



Faculty of Science  
uOttawa Department of Chemistry & Biomolecular Sciences

INTRODUCTION TO BIOCHEMISTRY  
BCH2333A  
Adam Shuhendler  
Winter 2022

## **Course Hours & Links**

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### **Lectures:**

Tuesday 13:00-14:20  
Location: Zoom

Thursday 11:30-12:50  
Location: Zoom

Tuesday Link: <https://uottawa-ca.zoom.us/j/99734176136?pwd=bUFvNGY1U29TcnpGa3h3a2NlcWVIQT09>

Meeting ID: 997 3417 6136  
Passcode: 7r8R7d

Thursday Link: <https://uottawa-ca.zoom.us/j/95595477245?pwd=bmJHWHZNNWgrdnhDbXYvVTItbEJ4QT09>

Meeting ID: 955 9547 7245  
Passcode: 2h2J4s

### **DGDs:**

Monday 10:00-11:20  
Location: Zoom  
Type: DGD 1 (A01)

Wednesday 10:00-11:20  
Location: Zoom  
Type: DGD 2 (A02)

Wednesday 13:00-14:20  
Location: Zoom  
Type: DGD 3 (A03)

Wednesday 16:00-17:20  
Location: Zoom  
Type: DGD 4 (A04)

**Monday A01:** <https://uottawa-ca.zoom.us/j/94780929672?pwd=a0IHcmJJTm82ck5Edlh4cFhURDINZz09>

Meeting ID: 947 8092 9672  
Passcode: 8i1L6t

**Wednesday A02:** <https://uottawa-ca.zoom.us/j/99413503705?pwd=eDBZcVhScDNiRW1oTnloYzZHV01iQT09>

Meeting ID: 994 1350 3705  
Passcode: 7i8T0q

**Wednesday A03:** <https://uottawa-ca.zoom.us/j/96470166201?pwd=ZHhreFF1RWNYQk1tZjB0bnZ4cFQvdz09>

Meeting ID: 964 7016 6201  
Passcode: 6a6W4b

**Wednesday A04:** <https://uottawa-ca.zoom.us/j/92166318392?pwd=bEI5MFkxY0xXcE9lekJmNFIFUHM3UT09>

Meeting ID: 921 6631 8392  
Passcode: 4c8P1x

**\*\*Note: DGDs start the week of January 18<sup>th</sup>.** DGDs are for lecture material only. The laboratory component is coordinated by Luc Poitras ([lpoitras@uottawa.ca](mailto:lpoitras@uottawa.ca)) and Josée Coutu ([josee.coutu@uottawa.ca](mailto:josee.coutu@uottawa.ca)). Please contact them for lab-specific questions.

## **Professor**

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Adam Shuhendler ([BCH2333AuO@gmail.com](mailto:BCH2333AuO@gmail.com))

### **Office Hours**

Thursday 14:00-15:00

Location: <https://uottawa-ca.zoom.us/j/93681346912?pwd=VWN2YWY1djNYeU03MCt4NUJaUDNrQT09>

Meeting ID: 936 8134 6912  
Passcode: 4j7I4n

**\*\*Note:** If you cannot attend during this hour, please email to make an appointment

## **Website**

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The course will be managed through Brightspace. Lecture notes and lecture recordings will be posted to Brightspace. **Please also contact [BCH2333AuODGD@gmail.com](mailto:BCH2333AuODGD@gmail.com) with course content-related questions.**

## **Course Description**

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The chemistry and biological properties of amino acids, protein, nucleic acids, lipids, and carbohydrates. The course includes laboratory and tutorial sessions. Priority given to students for whom this course is mandatory. Previously BCH2140 + BCH2336.

## **General and Specific Objectives**

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This course will introduce you to the fundamental concepts of biochemistry, with a focus on the structures and basic functions of the building blocks of life. These building blocks include amino acids, nucleic acids, lipids, and carbohydrates.

The general objectives of this course are:

1. Understand the chemical structures fundamental to biochemistry
2. Understand the driving forces (i.e. thermodynamics) that promote macromolecular structure and function

The specific objectives for the course are:

1. Be able to draw the chemical structure of amino acids and polypeptides, paying attention to stereochemistry, to describe the different chemical properties of amino acids, and to relate these properties to protein structure (secondary, super-secondary, tertiary and quaternary) and function.
2. Be able to draw the chemical structure of nucleic acids, polynucleotides, and base pairing, and describe the structural characteristics of the double helix that provides for information encoding, replication, and transmission.
3. Be able to draw the chemical structure of carbohydrates, paying attention to stereochemistry
4. Be able to draw the chemical structure of lipids, and describe the effect of lipid chemistry on cell membrane formation and function
5. Understand the driving forces behind protein folding
6. Understand enzyme activity, kinetics, and inhibition

## **Lecture Outline**

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Lecture 1: Origin of Life, Chemical Evolution

Lecture 2: Intermolecular Interactions, Water

Lecture 3: Acids, Bases, pH, Buffers

Lecture 4: Thermodynamics, Nucleotides

Lecture 5: Amino Acids and Peptides

Lecture 6: Carbohydrates, Lipids

Lecture 7: Protein Secondary Structure

Lecture 8: Super-secondary Structure, Tertiary Structure, Protein Folding

Lecture 9: Protein Folding Kinetics, Quaternary Structure, DNA Supramolecular Structure

Lecture 10: Alternative Secondary Nucleic Acid Structures, Tertiary Nucleic Acid Structures

Lecture 11: Protein Function: Oxygen Transport, Allostery

Lecture 12: Enzyme Kinetics

Lecture 13: Enzyme Kinetics – Inhibition

Lecture 14: Mechanisms of Enzyme Catalysis, Cofactors & Coenzymes

Lecture 15: Mechanisms of Enzyme Regulation

Lecture 16: Cytochrome P450s as Metalloenzymes Case Study

Lecture 17: RNA Secondary & Tertiary Structure, RNA Folding

Lecture 18: RNA Enzymes, HIV Protease Inhibitor Development

Lecture 19: Review Lecture

**\*\*Note:** All lectures will involve pre-recorded material that will be played during the lecture times, and posted to Brightspace. Lectures may be paused and extended clarification or information will be provided in real-time by Dr. Shuhendler. If a question from the lecture is not addressed, please email the question to [BCH2333AuODGD@gmail.com](mailto:BCH2333AuODGD@gmail.com) .

## **Evaluations**

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### ***Problem Sets (Homework)***

#### **Dates When Problem Sets Posted To Brightspace:**

Set 1 January 13th  
Set 2 February 1st  
Set 3 February 10th  
Set 4 March 3rd  
Set 5 March 10th  
Set 6 March 22nd

Problem sets will be discussed in DGD and Lectures. Answer keys will be posted to Brightspace 1 week after posting of Problem Set. Please ensure you sort out discrepancies between your answers and the answer key.

### ***Biochemist Biography***

**Evaluation Dates:** Submission to [BCH2333AuODGD@gmail.com](mailto:BCH2333AuODGD@gmail.com) by Tuesday April 8<sup>th</sup> before 1700h.

**Evaluation Percentage:** 5%

For this assignment, you will select a biochemist, living or dead, from an underrepresented group that has worked in an area related to the course material covered as described in the Lecture Outline (i.e. protein/DNA/lipid/carbohydrate structure or function, HIV therapeutics, RNA biochemistry). The definition of underrepresented group in STEM includes women, Indigenous Peoples, members of racialized minorities, people with disabilities, and LGBTQ2+ individuals, as defined by the Government of Canada.

In the course, we discuss some of the fundamental contributions of members of underrepresented groups to biochemistry as a discipline, and the purpose of this assignment is to expand the recognition of members of these groups for their previous and/or continued development of biochemistry.

The biography should be between one-half and a full page in length (standard margins, Times New Roman size 12 font, single spaced), and should cover the following information:

1. What was/is their topic of study? (Supported by 2 literature references)
2. What was/is their most significant contribution to biochemistry?  
(Supported by 2 literature references)
3. How does this contribution relate to material studied in BCH2333A?

Please include the name of the biochemist you choose at the top of your biography.

Submissions will be evaluated for plagiarism, so please work independently.

### ***Term Tests***

In response to the migration of this course to an online form, term tests will be broken down to smaller components, reducing the weight and content of each evaluation. All evaluations will be completed during lecture time and will be administered through Brightspace.

#### **Evaluation Dates:**

Test 1	January 20
Test 2	February 8
Test 3	March 1

Test 4        March 17  
Test 5        March 29  
Test 6        April 7

**Evaluation Percentage:** 5% *each*

### ***Final Exam***

**Evaluation Percentage:** 35%

\*\*Note: Final exam is cumulative

### ***Lab***

**Evaluation Percentage:** 30%

\*\* Note: You must pass the lecture component and the lab component to pass the class.

## **Texts and Course Materials:**

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There is no required textbook for BCH2333A.

Recommended textbooks include:

*Biochemistry, 4th Edition, Voet & Voet*

Hardcover ISBN 978-0-470-57095-1

Loose-leaf ISBN 978-0-470-91745-9

eBook ISBN 978-0-470-91410-6

Access to the online e-book of Voet Biochemistry can be acquired from [http://www.campusebookstore.com/AccessCodes/AccessCodeBrowse.aspx?COID=27121&bookseller\\_id=241](http://www.campusebookstore.com/AccessCodes/AccessCodeBrowse.aspx?COID=27121&bookseller_id=241) for \$139.00 (Course ID: 742640). This includes practice questions, extra resources, and the online textbook. A flyer can be found in Brightspace in 'course materials' with more details and instructions for purchasing.

*Lehninger Principles of Biochemistry, 6<sup>th</sup> Edition, Nelson & Cox*

Hardcover ISBN 978-1-4292-3414-6

You can also get earlier editions of the texts or similar textbooks.

Alternatively, a free biochemistry internet resource that may be useful is:

[https://biochem.science.oregonstate.edu/sites/biochem.science.oregonstate.edu/files/ahern/Biochemistry%20Free%20For%20All%201.3\\_compressed.pdf](https://biochem.science.oregonstate.edu/sites/biochem.science.oregonstate.edu/files/ahern/Biochemistry%20Free%20For%20All%201.3_compressed.pdf)

**This course assumes a basic grasp of thermodynamics** to explain why and when biochemical processes proceed. For a refresher on thermodynamics, a PDF called "*Thermodynamics Refresher*" has been posted on Brightspace under "Course Materials".

**All test and exam content is from the lecture slides.** The use of a textbook is encouraged in order to provide alternative explanations of the concepts discussed in class.

## **Biochemistry Help Centre**

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The Biochemistry Help Centre will be held over Zoom (link is available through BCH Help Centre document posted to Brightspace in “Supporting Course Materials”). The Help Centre runs from January 17<sup>th</sup> to April 8<sup>th</sup>:

Monday, 1300-1430 (French and English)

Tuesday, 0930-1100 (French and English)

1400-1600 (English only)

Thursday, 1300-1500 (English only)

Friday, 1600-1800 (English only)

\*\*Note, the centre will be closed for reading week

Any questions about the help centre can be directed to Dr. Fabien Gagosz ([fgagosz@uottawa.ca](mailto:fgagosz@uottawa.ca) )

## **Missed Term Test Policy**

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In order to reduce the burden and stress on you, the student, to manage missed tests due to illness or any other reason, **no medical notes or other notes will be required.** Instead, the weights of all missed tests will be transferred to the final exam.

## **Remarking Policy**

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The nature of the tests on Brightspace will remove the need for remarking, as marking will be done automatically.

## **Policy On Student Safety**

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*The following policy on ensuring a safe learning environment for all students was adapted from one written by Prof. Allyson McLean, and is fully supported by Prof. Adam Shuhendler.*

I recognize that there are many elements that are essential for students to thrive in an academic environment. Key to this is a student's right to be treated with respect and afforded the dignity of self that should be extended to all people. I

strongly believe that our students have a right to learn in a respectful environment and moreover that it is my responsibility to create this space for you.

To my students in BCH2333A, I affirm and pledge the following:

1. That my students have a right to learn in an environment that fosters respect and dignity for all;
2. That it is my responsibility to protect this right;
3. That academic freedom does not supersede this right;
4. That I believe concepts can and must be taught without the use of offensive language;
5. That I will provide a safe space for communication if any student feels that their rights have been infringed upon.

Racism has been escalating across Ontario University campuses ([http://www.ohrc.on.ca/en/news\\_centre/letter-universities-and-colleges-racism-and-other-human-rights-concerns](http://www.ohrc.on.ca/en/news_centre/letter-universities-and-colleges-racism-and-other-human-rights-concerns)). There is zero tolerance for hatred or racism in BCH2333A. Any behaviour compromising the safety of our learning environment will be escalated to the Faculty.

## **Plagiarism**

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### **Beware of academic fraud!**

Academic fraud is an act by a student that may result in a false evaluation (including papers, tests, examinations, etc.). It is not tolerated by the University. Any person found guilty of academic fraud will be subject to severe sanctions.

Here are some examples of academic fraud:

- Plagiarism or cheating of any kind;
- Present research data that has been falsified;
- Submit a work for which you are not the author, in whole or part;
- Submit the same piece of work for more than one course without the written consent of the professors concerned.

Please consult [this webpage](#): it contains regulations and tool to help you avoid plagiarism.

An individual who commits or attempts to commit academic fraud, or who is an accomplice, will be penalized. Here are some examples of possible sanctions:

- Receive an “F” for the work or in the course in question;
- Imposition of additional requirements (from 3 to 30 credits) to the program of study;
- Suspension or expulsion from the Faculty.

You can refer to the regulations on [this webpage](#).

## **Student Services**

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### [Academic Writing Help Centre](#)

At the AWHC you will learn how to identify, correct and ultimately avoid errors in your writing and become an autonomous writer.

In working with our Writing Advisors, you will be able to acquire the abilities, strategies and writing tools that will enable you to:

- Master the written language of your choice
- Expand your critical thinking abilities
- Develop your argumentation skills
- Learn what the expectations are for academic writing

### [Career Services](#)

Career Services offers various services and a career development program to enable you to recognize and enhance the employability skills you need in today's world of work.

### [Counselling Service](#)

There are many reasons to take advantage of the Counselling Service. We offer:

- Personal counselling
- Career counselling
- Study skills counselling

### [Access Service](#)

The Access Service acts as intermediary between students, their faculty and other University offices to ensure that the special needs of these students are addressed and that the best possible learning conditions are being offered.

Note that the University of Ottawa is affiliated with [AERO](#) and [ACE](#) services for the adaptation of accessible academic materials for students with perceptual disabilities. If you have any questions, please contact the [Accessibility Librarian](#) or the [Access services](#) for textbooks.

## Steps to Success in Biochemistry

1. **Read** the relevant sections in the text before the class.
2. **Review** your notes as soon as possible after each class. I will return your midterms as soon as possible, and you should review them as soon as possible too (aim to do this within a week at the most).
3. **Write** the key concepts in your own words.
  - a. Ask yourself questions like “why does that work?” and “how does that work?”
  - b. Try to identify the underlying concepts
4. **Practice** regularly:
  - a. **DO the assignments!** If you copy the correct answer from a Facebook post, you are not giving yourself a chance to learn the material. Write out the answers as well as answering the questions online. It can help with retention of the material. Ask questions to your TAs, in class, or at office hours about questions and problems you don't understand.
  - b. Do additional questions (not just the night before the exam). There are lots of introductory biochemistry texts that cover this material. Try problems from these texts. Note: Attempt each question **BEFORE** looking at the answer. It is much easier to understand the question with the answer in front of you.
5. **Attend tutorials** (DGD's) and extra help sessions.
6. **Group study** is extremely useful because discussions will help make the material and concepts easier to remember and deepen your understanding. You will be asked to work in small groups in class—take advantage of this learning opportunity!
7. **Ask** questions! Your professor and TA's are there to help you succeed, but you have to put the time and effort into the course.

**\*Learning takes time!** I recommend that you spend 2 – 4 hours studying per hour of lecture (this translates to 6 – 12 hours per week in BCH 2333)\*