



UM Learn

CHEM-MBIO-27...



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Overview

Welcome to Elements of Biochemistry - CHEM / MBIO 2770

Please read this important notice from the Faculty of Science: [Registration Advisory](#).

Note also that Wednesday September 22 is the last day for adding courses and VW day is Monday November 23.

Students with disabilities should contact Student Accessibility Services ([Email](#); Phone: 204-474-7423; [Web](#)) to facilitate the implementation of accommodations.

Please contact me if you wish to discuss the accommodations recommended by Student Accessibility Services.

Course Outline - 2020

Instructors

- Dr. Joe O'Neil
- Room 390 Parker
- Telephone: 474-6697

- Office Hours: Wednesdays from 5:00 - 6:00 pm.
 - E-mail: Joe.ONeil@umanitoba.ca

 - Dr. Ellert Nichols
 - Room 406B Parker Chemistry Building
 - Telephone: 474-7415
 - Office Hours:

There will be no scheduled laboratory office hours this term. Discussion forums for each experiment will be set up in the B01-B83 sections of UM Learn for the laboratory section of this course. Zoom meetings with Dr. Nichols can be scheduled on an as-needed basis.
 - E-mail: [Dr. Nichols](mailto:Dr.Nichols)
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Lectures

- Monday, Wednesday, & Friday 12:30-1:20 PM
 - *via* Zoom
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Laboratories

- Except for the information contained in this document, all further online information respecting the laboratory will be found in the B01-B83 sections of this course on UM Learn.
- The laboratory portion of CHEM/MBIO 2770 will be a mixture of online and in-person delivery. There are seven different experiments for which you will be provided data that you will use to prepare seven different lab reports. There will also be three in person, Core Skills Labs (I, II and III), that will provide you the opportunity to work with equipment commonly used in the biochemistry laboratory. The in-person laboratories will begin the Week of September 21 and students will be assigned to Core Skills Group (A, B, or C). The schedule for when each Group will report to the laboratory can be found in the B01-B83 sections of this course on UM Learn and in the core skills laboratory manual. Your Core Skills Group assignment and laboratory room number will

be provided to you during the second week of September.

- Core Skills Labs I and II will be graded on a pass/fail basis and you must pass them in order to pass the laboratory. Core Skills Lab III will be an evaluation of your pipetting technique for the determination of the protein concentration of a solution of unknown protein content. Marks will be assigned to the accuracy of your pipetting. Additional information will be available in your Core Skills Laboratory Manual.
- Information about the seven online experiments will be available through the B01-B83 sections of UM Learn for this course. The laboratory manual for the Core Skills Laboratories will be available at the University Bookstore.
- Please note that the Department of Chemistry no longer offers Lab exemptions.

Textbook

"*Biochemistry - A Short Course, 4th edition*" by: Tymoczko *et al.* Available in the Bookstore and also required for CHEM 2780 / MBIO 2780.

- [Publisher's WWW Site](#)
- [Sapling Overview](#)
- *Laboratory Manual, 2019*
Available in the Bookstore.
- "*Basic Concepts in Biochemistry: A Student's Survival Guide, 2nd Ed.*" by Hiram F. Gilbert
McGraw-Hill; ISBN 0-07-13567-6; QP 514.2 G56 2000.

Lecture Notes

Last year's lecture notes are available under "Lecture Notes" on the left. These will be replaced as we proceed through the course with updated versions for this year.

Evaluation

Mid-term Test 1 - Wednesday October 14, in-class	15%
Mid-term Test 2 - Monday November 23, in-class	15%
Final Exam - Scheduled by Student Records	40%
Optional bonus: Sapling online assignments Oct. 5 & Nov. 2	5%
Laboratory	30%

- [LetterGrades.pdf](#)

Note: You must obtain a grade of 50% (15/30) in the laboratory to pass the course.

Exam Format

- This year tests and exams will consist of written, short-answer questions, via Zoom.
 - Copies of midterm and final examinations and answers from previous years are available elsewhere on this page. Working through them will help prepare you for the examinations.
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Laboratory Exemptions

Please note that the Department of Chemistry no longer offers laboratory exemptions.

Continuation in CHEM 2780/MBIO 2780

Students wishing to continue with CHEM 2780/MBIO 2780, Elements of Biochemistry II in second term **MUST** obtain a C grade or better in CHEM 2770/MBIO 2770. Students who have registered in CHEM 2780/MBIO 2780 and receive a D or F grade in CHEM 2770/MBIO 2770 **MUST** withdraw from CHEM

2780/MBIO 2780 as soon as possible after they are made aware of their grade.

Final Exam Review

Students in the Faculty of Science are permitted to review their final exams before the deadline for appealing final grades ([Final Grade Appeal](#)). If you wish to view your final exam please fill in and submit an electronic application form: [Final Exam Viewing Form](#).

Academic Integrity

All faculty and students at the University of Manitoba are expected to act with academic integrity. For information on this topic please visit the Faculty of Science web site [Academic Integrity](#) and read the appropriate sections of the Academic Calendar and pages 7-8 and the inside cover of the lab manual.

Lecture Schedule

1. INTRODUCTION AND TYPES OF BIOLOGICAL MOLECULES (*Chapter 1*).

Students should read this chapter as a review of material covered in first-year courses in chemistry and biology.

Entropy, enthalpy, and free energy.

Equilibrium constants.

2. WATER -- ITS EFFECT ON BIOMOLECULES (*Chapter 2*)

Buffers. Ionization of H₂O, pH, weak and strong acids and bases.

Titration curves and pK_a values. Calculations of pH. Use of Henderson-Hasselbalch Equation in calculations and making buffer solutions. Carbonic acid/bicarbonate buffer in blood.

3. AMINO ACIDS (*Chapter 3*)

Structure and classification according to R group. Selected chemical properties.

Stereochemistry, chirality, *D*- and *L*-forms, biological importance of chirality.

Ionic properties and titration curves of amino acids. Isoelectric pH (pI).

4. PEPTIDES & PROTEINS (*Chapters 4 & 5*).

Introduction to peptide & protein structure

Working with proteins

Covalent (Primary) Structure -- sequence determination

Three-dimensional structure The peptide bond; secondary structure and the forces maintaining it exemplified by the alpha-helix and beta-sheet .

Tertiary & quaternary structures and the forces maintaining them exemplified by globular and fibrous proteins.

Denaturation by heat, pH changes *etc.*

5. ENZYMES (*Chapters 6-8*)

General properties and classification.

Enzymes as catalysts -- the active or catalytic site, activation energy and reaction rates.

Enzyme kinetics: reaction rates, effects of enzyme concentration, pH, temperature, and substrate concentration. Michaelis-Menten equation, significance of K_m and V_{max} . Lineweaver-Burk (reciprocal) plots. Enzyme specificity.

How enzymes increase reaction rates: proximity and orientation effects, bond-stress, catalytic

R-groups and role of metal ions.

Enzyme inhibition: Reversible inhibition -- competitive and non-competitive inhibition. Irreversible inhibition.

Enzyme regulation: allosteric effects, feed-back inhibitors, activators. Sigmoidal kinetics. Regulation via covalent modification.

6. CARBOHYDRATES (*Chapter 10*)

Monosaccharides: Aldose and ketose nomenclature, stereochemistry, *D*- and *L*-classification, enantiomers and epimers. Intramolecular hemiacetal and hemiketal formations. Anomers. Mutarotation.

Sugar derivatives, glycosides.

Disaccharides: maltose, isomaltose, lactose, sucrose.

Reducing and non-reducing sugars.

Polysaccharides: Starch, glycogen, chitin and cellulose.

7. LIPIDS & MEMBRANES (*Chapters 11 & 12*)

Classification of lipids.

Structure & properties of fatty acids.

Structure & properties of triacylglycerols (fats and oils), waxes.

Membrane lipids: glycerophospholipids, sphingolipids (glycosphingolipids and gangliosides). Sterols and steroids, e.g. Cholesterol.

Amphipathic nature of membrane lipids.

Membranes: Composition. The Fluid-Mosaic model: bilayers, integral and peripheral proteins,

control of membrane fluidity through changes in fatty acid composition.

Asymmetric nature of membrane surfaces. Selected functions of membranes.

8. NUCLEOTIDES and NUCLEIC ACIDS (*Chapter 33*)

Purines and pyrimidines. Nucleosides, nucleotides. Ribo- and deoxyribonucleotides.

Polynucleotides and nucleic acids. RNA and DNA.

Structure of DNA: Chargaff's rules, base pairing, the right-handed double-helical DNA and the forces stabilizing it. Some properties of DNA.

9. BIOENERGETICS (*Chapter 15*)

Spontaneous and non-spontaneous processes. Endergonic and exergonic processes. Standard free energy changes and equilibrium constants. Oxidation reduction reactions and reduction potential. Biological electron carriers.

ATP structure and properties as a "high-energy" phosphate. Low-energy phosphates. Free energies of hydrolysis as measure of phosphate transfer potentials. Other "high-energy" compounds.

Use of ATP in driving unfavorable reactions.

10. ATP PRODUCING PATHWAYS (*Chapters 16 and 18-21*)

Direct production via substrate level phosphorylation exemplified by anaerobic processes (glycolysis, alcoholic fermentation) (*Ch 16*).

Indirect production involving aerobic degradation of glucose (and other foodstuffs) via acetyl-S-Coenzyme A: the TCA Cycle (*Ch 18 & 19*).

Electron transport and oxidative phosphorylation: Components and energetics of the electron-transport chain. Chemiosmotic theory & ATP yield (*Ch 20 & 21*).

Useful WWW Sites for CHEM / MBIO 2770

[On-line Medical Dictionary](#)

[On-line Webster Dictionary](#)

[KEGG Metabolic Pathways](#)

[Cells Alive!](#)

[National Human Genome Research Institute](#)

[Material Safety Data Sheets](#)

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