

**CHEM 323 / ENCH 323**  
**Biological Chemistry**  
**Winter 2023**

**Course instructor:** Dr. Chantelle Capicciotti  
CHE 405, Chernoff Hall; BOTT 625, Botterell Hall  
[c.capicciotti@queensu.ca](mailto:c.capicciotti@queensu.ca)

**Web Site:** onQ: <https://onq.queensu.ca/d2l/home/688544>

**Lectures:** Tuesdays 8:30-9:30 am  
Wednesdays 10:30-11:30 am  
Fridays 9:30-10:30 am  
**Walter Light Hall, RM 210**

**TA:** Fabiola De Leon Gonzalez, [14fvdl@queensu.ca](mailto:14fvdl@queensu.ca)

**Office Hours:** Tuesdays 10:00 am – 11:00 am.

- Office hours will be held in my Chernoff Hall Office, Rm 405.
- If this time is not sufficient, please send me an email with “CHEM/ENCH 323” in the subject line to set an appointment date/time to meet. Can also post questions in the “Discussion Board” in OnQ.

Lectures will use a combination of PowerPoint slides and handwritten notes. In person lectures will be captured and posted on OnQ within 24 hours after each class. **It is expected that you attend class in person** – this results in a better understanding of course material and allows you to participate in discussions and questions. Captured lectures will be posted in the event you are unable to attend in person due to illness. ***Regular posting of lecture videos may be reconsidered throughout the timeline of the course if class attendance is low. In this event, lectures will still be captured; however, in the event of illness, you will need to contact me over email to obtain a link to the recording.*** The last 2 weeks of the course will be dedicated to group presentations on timely Biological Chemistry topics, the exact format will be determined closer to the time.

### **Intended Student Learning Outcomes**

At the end of CHEM 323, students will be able to...

- Identify important features of peptide, protein, nucleic acid, and carbohydrate structures. Recommend and illustrate structure determination techniques
- Articulate the meaning of kinetic parameters and justify how they are altered during enzyme inhibition
- Propose reaction mechanisms for enzyme-catalyzed reactions that produce peptide, nucleic acid, and carbohydrate based biomolecules.
- Interpret genetic information and predict the resultant protein structures
- Compare and discuss alternative synthetic and biosynthetic approaches for peptide and carbohydrate synthesis
- Extend and apply course concepts to discuss and present topics of biological importance

**Course Content Outline****1. Introduction to Biomolecules**

**2. Proteins: Properties of Amino Acids-** nomenclature, stereochemistry, acid/base, **Properties of Peptide Bonds-** formation, geometry, nomenclature, sequence analysis, **Polypeptide Structures-** conformations, secondary structure, interactions between secondary structure

**3. Enzymes: Enzyme Kinetics-** Michaelis Menten kinetics, parameters, **Enzyme Inhibition-** competitive, uncompetitive, mixed, **Mechanisms of Catalysis-** General acid/base, covalent, co- factors, metal ions

**4. Nucleic Acids: Structure and Synthesis of DNA-** DNA replication, selection, catalysis, error correction, ligation; **Structure and Transcription of RNA-** RNA polymerase, regulation, **Translation of RNA-** ribosome, tRNA, tRNA synthetases, initiation, recognition, bond formation, termination

**5. Carbohydrates: Structure and Properties of Carbohydrates** – nomenclature, mutarotation, anomeric effect, conformation of monosaccharides, oligosaccharides and glycosidic bonds, glycosyltransferases and biosynthesis.

**6. Peptide and Carbohydrate Synthesis and Biosynthesis: *Selected examples of the following topics may be discussed:*** solution and solid supported synthesis – peptides and carbohydrates; general strategies for making glycosidic bonds and orthogonal protecting group strategies; RiPPs (Ribosomally synthesized and post-translationally modified peptides); NRPs (non-ribosomal peptides); Chemo-enzymatic synthesis.

**7. Student Presentations on Biological Chemistry Topics:** A project where groups of 4 students will research a Biological Chemistry topic and then give a presentation for 15 mins to teach the rest of the class about this topic

**Approximate Content Timeline**

Week	Content Covered	Assessments (Tentative)
Week 1 (Jan 9-13)	Intro to Biological Chemistry and Proteins	
Week 2 (Jan 16-20)	Proteins	Assignment 1 Posted
Week 3 (Jan 23-27)	Proteins and Enzyme Kinetics	Assignment 1 Due
Week 4 (Jan 30-Feb 3)	Enzyme Kinetics and Mechanisms	
Week 5 (Feb 6-10)	Enzyme Kinetics and Mechanisms	Assignment 2 Posted
Week 6 (Feb 13-17)	Enzyme Mechanisms and Nucleic Acids	Assignment 2 Due
Reading Week (Feb 20-24)		
Week 7 (Feb 27-Mar 3)	Nucleic Acids	Midterm Exam: Mar. 2 <sup>nd</sup> 7-9 pm
Week 8 (Mar 6-10)	Nucleic Acids and Carbohydrates	Assignment 3 Posted
Week 9 (Mar 13-17)	Carbohydrates	Assignment 3 Due
Week 10 (Mar 20-24)	Peptide and Carbohydrate Synthesis and Biosynthesis	Assignment 4 Posted
Week 11 (Mar 27-31)	Group Presentations	
Week 12 (Apr 3-7)	Group Presentations	Assignment 4 Due

**Grading Scheme**<sup>§</sup>

<b>Assignments</b> - Individual assignments, up to 4 in total	<b>20%</b>
<b>Presentation</b> – Groups of 4 with active participation in question session	<b>15%</b>
<b>Midterm</b> – In-person, tentatively scheduled for Thurs. Mar. 2 <sup>nd</sup> , 7:00 – 9:00 pm Location TBD	<b>25%</b>
<b>Final Exam</b> - Scheduled during exam period in April	<b>40%</b>

<sup>§</sup>According to Queen's policy, students should delay finalizing any travel plans until after the examination schedule has been finalized. Exams will not be moved or deferred to accommodate employment, travel/holiday plans or flight reservations.

**Recommended Textbook**

**Biochemistry**, Voet & Voet, 4<sup>th</sup> edition

*Note: older editions are also accepted (just make sure that there is no ambiguity on the assigned reading, either with your fellow students or with the instructor)*

**Additional Useful Textbooks**

- **Foundations of Chemical Biology**, C.M. Dobson, J. A. Gerrard, A. J. Pratt, Oxford Chemistry Primers, Oxford University Press: this very short (92 pages) summarizes the essentials in an easy-to-read manner. This is an ebook available through the library.

- **Organic Chemistry**, Clayden, Greeves & Warren: strong Organic Chemistry refresher

**Useful websites**

- a) *To read more:* **Encyclopedia of Biological Chemistry:** <http://www.sciencedirect.com/science/referenceworks/9780124437104>. A collection of short review articles written by experts, A wonderful complement to the textbook!
- b) *For research:*
  - **Web of Science** (Access Through Databases Tab at <http://library.queensu.ca/>). This is a searchable database for scientific literature. Very helpful for finding journal articles by topic searching and for then finding other research that is related to those articles.
  - **National Center for Biotechnology Information (NCBI):** <https://www.ncbi.nlm.nih.gov/>. For journal articles, protein sequences, DNA sequences, align protein sequences (BLAST), find protein structures and lots more
  - **ExPASy Proteomics Server** (also known as Swiss-Prot): <http://ca.expasy.org/>. This an annotated database dedicated to proteins, which also contains lots of useful online tools for protein sequence and structure analysis. A user-friendly protein structure viewer is available for download as well (<http://ca.expasy.org/spdbv/>).
  - **Protein Data Bank:** <https://www.rcsb.org/>. This is where structures of proteins or nucleic acids, determined by X-ray or NMR, are deposited. You can search for a biomolecule then download the file to your own PC for viewing on PyMOL or Swiss-PDBView
  - **Nucleic Acids Database:** <http://ndbserver.rutgers.edu/>. More sources of nucleic acids structures (X-ray or NMR). Advanced searches are possible. Download the file to your own computer and view with free software.

**Useful software:**

Download one (or both) of the following FREE programs for viewing and analyzing 3- dimensional structures of biomolecules:

PyMol: <http://www.pymol.org/>

Swiss PDB-Viewer: <http://ca.expasy.org/spdbv/>

**Grading Method**

All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen's Official Grade Conversion Scale:

***Queen's Official Grade Conversion Scale***

<b>Grade</b>	<b>Numerical Course Average (Range)</b>
A+	90-100
A	85-89
A-	80-84
B+	77-79
B	73-76
B-	70-72
C+	67-69
C	63-66
C-	60-62
D+	57-59
D	53-56
D-	50-52
F	49 and below

**Late Policy**

Assignments must be handed in on OnQ in the appropriate drop box on or before the due date. Late assignments will be given a **penalty of 10% per day**. Extensions will be granted only in exceptional circumstances and must be discussed with me before the due date. Note all academic consideration for missed quizzes, tests, midterms, presentations, and assignments is now processed through the faculty portal, see Academic Considerations for Students in Extenuating Circumstances section below.

**Calculator Policy**

As noted in Academic Regulation 9.2, Calculators acceptable for use during quizzes, tests and examinations are intended to support the basic calculating functions required by most Arts and Science courses. For this purpose, the use of the **Casio 991 series** calculator is permitted and is the **only approved calculator for Arts and Science students**. This calculator sells for around \$25 at the Queen's Campus Bookstore, Staples and other popular suppliers of school and office supplies.

**Plagiarism**

Presenting another's ideas or phrasings as one's own without proper acknowledgement.

Examples: copying and pasting from the internet, a printed source, or other resource without proper acknowledgement; copying from another student; using direct quotations or large sections of paraphrased material in an assignment without appropriate acknowledgement; submitting the same piece of work in more than one course without the permission of the instructor(s).

## **Academic Integrity**

Queen's students, faculty, administrators and staff all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic Integrity is constituted by the six core fundamental values of honesty, trust, fairness, respect, responsibility and courage (see [www.academicintegrity.org](http://www.academicintegrity.org)). These values are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University (see the Senate Report on Principles and Priorities <http://www.queensu.ca/secretariat/policies/senate/report-principles-and-priorities>).

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 <http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations/regulation-1>), on the Arts and Science website (see <http://www.queensu.ca/artsci/academics/undergraduate/academic-integrity>), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

## **Accommodations Statement**

Queen's University is committed to achieving full accessibility for people with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. The Senate Policy for Accommodations for Students with Disabilities was approved at Senate in November 2016 (see <https://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/ACADACCOMMPOLICY2016.pdf>). If you are a student with a disability and think you may need academic accommodations, you are strongly encouraged to contact the Queen's Student Accessibility Services (QSAS) and register as early as possible. For more information, including important deadlines, please visit the QSAS website at: <http://www.queensu.ca/studentwellness/accessibility-services/>

## **Academic Considerations for Students in Extenuating Circumstances**

Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and are interfering with their ability to complete academic requirements related to a course for a short period of time. Students receiving academic consideration must meet all essential requirements of a course. The Senate Policy on Academic Consideration for Students in Extenuating Circumstances was approved at Senate in April, 2017 (see <https://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/Academic%20Considerations%20for%20Extenuating%20Circumstances%20Policy%20Final.pdf>).

Each Faculty has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances. Arts and Science undergraduate students can find the Faculty of Arts and Science protocol and the portal where a request can be submitted at: <http://www.queensu.ca/artsci/accommodations>. Students in other Faculties and Schools who are enrolled in this course should refer to the protocol for their home Faculty.

If you need to request academic consideration for this course, you will be required to provide the name and email address of the instructor/coordinator. Please use the following:

Instructor Name: Dr. Chantelle Capicciotti  
Instructor Email Address: [c.capicciotti@queensu.ca](mailto:c.capicciotti@queensu.ca)

## **Statement of the Location and Timing of Final Examinations**

The exam dates for each Term are listed on the Faculty of Arts and Science webpage under “[Important Dates](#).” Student exam schedules for the Fall Term are posted via SOLUS immediately prior to the Thanksgiving holiday; for the Winter Term they are posted on the Friday before Reading Week, and for the Summer Term they are individually noted on the Arts and Science Online syllabi. **Students should delay finalizing any travel plans until after the examination schedule has been posted. Exams will not be moved or deferred to accommodate employment, travel/holiday plans or flight reservations.**

## **Copyright of Course Materials**

Course materials created by the course instructor, including all slides, presentations, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor’s course materials or to provide an instructor’s course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor’s *express consent*. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights.

## **Discussion Guidelines**

University is a place to share, question and challenge ideas. Each student brings a different lived experience from which to draw upon. To help one another learn the most we can from this experience please consider the following guidelines.

1. Make a personal commitment to learn about, understand, and support your peers.
2. Assume the best of others and expect the best of them.
3. Acknowledge the impact of oppression on the lives of other people and make sure your writing is respectful and inclusive.
4. Recognize and value the experiences, abilities, and knowledge each person brings.
5. Pay close attention to what your peers write before you respond. Think through and re-read your writings before you post or send them to others.
6. It’s ok to disagree with ideas, but do not make personal attacks.
7. Be open to being challenged or confronted on your ideas and to challenging others with the intent of facilitating growth. Do not demean or embarrass others.
8. Encourage others to develop and share their ideas.