



# BIOC\*3570 Analytical Biochemistry - DRAFT

01

Summer 2022

Section(s): 01

Department of Molecular and Cellular Biology

Credit Weight: 0.75

Version 1.00 - April 25, 2022

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## 1 Course Details

### 1.1 Calendar Description

This course covers the tools and techniques by which biological molecules are isolated, separated, identified, and analyzed. Detailed discussion of experimental methods for macromolecule purification and characterization is included.

**Pre-Requisites:** (CHEM\*2400 or CHEM\*2480), BIOC\*2580

### 1.2 Course Description

Students must pass (mark of 50% or better) **both** the laboratory component (35%) **and** the theory component (65%) to obtain a final passing mark in the course. In cases where this standard is not reached, the final mark assigned will be either the mark calculated as given above or 47%, whichever is *less*. College policy precludes changes to the marking scheme for individual students, except under extenuating circumstances (e.g. illness).

Introductory biochemistry is a prerequisite for this course. The following aspects of the subject are important background, and familiarity with them will be assumed: basic aspects of protein and nucleic acid structure, including structures of all amino acids and nucleotides; flow of genetic information; basic enzymology. Please take some time to review this material carefully, especially if some time has passed since you took intro. biochemistry.

### 1.3 Timetable

Mon. - 8:30 a.m. - 9:50 a.m., SSC 2015

Wed. - 8:30 a.m. - 9:50 a.m., SSC 2015

Lecture slides will be uploaded the evening before class.

Labs - 1:30 p.m. - 3:20 p.m. your scheduled day of the week SSC 3101

All activities will be held in-person unless University policy changes

## 1.4 Final Exam

The Final Exam will be scheduled by the registrar's office, see WebAdvisor for details

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# 2 Instructional Support

## 2.1 Instructional Support Team

**Instructor:** Adrian Ionescu Dr.  
**Email:** ionescu@uoguelph.ca  
**Office:** SSC 2312  
**Office Hours:** Office hours will be held Wednesdays between 12:00 pm and 1:00 pm, or by appointment in office or virtual.

**Lab Co-ordinator:** Colin Cooper Dr.  
**Email:** ccoope08@uoguelph.ca  
**Office:** SSC 3502  
**Office Hours:** By appointment

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# 3 Learning Resources

## 3.1 Required Resources

### Computer with internet access (Equipment)

Lectures will be held face-to-face so computer with internet is not necessary, however, should future COVID-19 restrictions be imposed during the term, a computer with internet access and a webcam are required as course delivery methods would inevitably be moved to virtual format.

### Available from the Bookstore (Lab Manual)

### Lab Equipment (Equipment)

Lab Coat

Safety Glasses

Non-spiral bound lab book (lab books used in previous courses are allowed)

Permanent marker

### 3.2 Recommended Resources

#### **Principles and Techniques of Biochemistry and Molecular Biology (Textbook)**

*Principles and Techniques of Biochemistry and Molecular Biology*, by K. **Wilson and J. Walker**, 8<sup>th</sup> edition, **2018**.

This is an excellent reference text for a wide variety of standard experimental techniques. It is relatively inexpensive, available in multiple formats (e.g. hard/soft cover, electronic) and should be a useful reference for any future experimental work. It is available in the university book store and is also on reserve at McLaughlin Library. Older editions of the book are also acceptable.

#### **Lehninger et al. (Textbook)**

Any recent edition of the text by Lehninger *et al.* (e.g. 6th edition, 2013).

This text book is useful for general biochemical background you may need to brush up on. This text book (8th edition) is available at the book store and is also available on reserve (7th and 8th edition) at McLaughlin Library

#### **Youtube (Website)**

<https://youtube.com>

Search: enzyme techniques, electrophoresis molecular biology, recombinant, mass spectrometry, proteomics, fluorescence.

### 3.3 Additional Resources

#### **Biochemistry Lab: Modern Theory and Techniques (Textbook)**

*Biochemistry Lab: Modern Theory and Techniques*, by R. Boyer, 2<sup>nd</sup> edition, 2011.

Available on Reserve.

#### **Fundamental Laboratory Approaches for Biochemistry and Biotechnology (Textbook)**

*Fundamental Laboratory Approaches for Biochemistry and Biotechnology*, 2<sup>nd</sup> edition, by A. Ninfa & D. Ballou, 2010

Available on Reserve.

**Bioanalytical Chemistry (Textbook)**

*Bioanalytical Chemistry*, by Mikkelsen & Corton, 2004

Available on Reserve.

**Experimental Biochemistry (Textbook)**

*Experimental Biochemistry*, by Switzer and Garrity, 1999

Available on Reserve.

**Analytical Biochemistry (Textbook)**

*Analytical Biochemistry*, 2nd edition, by D.J. Holme and H. Peck, Longman, 1993

Available on Reserve.

**Physical Biochemistry (Textbook)**

*Physical Biochemistry* (2nd edition, 1982) D. Freifelder (QH 345.F72).

This is a particularly good reference text for spectroscopy, centrifugation, electrophoresis, and other physical techniques.

Available on Reserve.

## 4 Learning Outcomes

### 4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Understand the theoretical underpinnings and practical aspects of applying biochemical analysis methods.
2. Understand modern approaches to protein quantitation and characterization, including using chromogenic dyes, UV-Visible and fluorescence spectroscopy, electrophoresis, enzymatic assays, and mass-spectrometry.
3. Understand how proteins are purified from biological or recombinant sources, including diverse centrifugation approaches, and chromatographic methods that rely on ion-exchange, size-exclusion, hydrophobic exchange or affinity resins.

## 5 Teaching and Learning Activities

### 5.1 Lecture

#### Lecture 1

**Topics:** Introduction to analytical biochemistry

#### Lectures 2 - 3

**Topics:** Protein properties, handling and reagents

#### Lecture 4

**Topics:** Protein detection and quantitation 1: colorimetric stains

#### lecture 5

**Topics:** Protein detection and quantitation 2: antibodies

#### Lecture 6

**Topics:** Protein purification: introduction, protein expression and differential solubility

#### Lecture 7

**Topics:** Protein diffusion and hydrodynamics

#### Lecture 8 - 10

**Topics:** Protein chromatography: principles and instrumentation, ion exchange, hydrophobic exchange, size exclusion and affinity chromatography

#### Lecture 11 - 13

**Topics:** Electrophoresis: theory, materials, native electrophoresis, SDS PAGE, Western blotting, isoelectric focussing, 2D electrophoresis

#### **Lecture 14 - 15**

**Topics:** UV visible spectroscopy: theory, instrumentation and applications

#### **Lecture 16 - 17**

**Topics:** Fluorescence spectroscopy: theory, instrumentation and applications

#### **Lecture 18 - 21**

**Topics:** Mass spectrometry: theory, isotopes, instrumentation, MALDI and ESI, and proteomics

#### **Lectures 22 - 24**

**Topics:** Centrifugation: theory, instrumentation, differential centrifugation, density gradients, analytical ultracentrifugation

## **5.2 Laboratory**

Labs will be held in SSC3101 on your scheduled day, see CourseLink for more details.

The laboratory portion of the course is worth 35% of the course grade. A breakdown of activities will be available on CourseLink, which will lab reports (10%, 15% of final grade), and a lab notebook (10% of final grade).

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## **6 Assessments**

### **6.1 Assessment Details**

#### **Laboratory (35%)**

See CourseLink for more details.

Assessments will include two lab reports and a lab notebook.

Written assignments may be analyzed with anti-plagiarism software.

**Lecture Quiz 1 (5%)**

**Date:** Tue, May 31, 8:30 AM - Wed, Jun 1, 11:59 PM, CourseLink >> Quizzes  
First Lecture Quiz

Quiz will take approximately 30 minutes.

Quiz is worth 5% of the final grade

**Lecture Quiz 2 (5%)**

**Date:** Tue, Jun 14, 8:30 AM - Wed, Jun 15, 11:59 PM, CourseLink >> Quizzes  
Second Lecture Quiz

Quiz will take approximately 30 minutes

Quiz is worth 5% of the final grade

**Midterm (20%)**

**Date:** Wed, Jun 29, 8:30 AM, In Class  
Midterm will cover material covered in first half of the course

Midterm will take approximately 70 minutes

Quiz is worth 20% of the final grade

**Lecture Quiz 3 (5%)**

**Date:** Tue, Jul 12, 8:30 AM - Wed, Jul 13, 11:59 PM, CourseLink >> Quizzes  
Third Lecture Quiz

Quiz will take approximately 30 minutes

Quiz is worth 5% of the final grade

**Lecture Quiz 4 (5%)**

**Date:** Tue, Jul 26, 8:30 AM - Wed, Jul 27, 11:59 PM, CourseLink >> Quizzes  
Fourth Lecture Quiz

Quiz will take approximately 30 minutes

Quiz is worth 5% of the final grade

**Final Examination (Non-Cumulative) (25%)****Date:** In Class

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## 7 Course Statements

### 7.1 Policy on Missed Examinations

Only valid medical or compassionate reason will prevent a grade of zero for any missed examination. It is the student's responsibility to obtain the necessary documentation from Medical or Psychological Services or the Director of Student Affairs. *Make-up tests will not be given.*

### 7.2 Course Evaluation

As part of the faculty evaluation process in the Department of Molecular and Cellular Biology, students are reminded that written comments on the teaching performance of the lecturer may be sent to the Chair at any time. Such letters must be signed; a copy, with the signature removed, will be made available to the instructor. Your comments and feedback are always appreciated.

### 7.3 Recording of Lecture Materials

RELEVANT ONLY IF THE COURSE IS RETURNED TO ONLINE FORMAT: By enrolling in a course, unless explicitly stated and brought forward to their instructor, it is assumed that students agree to the possibility of being recorded during lecture, seminar or other "live" course activities, whether delivery is in-class or online/remote.

If a student prefers not to be distinguishable during a recording, they may:

1. turn off their camera
2. mute their microphone
3. edit their name (e.g., initials only) upon entry to each session
4. use the chat function to pose questions.

Students who express to their instructor that they, or a reference to their name or person, do not wish to be recorded may discuss possible alternatives or accommodations with their instructor.

### 7.4 Online Behaviour

**Inappropriate online behaviour will not be tolerated. Examples of inappropriate online**

**behaviour include:**

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student
- Stating false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online
- Discriminating against fellow students, instructors and/or TAs
- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your user name and password
- Recording lectures without the permission of the instructor

## 8 Department of Molecular and Cellular Biology

### Statements

#### 8.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. [B.Sc. Academic Advising](#) or [Program Counsellors](#)

#### 8.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist. <http://www.learningcommons.uoguelph.ca/>
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: <http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help> and <http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help>

## 8.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance. <https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention. <https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. <http://www.selfregulationskills.ca/>

## 8.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) <http://www.e-laws.gov.on.ca/index.html>. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar. (<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml>)

## 8.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

# 9 University Statements

## 9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

## 9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

### 9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

### 9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

### 9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or

changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website  
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website  
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

## 9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

## 9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

## 9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars  
<https://www.uoguelph.ca/academics/calendars>

## 9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

## 9.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

## 9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campusess/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campusess/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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