do not hesitate to ask for advice and assistance.

Grade assessment:

Laboratory	25
Mid-term examination	35
<u>Final examination</u>	<u>40</u>
Total	100

Students must pass the combined exam component, *i.e.*, earn 37/75 for the sum of the two exams, in order to pass the course. A high laboratory mark cannot be used to secure a pass if the examinations are failed. Students must also pass the laboratory portion, *i.e.*, earn 12.5/25. In cases where this standard is not achieved, the final mark assigned will either be the mark calculated or 47%, whichever is

less. College policy precludes changing the marking scheme for individual students, except in case of illness.

Calendar description: The evolution, chemical structure, and biological roles of the major molecular components of the cell: proteins, nucleic acids, lipids, and carbohydrates, enzymology, intermediary metabolism, with emphasis on catabolic processes.

Course synopsis: Chemical evolution and the origin of life; the properties of the living state; lipids and membranes; the structures of metabolites and macromolecules, especially proteins and DNA; carbohydrate chemistry; enzymology; enzyme kinetics; aspects of intermediary metabolism, emphasizing the catabolism of fatty acids and carbohydrates; electron transport and oxidative phosphorylation. DNA structure is presented but dynamic aspects of nucleic acid biochemistry, such as transcription and translation, are covered in MBG*2020, Introductory Molecular Biology. The unifying theme in this course is the oneness of all earthly life forms, attesting to their common evolutionary origin. In addition to studying the factual content of the science, we will also consider its historical development, experimental basis, and relationship to other aspects of science and society (University of Guelph Learning Objectives).

Course manual: The lecture manual (Summer 2010 edition, tan cover) can be purchased in room SC4480 for \$20.00 (cash only); sales hours: 10 a.m.- noon and 2-4 p.m., May 13-20.

See: <http://mcb.cbs.uoguelph.ca/pdfdocs2010/s10-manualsales.pdf>

The manual contains many of the lecture overheads and some accompanying explanatory text. We will also use figures from the textbook in class; very few of these are included in the manual, for copyright reasons. The manual is a condensed synopsis of the lectures. Over the years, we have found that certain questions (or points of confusion) arise frequently and are not addressed by the textbooks; the manual tries to clarify some of these points. The manual is not a substitute for the textbook, which is far more detailed, comprehensive, and illustrated. Biochemistry textbooks are so detailed that students may find it difficult to distill the essential ideas about a topic; the manual is intended to help with that process. The manual is best read along with the textbook. A set of Practice Problems and copies of last summer's mid-term and final examination, with answers, will be made available. Sample exam. questions will also be considered in class.

Textbook: There are many textbooks of biochemistry in print. Probably the best-regarded are the two "classics" by the late Albert Lehninger and by Lubert Stryer, each of which has gone through many editions and versions. We will use "Lehninger" as the primary reference text for the course.

Recommended textbook: David L. Nelson and Michael M. Cox, Lehninger's Principles of Biochemistry, 5th ed., Bedford, Freeman, and Worth Publishers, 2008 ISBN: 0-7167-7108-X

This book covers much more material than we cover in BIOC*2580, and aims at a more advanced level of sophistication. However, we will only cover a portion of the textbook content and you will not be expected to memorize every detail. Nelson and Cox is used in several later biochemistry courses, including BIOC*3560 (Structure and Function in Biochemistry) and BIOC*4580 (Membrane Biochemistry). It will also be a valuable resource in other courses, such as cell biology, molecular biology, immunology, and pharmacology. If you choose to buy this book, you will probably not need to buy any other biochemistry textbook. (The 4th ed. of Nelson and Cox is still fine for this course; lots of used copies of the 4th edition should be available.)

In addition to the biochemistry text, you should also be ready to consult a general chemistry text, such as the one you used for CHEM*1040/1050, for coverage of the basics of kinetics, thermodynamics, electrochemistry, and organic chemistry. We will rely on your first-year chemistry background. Student difficulties encountered in Introductory Biochemistry can often be traced back to incomplete understanding of first-year chemistry topics. So, if you had difficulties in CHEM*1040/1050, please put extra effort into reviewing that material now.

Textbook reading assignments are indicated on the lecture schedule. Students are expected to read the appropriate textbook sections before the corresponding lectures. We cover a great deal of content in this course. Try to establish a regular study discipline of reading the assigned text sections ahead of the lectures. Please don't get behind in your studying.

This course is not an exercise in memorizing facts by rote, although some things will indeed have to be committed to memory. The course content of BIOC*2580 is also conceptual. Students sometimes ask whether examinations will be based "on the textbook", or "just on the lectures". If you attend the lectures and labs, attempt the problems, and study the lecture manual thoroughly, you can expect to do very well in the course. But to achieve mastery of the subject, textbook study is indispensable.

The material we study here is fundamental to further work in any field of biological science ... nutrition, molecular biology, zoology, medicine, etc. Students often tell us that it was not until their third and

fourth years of study that they came to appreciate how valuable and important BIOC*2580 was to their program of studies.

Midterm examination: The 1½-hour mid-term exam. will be held Tuesday, June 29 at 7:00 p.m. in room MacN 113. A conflict is defined as a previously-scheduled academic commitment, such as a lab. or class, at exactly the same time as the mid-term. If you have a conflict, please inform me by e-mail, as soon as possible, stating the nature of the conflict.

Both the mid-term exam. and the final exam. will use a variety of question styles, which could include, for example, multiple-choice, “fill-in-the-blank”, calculation, short written answer, structure-drawing, or essay format questions. Both factual recall and understanding of principles will be tested. Last year’s exams will be made available, for your guidance and practice.

Final examination: Friday August 20, 19:00 (7 p.m.) location **t.b.a.**

The two-hour final examination will cover the entire course, with strong emphasis on the material covered after the midterm examination. A metabolic chart (which will be posted on the course home page) will be provided on the final examination. The chart shows chemical structures organized into metabolic pathways, but it does not show compound or enzyme names, reaction stoichiometries and mechanisms, etc., which students are expected to learn.

You should be prepared to reproduce, during the examinations, any of the following structures: amino acid constituents of proteins; all of the nucleotide components of DNA and RNA; the complete covalent structures of protein, RNA, and DNA; NAD⁺/ NADH/ NADP⁺/ NADPH; the common saturated fatty acids presented in class, and their names; the systematic notation for saturated and unsaturated fatty acids; structures of triacylglycerol and phospholipids, as presented in class; all of the metabolites involved in fatty acid catabolism and glycolysis. (Further details will be given later.)

Laboratory:

Lab. rules: Lab coats are required. Sandals are not allowed. Each student must obtain goggles and wear them in all lab. sessions.

The lab. manual (with four Exercise Books), Summer 2010 edition in pink cover, \$10.00, will also be sold by the department (see instructions for lecture manual purchase, above). *Requests for lab. exemptions or section changes:* Contact Ms. Kaur by e-mail. To obtain an exemption, you must provide Ms. Kaur with documentation of your lab. grade from a previous course attempt.

Laboratory grades will be calculated as follows:

<i>Quizzes</i>	<i>10%</i>
<i>Notebook</i>	<i>15%</i>
<i>Lab component</i>	<i>25%</i>

Attendance at all laboratory periods is mandatory. Students who miss laboratories without satisfactory explanation may be given an “incomplete” grade for the entire course.

Laboratory Schedule		
Dates	Lab. Activity	Notes
May 17-19	Lab 1 - Buffers	Quiz 1
May 25-27	No lab	
May 31-June 2	Lab 2 - Amino Acids	Quiz 2
June 7-9	No lab	
June 14-16	Lab 3 - Proteins	Quiz 3
June 21-23	No lab	
June 28-30	Lab 4 - Enzymes	Quiz 4
July 5-7	No lab - Computer exercise	Kinetics - to be done independently
July 12-14	No lab	
July 19-21	Lab 5 - Lipids	Quiz 5

Notices: The instructors will endeavour to follow this outline closely; should any amendments be required, the class will be notified promptly. Students are expected to attend lectures and labs. Only valid excuses (medical or compassionate) will prevent a grade of zero for any missed lab., lab. quiz, or examination. Documentation may be required. There will be *no "make-up" mid-term exam*. If the mid-term is not taken, for a valid reason, then the final exam will constitute 75% of the final grade. College policy precludes changes to the grading scheme for individual students, except in case of illness. Every student must bring his/ her identification card to the mid-term and final exams. All exams must be written in ink. No additions must be made after return of the paper. Midterm papers may be returned to the instructor for correction of grading errors, only within one week of the return of the graded papers. The instructor may refuse to re-grade a paper, at his discretion. The use of stored programs or stored alphanumeric information on calculators, during examinations or tests, is not allowed. Signed written comments on the teaching performance of the lecturers may be sent to the Chair, Department of Molecular and Cellular Biology, at any time (a copy will be made available to the instructor after submission of final grades). *Electronic recording of classes is expressly forbidden* without prior consent of the instructor. When recordings are permitted, they are solely for the use of the authorized student and may not be reproduced or transmitted to others without the express written consent of the instructor. *Use of mobile telephones or other communication devices in class is prohibited*, except for emergency contact. *Statement on the use of animals:* No animals are used directly in the laboratory exercises for BIOC*2580. However, some enzymes or biochemical substances may be derived from animal sources. Typically, these preparations are made from byproducts of cattle used in meat production. Efforts have been made to reduce the use of animal products by using equivalent substances derived from microbial or plant sources.

class	date	section	lecture topic	lecturer	Nelson and Cox	
					4 th ed	5 th ed
1	May 14	Introduction to biochemistry		PDJ	1-3; 12-21	1-2; 11-19
2	May 17	The origin of life; prebiotic chemistry		PDJ	31-35	29-33
3	May 19	Non-covalent chemical forces (mainly review)		PDJ	47-58	43-54
4	May 21	Acids and bases; ions; cytosol		PDJ	60-70	54-66
5	May 26	Proteins	Introduction	PDJ	75-76	71-73
6	May 28	Proteins	Amino acid building blocks	PDJ	76-85	73-81
7	May 31	Proteins	Peptides	PDJ	85-89	82-85
8	Jun 02	Proteins	Purification	PDJ	89-94	85-92
9	Jun 04	Proteins	Sequencing	PDJ	96-101	92-100
10	Jun 07	Proteins	Secondary structure	EW	116-125	113-123
11	Jun 09	Proteins	Secondary structure, cont'd	EW	116-125	113-123
12	Jun 11	Proteins	Tertiary structure and folding	EW	132-135; 147-149	129-131; 140-143
13	Jun 14	Enzymes	Introduction	EW	190-193	183-185
14	Jun 16	Enzymes	Enzyme mechanisms	EW	196-202	186-194
15	Jun 18	Enzymes	Enzyme assays; kinetics	EW	202-203	194-195
16	Jun 21	Enzymes	The Michaelis-Menten equation	EW	203-207	195-199
17	Jun 23	Enzymes	Inhibition	EW	209-213	201-205
18	Jun 25	Lipids	Fatty acids, triacylglycerols	EW	343-348	343-348
19	Jun 28	Lipids	Phospholipids and membranes	EW	348-350	349-350
20	Jun 30	Carbohydrates	Fischer formulae	PDJ	238-241	235-238
21	Jul 02	Carbohydrates	Rings and glycosides	PDJ	241-246	239-244
22	Jul 05	Nucleic acids	Sugar-phosphate backbone	PDJ	273-276	271-274
23	Jul 07	Nucleic acids	Bases, nucleotides; RNA and DNA	PDJ	276-281	274-277
24	Jul 09	Nucleic acids	The DNA double helix	PDJ	282-283	277-280
25	Jul 12	Metabolism	ATP as cellular energy currency	PDJ	496-503	501-509
26	Jul 14	Metabolism	Adenosine-containing cofactors	PDJ	512-517; 603	516-521; 617
27	Jul 16	Metabolism	Metabolic pathways	PDJ	481-488	485-488
28	Jul 19	Metabolism	Redox reactions (mainly review)	PDJ	507-512	512-516
29	Jul 21	Catabolic pathways	Lipid transport and metabolism	EW	631-637	647-652
30	Jul 23	Catabolic pathways	Fatty acid β -oxidation	EW	637-639	652-656
31	Jul 26	Catabolic pathways	Acetate to CO ₂ : the citric acid cycle	EW	601-616	615-631
32	Jul 28	Catabolic pathways	The electron transport chain	EW	690-701	707-718
33	Jul 30	Catabolic pathways	Chemiosmotic energy transduction	EW	701-707	718-722
34	Aug 04	Catabolic pathways	Oxidative phosphorylation	EW	708-716	723-731
35	Aug 06	Catabolic pathways	Glycolysis: anaerobic energy generation	EW	521-533	527-538
36	Aug 09	Catabolic pathways	Glycolysis (continued); fermentation	EW	521-533	527-538