Carleton University

Office of the Vice-Provost and Associate Vice-President (Academic)

memorandum

DATE: April 17, 2025

TO: Senate

FROM: Dr. David Hornsby, Vice-Provost and Associate Vice-President (Academic), and Chair, Senate Quality Assurance and Planning Committee

RE: 2025-26 & 2026-27 Calendar Curriculum Proposals
Undergraduate and Graduate Major Modifications

Background

Following Faculty Board approval, as part of academic quality assurance, major curriculum modifications are considered by the Senate Quality Assurance and Planning Committee (SQAPC) before being recommended to Senate. Major curriculum modifications are also considered by the Senate Committee on Curriculum, Admissions and Studies Policy (SCCASP).

Library Reports (as required)

In electronic communication members of the Library staff, upon review of the proposals, confirmed no additional resources were required for the major modifications included below.

Documentation

Recommended calendar language, along with supplemental documentation as appropriate, are provided for consideration and approval.

Omnibus Motion

In order to expedite business with the multiple changes that are subject to Senate approval at this meeting, an omnibus motion will be moved and include all items below. Senators may wish to identify any of the 3 major modifications that they feel warrant individual discussion that will then not be covered by the omnibus motion. Independent motions as set out below will nonetheless be written into the Senate minutes for those major modifications that Senators agree can be covered by the omnibus motion.

THAT Senate approve the major modifications as presented below.

Major Modifications

1. **BSc. Biochemistry and Biotechnology**
   SCCASP approval: April 1, 2025
   SQAPC approval: April 10, 2025

Senate Motion April 25, 2025

THAT Senate approve the name change and major modification to the BSc Hons program in Biotechnology and the introduction of BTEC 4908, 4909 & 4910 as presented with effect from Fall 2026.

2. **Chemistry and Earth Sciences**
   SCCASP approval: April 15, 2025
   SQAPC approval: April 24, 2025

Senate Motion April 25, 2025

THAT Senate approve the major modification to the undergraduate program in Chemistry and Earth Sciences as presented with effect from Fall 2025.

3. **MSc Earth Sciences Accelerate Pathway**
   SCCASP approval: January 21, 2025
   SQAPC approval: April 24, 2025

Senate Motion April 25, 2025

THAT Senate approve the introduction of an accelerated pathway to the MSC in Earth Sciences as presented with effect from Fall 2025.

Template for Major Modifications: A1

MEMORANDUM

To: Vice-President's Academic and Research Committee (VPARC) for A1s

From: Dr. Véronic Bézaire, Director of the Institute of Biochemistry
Dr. Tyler Avis, Full Professor, Institute of Biochemistry, Department of Chemistry
Dr. Kyle Biggar, Associate Professor, Institute of Biochemistry, Department of Biology
Dr. Allyson Brady, Assistant Professor, Institute of Biochemistry, Department of Biology
Dr. Eugene Fletcher, Assistant Professor, Institute of Biochemistry, Department of Biology
Dr. Farah Hosseinian, Full Professor, Institute of Biochemistry, Department of Chemistry
Dr. Martha Mullally, Associate Professor, Institute of Biochemistry, Department of Biology
Dr. Ethan Hermer, Professional Programs Officer, Faculty of Science

CC: Dr. Maria DeRosa, Dean, Faculty of Science
Dr. Julia Wallace, Associate Dean (Undergraduate Affairs), Faculty of Science

Date: January 7, 2025

Subject: Major Modification to Bachelor of Science in Biochemistry and Biotechnology. Track [A1]

Modification Description

The goal of this proposal is to align the Bachelor of Science in Biochemistry and Biotechnology curriculum with the needs of incoming students and society, further align biotechnology programming with Carleton Universities' Strategic Integrated Plan, and identify Carleton as the top Ontario destination for industry focused, modern biotechnology training. Over the last eight years, teaching and research expertise in biotechnology has increased tremendously through faculty hires in the Department of Biology, the Department of Chemistry, and the Institute of Biochemistry. However, new, incoming enrolment in Carleton's biotechnology programs has remained relatively static over the last six years relative to the increase in Biotechnology applications and enrolments in Ontario (Appendix D; Figure 1, Table 1, Table 2) as well as societal interest through venture capital investment and provincial interest in biotechnology (BIOTECanada, 2020; Government of Ontario, 2022). We will leverage the pre-existing interdisciplinary nature of the Institute of Biochemistry and create additional opportunities for entrepreneurship and innovation in STEM, in cooperation with the Sprott School of Business and Faculty of Engineering and Design. These novel collaborations will elevate our current Biotechnology offering from a program focused on just the core science of Biotech to a program that encompasses the pipeline from discovery to market. Altogether, we aim to signal to industry partners and prospective applicants that Carleton University is the top choice for biotechnology in Ontario.

We are proposing to rename the *BSc. Honours in Biochemistry and Biotechnology* to *BSc. Honours in Biotechnology* to signal the stronger Biotechnology focus. We are modifying the curriculum and its learning outcomes to increase the entrepreneurial and biotechnology focus of the program. In alignment with the interdisciplinary nature of Biotechnology, the BSc Honours in Biotechnology program

structure is built on foundational science courses across the Institute's contributing units of Biology and Chemistry.

To promote meaningful integration of biotechnology and entrepreneurship, courses in business (BUSI) and biotechnology (BTEC) start early in the degree and are carefully scaffolded across the years as shown below (see Appendix A for new BTEC course descriptions). The new BTEC courses elevate the current program by focusing on the applied aspects of Biotechnology. Students will learn to navigate the regulatory and intellectual property landscape in Canada and internationally, apply principles of quality assurance and quality control to ensure products are safe for market, and develop solutions to modern problems in fields such as agrifood, industrial microbiology, regenerative medicine, environmental remediation and biotherapeutics. These new BTEC courses have also opened stronger avenues of cross-faculty collaboration as the Faculty of Engineering and Design has indicated their interest in utilizing some of these new BTEC courses when they refresh their Bachelor of Engineering in Biomedical and Electrical Engineering and Biomedical and Mechanical Engineering programs (Appendix B). By focusing the curriculum on innovation and entrepreneurship, we are preparing students to create and capitalize on the ever-changing Biotechnology economy.

This refresh is also opening doors to new external partnerships. We are in discussions with Algonquin College to offer a 3+2 version of this degree that follows their Advanced Diploma in Biotechnology. We are also establishing a Biotechnology Professional Advisory Board to provide guidance on the program and other biotechnology-related initiatives within the Faculty of Science. The Board will comprise members from private industry, not-for-profit organizations, and government sectors, who will offer insights to enhance the curriculum and strengthen its alignment with industry needs. By collaborating directly with this community, we aim to enrich the program with research opportunities, facilitate student projects, and create logical pathways for employment. This Advisory Board will amplify Carleton's foundational research impact and enable biotechnology students to apply their skills through campus incubators and partnerships with local industry leaders. Ultimately, this program will produce industry-ready graduates, elevate Carleton University's reputation, and expand its research capacity in Canada's growing biotechnology sector.

A. Credits included in the Major CGPA (11.0 credits)

1. 2.0 credits in:

BTEC 2XXX [0.5]	(cross-listed BIOL 2301 Biotechnology I)
BTEC 3XXX [0.5]	(cross-listed BIOL 3301 Biotechnology II)
BTEC 3XXX [0.5]	Regulations and Intellectual Property
BTEC 3XXX [0.5]	Quality Control and Quality Assurance

2. 1.0 credit from:

BTEC 4908 [1.0]	Honours Research Thesis
BTEC 4XXX [1.0]	Practicum Research Project
BTEC 4XXX [1.0]	Consulting Project

3. 2.0 credits from:

BTEC 3XXX [0.5]	Agri-Food Technologies
BTEC 4XXX [0.5]	Food Bio-Innovations
BTEC 4XXX [0.5]	Biotherapeutics and Vaccines
BTEC 4XXX [0.5]	Regenerative Medicine
BTEC 4XXX [0.5]	Environmental Bioremediation
BTEC 4XXX [0.5]	Industrial Microbiology

4. 1.5 credits from:

BIOL 2001 [0.5]	Animals Form and Function
BIOL 2002 [0.5]	Plants Form and Function
CHEM 2204 [0.5]	Organic Chemistry II
CHEM 2501 [0.5]	Introduction to Bioinorganic Chemistry
CHEM 2800 [0.5]	Environmental Chemistry
FOOD 2002 [0.5]	Food Processing

5. 1.5 credits from:

BIOL 3201 [0.5]	Cell Biology
BIOL 3205 [0.5]	Plant Biochemistry & Physiology
BIOL 3303 [0.5]	Experimental Microbiology
BIOC 3103 [0.5]	Practical Biochemistry I
BIOC 3104 [0.5]	Practical Biochemistry II
BIOC 3203 [0.5]	Biochemical Pharmacology
CHEM 3201 [0.5]	Advanced Organic Chemistry I
CHEM 3205 [0.5]	Experimental Organic Chemistry
CHEM 3800 [0.5]	Chemistry of Environmental Pollutants
FOOD 3001 [0.5]	Food Chemistry
FOOD 3002 [0.5]	Food Analysis
FOOD 3003 [0.5]	Food Packaging
FOOD 3005 [0.5]	Food Microbiology
FOOD 3006 [0.5]	Upcycling and Sustainable Food Systems

6. 1.0 credit in BTEC, BIOL, BIOC, CHEM, FOOD at 4000 level

7. 1.5 credits in:

BUSI 1800 [0.5]	Introduction to Business
BUSI 2800 [0.5]	Entrepreneurship
PHIL 2408 [0.5]	Bioethics

8. 0.5 credit from:

BUSI 2301 [0.5]	Supply & Operations
BUSI 3119 [0.5]	Business & Environmental Sustainability
BUSI 3600 [0.5]	Entrepreneurial Strategies
BUSI 3810 [0.5]	Business Development

B. Credits not included in the Major CGPA (9.0 credits)

9. 2.5 credits in:

BIOL 1103 [0.5]	Foundations of Biology I
BIOL 1104 [0.5]	Foundations of Biology II
BIOL 2104 [0.5]	Introductory Genetics
BIOL 2303 [0.5]	Microbiology
BIOL 3104 [0.5]	Molecular Genetics

10. 1.5 credits in:

BIOC 2200 [0.5]	Cellular Biochemistry
BIOC 3101 [0.5]	General Biochemistry I
BIOC 3102 [0.5]	General Biochemistry II

11. 2.0 credits in:

CHEM 1001 [0.5]	General Chemistry I
CHEM 1002 [0.5]	General Chemistry II
CHEM 2203 [0.5]	Organic Chemistry I
CHEM 2303 [0.5]	Analytical Chemistry II

12. 1.5 credits in:

MATH 1007 [0.5]	Elementary Calculus I
MATH 1107 [0.5]	Linear Algebra
PHYS 1007 [0.5]	Elementary Physics

13. 0.5 credit from:

BIOL 1105 [0.5]	Introduction to Biological Data
BIOC 2500 [0.5]	Research Design and Skills in Biochemistry
STAT 2507 [0.5]	Introduction to Statistical Modeling I

14. 1.0 credit in free electives

Personal interests in biology, biochemistry, chemistry or food science can be tailored in Items 4 and 5. The degree culminates with project-based courses (Item 3), and a choice between original research (Item 2) and work-integrated learning in local biotechnology companies (Item 2). This program will train science students to be job-ready in 4-5 years with a complimentary skillset in entrepreneurship and innovation.

Impact on Other Programs

We do not foresee this program significantly reducing student enrollment in other programs. Students may move into the BSc. Biotechnology from the Department of Chemistry and the Department of Biology's programs, but it is equally possible that net new students will move the opposite way to pursue a more theory-based degree. Therefore, we see a minimal impact to the Departments of Chemistry and Biology, mitigated by the opportunity for net new students to transfer into their undergraduate programs. Additionally, by creating a focused Biotechnology degree, core courses may be packaged as a minor in the future. Students in the BSc Biotechnology who are interested in graduate studies will be well equipped and acquainted with the Department of Chemistry and the Department of Biology's graduate programs, including the Department of Biology's Master's in Biotechnology (M. Biotechnology), thereby supporting the research programs of members of the Institute. The proposed modifications are designed for a strong stand-alone undergraduate program and as a stepping stone for the M. Biotechnology. The Department of Biology is undergoing its own refresh of its programming offerings. These changes to the BSc Biochemistry and Biotechnology further differentiate the program from the current BSc Biology and Biotechnology. We have discussed these possibilities with both the Department of Biology and the Department of Chemistry (Appendix B). Furthermore, this program will utilize new courses from the Sprott School of Business, and the Department of Philosophy and we have received support from all units to do so (Appendix B). We also have letters of support from the Department of Health Sciences, the Faculty of Engineering and Design and a letter specifically from members of the Department of Systems and Computer Engineering, and the Department of Mechanical and Aerospace Engineering. Units in the Faculty of Engineering and Design are particularly interested in how the revised BSc Biotechnology could add value to their biomedical programming.

Impact on Learning Outcomes and Curriculum Map

The major program modifications offer an opportunity to clarify program learning outcomes (LO) of the current BSc Honours in Biochemistry & Biotechnology. Several learning outcomes have been updated to capture the context of the biotechnology industry, a critical aspect of the proposed modifications which was missing in the original program. BTEC LO 6, 7, 8, and 11 clarify the proposed modification's emphasis on entrepreneurship and innovation. LO comparison of the original BSc Honours in Biochemistry & Biotechnology to the BSc Honours in Biotechnology are in Appendix C.

BTEC LO1. Evaluate the relationships between structure and function from atoms to organisms

BTEC LO2. Explain fundamental concepts of biology, biochemistry, and chemistry in biotechnology

BTEC LO3. Perform standard biotechnology laboratory techniques and use computational / bioinformatic tools effectively

BTEC LO4. Record, analyze, and interpret data from experiments in biotechnology as per industry standards

BTEC LO5. Communicate biotechnology findings to experts and non-experts through reports, visualizations, presentations, and other formats

BTEC LO6. Develop entrepreneurial skills applicable to the biotechnology industry

BTEC LO7. Evaluate the nature of biotechnology regulatory and policy issues

BTEC LO8. Evaluate ethical, societal and environmental impacts of the biotechnology industry

BTEC LO9. Search and critically assess scientific literature and other information resources to identify gaps in knowledge and available biotechnologies.

BTEC LO10. Integrate interdisciplinary research findings to propose viable solutions to complex societal problems using biotechnology

BTEC LO11. Contribute to and report on biotechnological innovations in agri-food, biomedical, and environmental fields

Assessment and achievement of the revised LO has been carefully considered and mapped across the years as detailed below. As intended, foundational courses in biology, chemistry, biochemistry and business introduce underlying concepts necessary to LO progression. BTEC 2XXX and BTEC 3XXX courses serve to integrate and reinforce foundational knowledge in the context of biotechnology. Lastly, BTEC 4XXX options and capstone courses offer the opportunity to master and assess LO within specific fields of biotechnology (see Appendix A for where LOs are embedded in new BTEC courses).

Learning Outcome	Year(s) Assessed	Program Components	Level
Evaluate the relationships between structure and function from atoms to organisms	**2029**	BIOL/CHEM 1/2XXX BIOC 2200 Cellular Biochemistry BIOC 3101 General Biochemistry I BIOC 3102 General Biochemistry II	I I R M
Explain fundamental concepts of biology,	**2030**	BIOL/CHEM 1/2XXX BIOC 2200 Cellular Biochemistry BTEC 2XXX Biotechnology I	I I R

biochemistry, and chemistry in biotechnology		BTEC 3XXX Biotechnology II BTEC 4XXX Options	R M
Perform standard biotechnology laboratory techniques and use computational / bioinformatic tools effectively	**2031**	BIOL/CHEM 1XXX courses with labs BIOL/CHEM/BIOC/FOOD 2/3XXX courses with labs BTEC 4XXX Options	I R M
Record, analyze, and interpret data from experiments in biotechnology as per industry standards	**2029**	BIOL/CHEM 1XXX courses with labs BIOL/CHEM/BIOC 2/3XXX courses with labs BTEC 3XXX Quality Control and Quality Assurance BTEC 4XXX Options	I R M M
Communicate biotechnology findings to experts and non-experts through reports, visualizations, presentations, and other formats	**2030**	BUSI 2800 Entrepreneurship BTEC 2XXX Biotechnology I BUSI 2/3XXX Options BTEC 3XXX Biotechnology II BTEC 490X Capstone options	I I R M M
Develop entrepreneurial skills applicable to the biotechnology industry	**2029**	BUSI 1800 Introduction to Business BUSI 2800 Entrepreneurship BUSI 2/3XXX Options BTEC 2XXX Biotechnology I BTEC 3XXX Biotechnology II	I I R R M
Evaluate the nature of biotechnology regulatory and policy issues	**2030**	PHIL 2408 Bioethics BTEC 3XXX Regulations and Intellectual Property BTEC 490X Capstone options	I R M
Evaluate ethical, societal and environmental impacts of the biotechnology industry	**2029**	PHIL 2408 Bioethics BTEC 2XXX Biotechnology I BTEC 3XXX Biotechnology II BTEC 4XXX Options	I I R M
Search and critically assess scientific literature and other information resources to identify gaps in knowledge and available biotechnologies.	**2031**	BIOL/CHEM 1XXX courses with labs BIOL/CHEM/BIOC 2/3XXX courses with labs BTEC 2XXX Biotechnology I BTEC 3XXX Biotechnology II BTEC 490X Capstone options	I I R R M
Integrate interdisciplinary research findings to propose viable solutions to complex societal problems using biotechnology	**2030**	BIOL/CHEM/BIOC/FOOD 2XXX options BIOL/CHEM/BIOC/FOOD 3XXX options BTEC 2XXX Biotechnology I BTEC 3XXX Biotechnology II BTEC 4XXX Options BTEC 490X Capstone options	I I I R M M
Contribute to and report on biotechnological innovations in agri-food, biomedical, and environmental fields	**2031**	BIOL/CHEM 1XXX courses with labs BIOL/CHEM/BIOC/FOOD 2/3XXX courses with labs BTEC 490X Capstone options	I R M

Societal Need

Strengthening the existing biotechnology programming at Carleton University is not just a strategic academic initiative but a key response to the societal demands in Ontario as identified by the Province of Ontario's five-year "Taking Life Sciences to the Next Level" strategic plan (Government of Ontario, 2022). Training and education initiatives are key components of this plan, fostering sector growth through a generation of high-quality trainees and future entrepreneurs to support and grow Ontario-led innovations. With Ottawa serving as a hub for diverse biotechnology and regulatory agencies, there exists a glaring need for highly trained professionals in biotechnology and its closely related disciplines (e.g., business, life sciences, and engineering).

Federally, modest growth is predicted between 2021 and 2029 with a 4:1 shortage of jobs to workers (65, 000 additional workers are needed; BioTalent Canada, 2021a, 2021b). Most hires will be in the bio-health sector, but bio-industrial and agri-bio will need a significant number of employees. Across all sectors, companies are interested in hiring students with suitable communication, collaboration, problem solving skills as well as the knowledge required to grow and commercialize innovations (BioTalent Canada, 2021b). In Ontario, it is predicted that the province will need an additional 24, 500 bio-economy workers to fill the predicted available positions by 2029. Specifically, these positions will be in distribution, manufacturing and management capacities. 54% of these positions will be in bio-health, especially in Eastern Ontario and include careers in medical and control device manufacturing, medical and diagnostic labs, pharmaceutical manufacturing, testing laboratories, and hospitals. Additionally, there will be hiring gaps in physical, engineering and life sciences research and development. Although the skills gaps match the previously mentioned federal trends, Ontario lacks candidates with knowledge of regulatory affairs, and project management. Importantly, Ontario companies also desire employees who can develop and commercialize innovations from research and development (BioTalent Canada, 2021c). We believe this program will put students in a strong position to meet these needs and find careers across biotechnology fields such as biofuels plant manager, bioinformatician, business development manager, clinical research associate, development project manager, government relations officer, instrument technician, intellectual property officer, laboratory technician, manufacturing supervisor, marketing manager, materials manager, pre-clinical/clinical or field trial project manager, process development technician, quality assurance manager, quality control analyst, quality control inspector, regulatory affairs specialist, research assistant, research director, research manager, research scientist, sales representative, scientific writer, and a technical support manager (BioTalent Canada, 2024). With their strong foundation in theoretical knowledge and practical skills, graduates will be well-positioned to excel in research intensive roles in the fields of molecular biology, biochemistry, pharmacology, and biotechnology as well. Through these available positions, graduates will contribute to groundbreaking discoveries and advancements in their respective fields or in industry joining bio-energy, bio-industrial, agri-bio or bio-health companies to work in regulatory affairs, management, quality control and assurance, or manufacturing and production (BioTalent Canada, 2021a).

A dedicated program at Carleton University would cater to this demand by producing graduates with a strong chemistry and biology theory background, an entrepreneurial, business focused mindset, and the understanding of regulations to execute on biotechnology innovations. These graduates will play a pivotal role in advancing Ontario's industrial life science sector on multiple fronts, including social, economic, and health domains. Socially, the proposed Biotechnology program will spearhead groundbreaking research aimed at addressing pressing health issues, contributing to the overall

betterment of public health and quality of life. Economically, it will support initiatives that encourage students to drive innovation and entrepreneurship, fostering growth in the biotechnology sector and attracting investment to the region. Culturally, as interdisciplinary students, they will serve as ambassadors of scientific education, promoting a culture of public awareness of science, exploration, and collaboration. By nurturing a cohort of highly skilled professionals, Carleton University's biotechnology program will not only meet the immediate needs of Ottawa and Ontario but also contribute to the broader international landscape, shaping the future of biotechnology on a global scale.

Students

For the Ontario universities where this data is available[1], the demand for Biotechnology programming in the last six years has shown a sharp increase in both applications (First-Choice Applicants 2017-2022: 229-264; Appendix D. Figure 1., i; Table 1) and registrations (Registrations 2017-2022: 165-189; Appendix D. Figure 1, ii; Table 1), with most of this increase occurring after 2020. However, this sharp increase has not been seen at Carleton University (Appendix D. Figure 1, iii; Table 2). The University of Ottawa and McMaster University, two programs where Biotechnology is combined with Engineering, have the highest registrations (McMaster: 52 ± 9[2]. uOttawa: 46 ± 8[2]) which are more than double the combination of Carleton's current Biotechnology offerings (19 ± 4[2]; Appendix D. Table 2)[3]. Additionally, Waterloo, which offers a combination of Biotech and finance, has had a strong increase in applications since 2019, going from 6 registrations a year to between 19-26 a year. Other programs, which provide Biotechnology in the form of add-ons to pre-existing degrees or combinations of just Biology and Chemistry have only seen slight increases in registrations or stayed relatively stagnant, a trend also seen with Carleton University's two Biotech programs (Appendix D. Figure 1. Iii, Table 2). Additionally, many current programs, for example Brock University (Appendix E), have curriculum that are effectively double majors with no focus on Biotechnology in the coursework. Overall, there is increasing demand for Biotechnology programs. However, this demand is strongest in programs that go beyond providing a combination of Biology and Chemistry, and instead add a practical or business focus to the degree. Therefore, by modifying our Biotechnology programming to match the trends and avoid current pitfalls, we expect to find a similar increase in registrations experienced by other Universities during their growth periods.

Resources

We predict these changes could lead to a modest, sustained increase of 18 students in the program. The resources below are going to be repurposed from pre-existing Faculty of Science resources.

[1] Brock University:BSc in Biotechnology; McMaster University: Biotechnology; University of Ottawa Biotechnology; Wilfrid Laurier University: BSc Biochemistry and Biotechnology, BSc Biochemistry and Biotechnology (with Management option)); Ontario Tech: BSc Applied Biotechnology, BSc Applied Biotechnology (Co-op Option); University of Waterloo: Biotechnology (CPA); and York University: BSc Biotechnology.

[2] Mean +/- Standard Deviation

[3] Measured as academic unit weighted counts of new, first year enrolments.

Faculty resources

To bolster the Institute of Biotechnology's industry specific knowledge and connections, the Institute of Biochemistry requests an assistant professor, teaching stream starting in Year 3.

Contract instructors

No additional contract instructors are required for this program.

Administrative support

An additional lab coordinator (10R) in Year 2 will aid in running the lab components of the new BTEC courses.

Library resources

Current library resources should cover the needs of the program.

Space

We will utilize pre-existing space for the program.

Governance

There will be no impact to governance due to this change.

Tuition

Tuition will remain the same as it was previously.

References

BioTalent Canada. (2021a). *Close-up on the Bio-Economy: Canada*.

BioTalent Canada. (2021b). *Close-up on the bio-economy: Labour market intelligence*. https://www.biotalent.ca/reports/close-up-on-the-bio-economy-demand-and-supply-outlook/

BioTalent Canada. (2021c). *Close-up on the Bio-Economy: Ontario*. https://www.biotalent.ca/reports/close-up-on-the-bio-economy-ontario/

BioTalent Canada. (2024). *BioCareer Pathways*. BioTalent Canada. https://www.biotalent.ca/careerpathways/

BIOTECanada. (2020). *Canadian Biotechnology: Solving for Today. Building for Tomorrow.* https://www.biotech.ca/wp-content/uploads/2020/09/solving-for-today-building-for-tomorrow.pdf

Government of Ontario. (2022). *Taking Life Sciences to the Next Level: Ontario's Strategy*. https://www.ontario.ca/page/taking-life-sciences-next-level-ontarios-strategy

Appendix A. Proposed Course Synopses

BTEC 3XXX Regulations and Intellectual Property

Course Description: Regulatory frameworks and intellectual property processes in biotechnology industries. Case studies and discussions of regulatory approval, compliance requirements, patentability criteria, IP protection, and ethical consideration in biotechnology innovation and commercialization.

Prerequisite: BIOC 2200 Cellular Biochemistry or Biomedical Engineering or
Workshop three hours a week.

Learning Outcomes: By the end of the course students will be able to:

- Identify and analyze the key regulatory agencies and frameworks governing biotechnology in Canada and internationally.
- Explain the significance of the Food and Drugs Act, CEPA, and other relevant Canadian regulations in biotechnology.
- Evaluate the processes for conducting clinical trials and obtaining regulatory approval for biotechnological products.
- Understand the principles of intellectual property law as they apply to biotechnology, including patentability criteria and the types of IP protection available.
- Compare and contrast Canadian and international IP regimes, including the implications of treaties such as the PCT and TRIPS.
- Assess the ethical considerations and compliance requirements associated with biotechnology research and development.
- Examine real-world case studies to illustrate the interplay between regulations, IP, and market dynamics in the biotechnology industry.
- Develop strategies for navigating the regulatory and IP landscape to effectively commercialize biotechnological innovations.

BTEC 3XXX Quality Control and Quality Assurance

Course Description: Quality control (QC) and quality assurance (QA) in biotechnology. Case studies and discussions of Quality Management Systems (QMS) and methodologies, risk assessment and mitigation strategies, data integrity, and trends to ensure high-quality standards in biotechnological products and processes.

Prerequisite: BIOC 2200 Cellular Biochemistry or CHEM 2303 Analytical Chemistry II
Workshop three hours a week.

Learning Outcomes: By the end of the course students will be able to:

- Explain the fundamental concepts of quality control and quality assurance in biotechnology.
- Identify and interpret the regulatory requirements and standards relevant to the biotechnology industry.
- Implement a Quality Management System (QMS) and understand its components.
- Apply various quality control techniques to assess and ensure the quality of biotechnological products.
- Conduct risk assessments and develop strategies to mitigate potential quality issues.
- Evaluate data integrity practices and their significance in maintaining compliance and quality assurance.
- Demonstrate an understanding of training and competency requirements for personnel involved in QC and QA processes.
- Analyze real-world case studies to draw lessons and best practices in quality control and assurance.

BTEC 3XXX Agrifood Technologies

Course Description: Role of biotechnology in agriculture. Includes crop and animal biotechnology concepts for enhanced crop yield, pest resistance, nutritional quality, and livestock health. Principles of sustainable agriculture to promote environmentally friendly farming practices, ensuring a balance between productivity and ecological integrity.

Includes: Experiential Learning Activity
Prerequisite: BIOC 2200 Cellular Biochemistry or BIOL 2104 Introductory Genetics
Workshop or laboratory four hours a week.

Learning Outcomes: By the end of this course, students will be able to:

- Explain the principles and techniques of crop biotechnology, including genetic engineering, molecular breeding, and their applications in enhancing crop yield, pest resistance, and nutritional value.
- Analyze the role of animal biotechnology in improving livestock production, health, and welfare through methods such as cloning, transgenics, and reproductive technologies.
- Discuss the principles of sustainable agriculture and evaluate how biotechnology can optimize agricultural practices and soil health.

BTEC 4XXX Food Bio-Innovation

Course Description: Biotechnological advancements transforming the food industry with emphasis on new food sources, new ingredients, and new production and processing methods.

Includes: Experiential Learning Activity
Prerequisite: BIOC 2200 Cellular Biochemistry
Workshop or laboratory four hours a week.
Learning Outcomes: By the end of this course, students will be able to:

- Explain the principles and applications of biotechnology in food processing and preservation, including fermentation, enzyme usage, biocatalysts, and innovative packaging techniques.
- Analyze sustainable and ethical food sources, including protein and dairy alternatives, lab-grown meat, and fermentation-derived proteins.
- Identify and discuss the potential of agrifood byproducts and value-added products in enhancing food quality and reducing waste.
- Critically evaluate the impact of food bio-innovations on consumer health, food security, and environmental sustainability.

BTEC 4XXX Industrial Microbiology

Course Description: Industrial use of native and engineered microorganisms for generating products like traditional beverages, biopharmaceuticals, hormones, organic acids, biofuels, biopesticides, food additives and more. Critical reasoning skills applied to case studies and project development.

Includes: Experiential Learning Activity
Prerequisite: BIOL 2303 Microbiology or HLTH 2004 Microbiology and Virology or FOOD 3005 Food Microbiology
Workshop or laboratory four hours a week.
Learning outcomes: By the end of the course students will be able to:

- Explain the role of microorganisms in industrial fermentation
- Identify successful microbial biotech companies and describe the process used by these companies to produce biochemicals, enzymes or hormones
- Design a fermentation process to produce an industrial bioproduct, considering the choice of biomass feedstock, microbial strain and the type of fermentation (batch, continuous and fed batch)

BTEC 4XXX Regenerative Medicine

Course Description: In-depth exploration of regeneration medicine, focusing on the mechanisms, techniques, and applications involved in repairing or replacing damaged tissues and organs. Students engage with cutting-edge research and innovative approaches in the field.

Includes: Experiential Learning Activity
Prerequisite: BIOL 3201 Cell Biology or HLTH 3303 Molecular and Cellular Pathology II

Workshop or laboratory four hours a week.

Learning Outcomes: By the end of the course students will be able to:

- Explain the fundamental concepts and principles of regenerative medicine.
- Explore the sources and culture techniques of cells for effective tissue regeneration.
- Compare types and properties of biomaterials for tissue regeneration.
- Analyze the design and function of scaffolds in promoting tissue growth.
- Evaluate cell manufacturing and scale-up approaches.
- Develop critical thinking and collaborative skills through active learning and real-world case studies.

BTEC 4XXX Biotherapeutics and Vaccines

Course Description: In-depth exploration of protein and mRNA-based biotherapeutics and vaccines in biotechnology. Emphasizes modern technologies, focusing on design principles, production challenges, and commercial scaling, equipping students with essential knowledge about scientific and technological aspects critical for effective biotherapeutic and vaccine development.

Includes: Experiential Learning Activity
Prerequisite: BIOL 2104 Introductory Genetics or HLTH 2004 Microbiology and Virology
Workshop or laboratory four hours a week.

Learning Outcomes: By the end of this course, students will be able to:

- Explain the fundamental concepts and processes involved in the development of biotherapeutics and vaccines.
- Apply immunological principles to the design of vaccines and therapeutic proteins.
- Differentiate the production techniques and challenges associated with biopharmaceuticals.
- Evaluate the quality control measures for biotherapeutics and vaccines as they relate to scalable product
- Analyze case studies to understand the practical challenges and successes in the field of biotherapeutics and vaccine development.

BTEC 4XXX Environmental Bioremediation

Course Description: The use of living organisms to remediate contaminated soils and waters. Case studies and discussions of bioremediation processes from a chemical and biological perspective,

environmental factors that influence the selection of bioremediation technologies, limits of bioremediation strategies and techniques, and current advances in the field.

Includes: Experiential Learning Activity
Prerequisite: BIOL 2303 Microbiology or HLTH 2004 Microbiology and Virology or CHEM 2800 Environmental Chemistry or FOOD 3005 Food Microbiology
Workshop or laboratory four hours a week.

Learning outcomes: By the end of the course students will be able to:

- Explain the role of microorganisms in bioremediation
- Describe different bioremediation strategies and the decision-making process involved in technique selection
- Evaluate the suitability and compare the effectiveness of different bioremediation techniques in the remediation of a contaminated site
- Design a potential bioremediation strategy for a given environmental problem and site characteristics
- Analyze case studies to understand real-world challenges faced with bioremediation applications

BTEC 490X [1.0 credit] Consulting Project

This course is designed to give students practical experience as a biotechnology consultant by working on a concrete issue brought forward by a biotechnology partner. Evaluation based on a written report and presentation.

Includes: Experiential Learning Activity
Prerequisite: Fourth-year standing in Honours Biotechnology program.

BTEC 490X [1.0 credit] Practicum

Field placement in private sector providing practical experience in a biotechnology-related field. Sites may vary each year. Evaluation based on a written report and presentation.

Includes: Experiential Learning Activity
Prerequisite: Fourth-year standing in Honours Biotechnology program.

BTEC 4908 [1.0 credit] Research Thesis

Students carry out a research project approved by the Director, under the supervision of a faculty member of the Institute, in either the Biology or Chemistry departments. Evaluation based on a written thesis and presentation.

Includes: Experiential Learning Activity
Prerequisite: Fourth-year standing in Honours Biotechnology program.

Appendix B. Letters of Support

Bruce C. McKay
Chair and Professor
Department of Biology
1125 Colonel By Drive
Ottawa, ON Canada K1S 5B6
(613) 520-2600 x3265

STATEMENT OF SUPPORT FROM SISTER UNIT

The Institute of Biochemistry is proposing to transform its Bachelor of Science (B.Sc.) Honours Biochemistry and Biotechnology Program into a refocused B.Sc. Honours in Biotechnology Program. Veronic Bezaire, Director of the Institute of Biochemistry, presented this proposal at our Department Board Meeting on September 20, 2024.

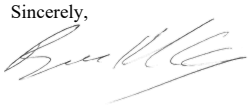
Members of the Department found the changes to be positive. The Department of Biology supports the major modifications to the B.Sc. Honours Biochemistry and Biotechnology, as presented to the Department with the reservations listed below.

We look forward to working with the Institute of Biochemistry to help deliver its programs.

[ ] I support this change unconditionally.
[ ] I do not support this change.
[X] I support this change, with the following reservations:

Several of the key 1st and 2nd year courses in the Department have been at capacity in recent years due to constraints imposed by teaching laboratory space. Some of this pressure has been reduced by decreased enrollment in several Science programs in 2024-25. However, a large increase in enrollment of students in the B.Sc. Honours in Biotechnology could return us to or exceed our capacity to deliver BIOL 1103, BIOL1104, BIOL2001, BIOL2104 and/or BIOL2200. In addition, the proposal includes new courses that may require instructors from Biology. Additional resources could be required in upcoming years.

Sincerely,



Name: Bruce McKay
Title: Chair
Academic unit: Biology
Date: October 18, 2024
Notes:

Carleton University
Faculty of Science

Seán Barry, Chemistry
Professor and Chair
Director, CU NanoFab

203 Steacie Building
1125 Colonel By Drive
Ottawa, Canada K1S 5B6
Tel: (613) 520-2600 ext.

November 19, 2024

STATEMENT OF SUPPORT FROM SISTER UNIT

RE: The Institute of Biochemistry is proposing to transform its Biochemistry and Biotechnology Bachelor of Science (B.Sc.) Honours into a Biotechnology B.Sc. Honours to build on Carleton's strong research and pedagogical background in biotechnology, biochemistry, entrepreneurship, food science, chemistry, and health.

On behalf of the Chemistry Department, we support the Biotechnology B.Sc. Honours program. The Chemistry Department can accommodate additional Biotechnology B.Sc. Honours students who wish to take any Chemistry course. We look forward to continuing to collaborate to expand elective options and future program additions.

[X] I support this change unconditionally.
[ ] I do not support this change.
[ ] I support this change, with the following reservations:

Seán Barry
Professor and Chair, Chemistry
Carleton University

Institute of Biochemistry
Carleton University
1125 Colonel By Drive
Ottawa, Ontario, Canada K1S 5B6

March 1, 2024

Dear Faculty member,

We are writing to share a notable development being considered at Carleton University, particularly related to some of your research and teaching expertise in the realm of biotechnology and/or medical devices. As a faculty member dedicated to the advancement of engineering within the bio-med and biotech fields, your expertise and insights are invaluable to us.

At present, Carleton University hosts a several Biotechnology programs dispersed across departments and institutes in the Faculty of Science. However, we are contemplating the establishment of a dedicated, stand-alone program focused explicitly on biotechnology and biotechnology entrepreneurship. This initiative is aimed at consolidating our efforts in this field and leveraging the collective strengths of our Institute of Biochemistry, supported by the Sprott School of Business.

Although in its early stages of planning, the envisioned program aims to delve into broad-ranging biotechnological topics, aligning with the diverse research strengths currently existing within Carleton. The program's focal points will encompass pivotal areas such as agri-food, microbiology, and health technologies, reflecting our institution's expertise and potential for groundbreaking research in these domains. **We are reaching out to esteemed faculty members such as yourself to gather insights, perspectives, and potential support for this initiative. Your expertise in bio-medical and biotech engineering could significantly contribute to the design, curriculum, and success of this proposed program.**

Please consider this letter only as an expression of our intent to garner support for this biotechnology program. We value your input and are eager to explore potential collaborations that align with your expertise and interests. As such, this letter does not imply any obligations but rather seeks to initiate a dialogue regarding the value and feasibility of such a program. Your feedback and potential involvement would be immensely appreciated as we strive to create a dynamic and impactful biotechnology program at Carleton University.

We would be delighted to discuss this further at your convenience. Thank you for your time, consideration, and continued dedication to advancing knowledge in the field of biotechnology. If you are in favor of supporting the concepts and value of such a comprehensive biotechnology program at Carleton, it would be greatly appreciated if we could recirculate this letter in preparation for your signature of support.

Warm regards,

Drs. Kyle Biggar & William Willmore
On behalf of the Institute of Biochemistry

- *Signature page to follow* -

Carleton UNIVERSITY
Canada's Capital University

Institute of Biochemistry
Carleton University
1125 Colonel By Drive
Ottawa, Ontario, Canada K1S 5B6

The undersigned Engineering Faculty acknowledge their support and recognize the institutional value in developing a dedicated, stand-alone program focused explicitly on biotechnology and biotechnology entrepreneurship at Carleton University.

Dr. James R. Green
Dept. of Systems and Computer Engineering
Faculty of Engineering, Carleton University

Dr. Leila Mostaco-Guidolin
Dept. of Systems and Computer Engineering
Faculty of Engineering, Carleton University

Dr. Andrew Harris
Dept. of Mechanical and Aerospace Engineering
Faculty of Engineering, Carleton University

Howard Nemiroff, Dean
Sprott School of Business
Carleton University

Rebecca Sprott, Assoc Dean
School of Business
Carleton University

February 12, 20024

Dr. Maria DeRosa, Dean
Faculty of Science
Carleton University

Subject: Letter of Support for Collaboration Between Sprott School of Business and BSc Biotechnology Program

Dear Dr. DeRosa,

We are writing to express our enthusiastic support for the proposed collaboration between the Sprott School of Business and the new BSc Biotechnology program at Carleton University. We believe that this partnership presents a unique opportunity to create a dynamic and innovative learning environment that will prepare students for the challenges and opportunities at the intersection of business and biotechnology.

The Sprott School of Business is committed to fostering interdisciplinary collaboration and providing students with a well-rounded education that prepares them for the complexities of the modern business landscape. We recognize the growing importance of biotechnology in various industries and are excited about the prospect of contributing our expertise to the development of the BSc Biotech program.

Our faculty at Sprott is well-equipped to offer targeted business courses that align with the specific needs of biotechnology students. These courses will focus on developing key skills required for business start-ups, including strategic planning, financial management, marketing, and entrepreneurship. By integrating these business principles into the biotechnology curriculum, students will gain a comprehensive understanding of how to successfully navigate the business aspects of the biotechnology field.

Furthermore, we see great potential for cross-pollination between business and biotechnology students. Collaboration between these two programs will foster a collaborative mindset, encouraging students to work together and leverage their diverse skills and perspectives. This interdisciplinary approach will prepare graduates to tackle real-world challenges that require a combination of scientific knowledge and business acumen.

At Sprott, we also emphasize the value of failure as a crucial aspect of the learning process. Understanding the potential pitfalls and setbacks in business and biotechnology is essential for personal and professional growth. By embracing failure as a valuable learning experience, students will develop resilience and adaptability, key qualities for success in both the business and biotechnology sectors.

In conclusion, we believe that the collaboration between the Sprott School of Business and the BSc Biotechnology program at Carleton University will create a unique and enriching educational experience for students. This partnership will not only differentiate the BSc Biotech program, but also prepare graduates to excel in a rapidly evolving and competitive global market.

We look forward to the opportunity to work closely with the BSc Biotechnology program and contribute to the success of this exciting initiative. Please feel free to reach out if you require any further information or if there are additional ways we can support the collaboration.

Thank you for considering our support for this innovative partnership.

Sincerely,

Howard Nemiroff
Dean, Sprott School of Business, Carleton University

Rebecca Renfroe
Associated Dean, Student Success and Recruitment, Undergraduate Programs, Sprott School of Business, Carleton University

STATEMENT OF SUPPORT FROM SISTER UNIT

The Institute of Biochemistry is proposing to transform its Biochemistry and Biotechnology Bachelor of Science (B.Sc.) Honours into a Biotechnology B.Sc. Honours to build on Carleton's strong research and pedagogical background in biotechnology, biochemistry, food science, chemistry and health.

[X] I support this change unconditionally.

[ ] I do not support this change.

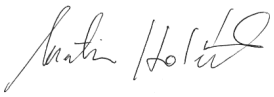
[ ] I support this change, with the following reservations:

On behalf of the Department of Health Sciences, I support the BSc Honours in Biotechnology. The following Health Sciences courses might be relevant to the proposed program, can accommodate additional students, and could be included as elective options:

HLTH 3103 Health Policy and Canada's Health Care System
HLTH 3104 Regulatory Issues and Human Health
HLTH 3322 Immunity and Immune-Related Disorders
HLTH 4102/5350 New Health Technologies

While not included in the proposal, we also see potential interest from the BHSc students in some of the courses offered as part of the BSc Biotechnology degree, particularly if offered as a Minor. We look forward to future collaboration on expanding elective options for undergraduate students in our respective programs.

Signature:



Name: Martin Holcik
Title: Chair
Academic unit: Department of Health Sciences
Date: October 25, 2024

STATEMENT OF SUPPORT FROM SISTER UNIT

The Institute of Biochemistry is proposing to transform its Biochemistry and Biotechnology Bachelor of Science (B.Sc.) Honours into a Biotechnology B.Sc. Honours to build on Carleton's strong research and pedagogical background in biotechnology, biochemistry, entrepreneurship, food science, chemistry, and health.

[X] I support this change unconditionally.

[ ] I do not support this change.

[ ] I support this change, with the following reservations:

On behalf of the Department of Philosophy, we support the Biotechnology B.Sc. Honours program. We support the inclusion of PHIL 2408 Bioethics in the Biotechnology B.Sc. Honours curriculum, and we have the capacity to support additional Biotechnology students. If there is strong growth in course enrolment, we will need to discuss allocation of Teaching Assistants for the tutorial sections of the course.

We look forward to expanding and improving collaboration between our respective units.

Signature:

Name: Dr. Melissa Frankel
Title: Chair (Interim)
Academic unit: Department of Philosophy
Date: November 15, 2024

STATEMENT OF SUPPORT FROM SISTER UNIT

The Institute of Biochemistry is proposing to transform its Biochemistry and Biotechnology Bachelor of Science (B.Sc.) Honours into a Biotechnology B.Sc. Honours to build on Carleton's strong research and pedagogical background in biotechnology, biochemistry, entrepreneurship, food science, chemistry, and health.

[X] I support this change unconditionally.

[ ] I do not support this change.

[ ] I support this change, with the following reservations:

On behalf of the Faculty of Engineering and Design, we support the Biotechnology B.Sc. Honours program. We support the creation of the BTEC 3XXX Regulations and Intellectual Property, BTEC 4XXX Regenerative Medicine and other BTEC courses that may be utilized in future refreshes of FED programs such as the Biomedical and Mechanical Undergraduate program.

We look forward to expanding and improving collaboration between our respective units.

Signature:

Name: Dr. Larry Kostiuk
Title: Dean
Academic unit: Faculty of Engineering and Design
Date: January 5, 2025

Appendix C. Program learning outcomes revisions from existing BSc Honours in Biochemistry & Biotechnology to proposed BSc Honours in Biotechnology.

Revised LO *BSc Biotechnology*	Existing LO *BSc Biochemistry and Biotechnology*
BTEC LO1. Evaluate the relationships between structure and function from atoms to organisms.	**LO6a.** Describes how the principles of Biochemistry are applied to the function of cells and their underlying metabolic processes.
BTEC LO2. Explain fundamental concepts of biology, biochemistry, and chemistry in biotechnology.	**LO7.** Describes how the basic principles of Biology and Chemistry apply to biochemical molecules (small molecules, macromolecules). **LO6b.** Describes how the principles of biochemistry are applied to the manipulation of living organisms for industrial, medical, agricultural and environmental purposes.
BTEC LO3. Perform standard biotechnology laboratory techniques and use computational / bioinformatic tools effectively.	**LO5a.** Develops, performs and optimizes laboratory procedures safely and according to current best practices and regulations.
BTEC LO4. Record, analyze, and interpret data from experiments in biotechnology as per industry standards.	**LO8.** Analyzes data, interprets it, assesses its validity, and visually presents it in an appropriate format (lab reports, presentations, etc.). **LO11a.** Demonstrates responsibility, critical thinking and good judgement. Demonstrates the ability to troubleshoot and optimize, based on previous results.
BTEC LO5. Communicate biotechnology findings to experts and non-experts through reports, visualizations, presentations, and other formats.	**LO4a.** Communicates scientific information orally using strategies appropriate for scientific audiences. **LO4b.** Communicates scientific information in writing using strategies appropriate for scientific audiences. **LO4c.** Communicates scientific information, both orally and in writing, using strategies appropriate for non-scientific audiences.
BTEC LO6. Develop entrepreneurial skills applicable to the biotechnology industry.	N/A
BTEC LO7. Evaluate the nature of biotechnology regulatory and policy issues.	**LO9.** Demonstrates an awareness of policies and regulations affecting ethical practices in research
BTEC LO8. Evaluate ethical, societal and environmental impacts of the biotechnology industry.	**LO12a.** Communicates an awareness of the importance of Biochemistry in the context of the broader human endeavor.

BTEC LO9. Search and critically assess scientific literature and other information resources to identify gaps in knowledge and available biotechnologies.	**LO2.** Searches, summarizes, and critically assesses the primary literature and other information resources to identify gaps in scientific knowledge, and develops questions and hypotheses to address these gaps.
BTEC LO10. Integrate interdisciplinary research findings to propose viable solutions to complex societal problems using biotechnology.	**LO3.** Integrates knowledge from other disciplines (e.g., mathematics, statistics, computer sciences, chemistry, biology and physics, as well as non-science disciplines) to solve complex biochemical problems.
BTEC LO11. Contribute to and report on biotechnological innovations in agri-food, biomedical, and environmental fields.	**LO1.** Designs and conducts original research on a topic relevant to Biochemistry. **LO10.** Collaborates as part of a team in both the classroom and laboratory environments.

Appendix D. Tables and Figures

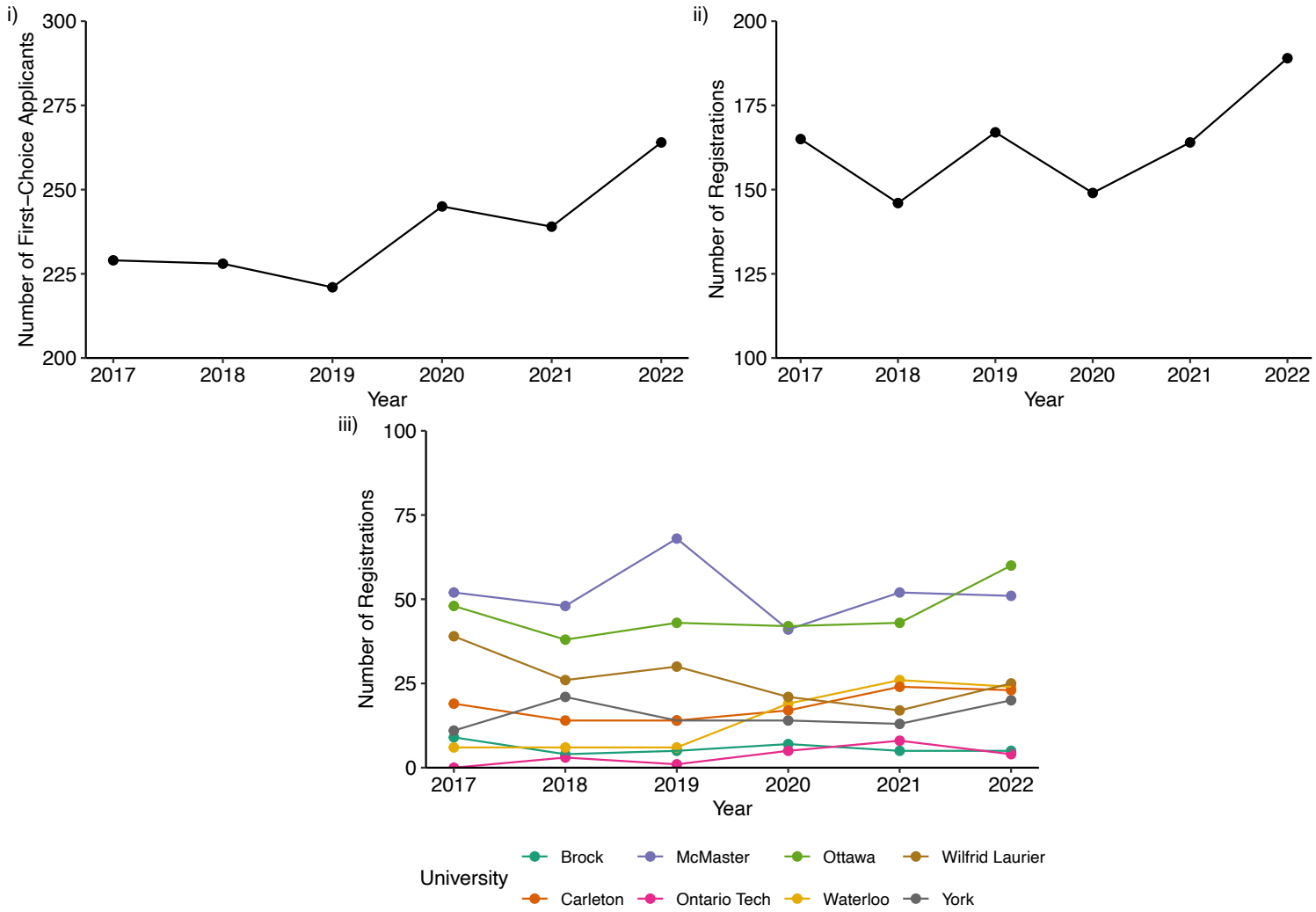


Figure 1. i) Number of First-Choice applicants for Biotechnology programs in Ontario from 2017-2022. Data was obtained from Carleton University's Office of Institutional Research and Planning. This is not exhaustive as we were unable to obtain data for some programs. Data for Brock University (BSc in Biotechnology), McMaster University (Biotechnology), the University of Ottawa (Biotechnology), Wilfrid Laurier University (BSc Biochemistry and Biotechnology and BSc Biochemistry and Biotechnology (with Management option)), Ontario Tech (BSc Applied Biotechnology and BSc Applied Biotechnology (Co-op Option), the University of Waterloo (Biotechnology (CPA)) and York University (BSc Biotechnology) are included.

ii) Number of Registrations for Biotechnology programs in Ontario from 2017-2022. Data was obtained from Carleton University's Office of Institutional Research and Planning. This is not exhaustive as we were unable to obtain data for some programs. Data for Brock University (BSc in Biotechnology), McMaster University (Biotechnology), the University of Ottawa (Biotechnology), Wilfrid Laurier University (BSc Biochemistry and Biotechnology and BSc Biochemistry and Biotechnology (with Management option)), Ontario Tech (BSc Applied Biotechnology and BSc Applied Biotechnology (Co-op Option), the University of Waterloo (Biotechnology (CPA)) and York University (BSc Biotechnology) are included.

iii) Number of Registrations for Biotechnology programs at each University in Ontario from 2017-2022. External data was obtained from Carleton University's Office of Institutional Research and Planning. The Carleton University data was obtained from the internal Data Cube as "New Enrolments". This is not exhaustive as we were unable to obtain data for some programs. Data for Brock University (BSc in Biotechnology), McMaster University (Biotechnology), the University of Ottawa (Biotechnology), Wilfrid Laurier University (BSc Biochemistry and Biotechnology and BSc Biochemistry and Biotechnology (with Management option)), Ontario Tech (BSc Applied Biotechnology and BSc Applied Biotechnology (Co-op Option), the University of Waterloo (Biotechnology (CPA)) and York University (BSc Biotechnology) are included. Carleton University (BSCH – Biochem & Biotech and BSCH – Biology and Biotech) utilizes New, First Year Academic Unit weighted count data as registration data.

Table 1. Number of registrants (number of first choice applicants) by year for the Universities that offer a Biotechnology program in Ontario. Data obtained through OIRP.

	Year					
University - Program	2017	2018	2019	2020	2021	2022
Brock University - BSc in Biotechnology	9 (7)	4 (6)	5 (18)	7 (11)	5 (8)	5 (12)
McMaster University - Biotechnology	52 (68)	48 (50)	68 (51)	41 (69)	52 (60)	51 (48)
Ontario Tech - BSc Applied Biotechnology	0 (0)	3 (6)	1 (7)	5 (6)	8 (11)	3 (5)
Ontario Tech - BSc Applied Biotechnology (Co-op Option)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (6)
University Of Ottawa - Biotechnology	48 (67)	38 (61)	43 (56)	42 (62)	43 (62)	60 (65)
University Of Waterloo - Biotechnology (CPA)	6 (14)	6 (31)	6 (23)	19 (27)	26 (37)	24 (48)
Wilfrid Laurier University - BSc Biochemistry and Biotechnology	34 (37)	24 (33)	26 (35)	20 (35)	13 (20)	24 (37)
Wilfrid Laurier University - BSc Biochemistry and Biotechnology (with Management option)	5 (5)	2 (6)	4 (6)	1 (3)	4 (5)	1 (3)
York University - BSc Biotechnology	11 (30)	21 (33)	14 (23)	14 (30)	13 (32)	20 (42)

Table 2. Number of new, fall, first-year students in the two Bachelor of Science Biotechnology programs offered at Carleton University (2024). Data retrieved from the OIRP Data Cubes.

	Year						
Bachelor of Science Program	2017	2018	2019	2020	2021	2022	2023
Biochem & Biotech	12	5	9	10	14	8	15
Biology & Biotech	7	9	5	7	10	15	6

Appendix E. Brock University BSc Honours in Biotechnology

Calendar: https://brocku.ca/webcal/undergrad/BTEC.html

Year 1	
BIOL 1P91 **BIOL 1P92**	Introduction to Biology I Introduction to Biology II
CHEM 1P91 **CHEM 1P92**	Chemical Principles and Properties I Chemical Principles and Properties II
one of MATH 1P01 Calculus Concepts I and 1P02 Calculus Concepts II, MATH 1P05 Applied Calculus I and 1P06 Applied Calculus II (recommended), MATH 1P97 Calculus with Applications and STAT 1P98 Practical Statistics	
PHYS 1P21 or PHYS 1P91 **PHYS 1P22 or PHYS 1P92**	Introductory Physics I or Introductory Physics I with Laboratory (recommended) Introductory Physics II or Introductory Physics II with Laboratory (recommended)
one Humanities context credit or Social Sciences context credit	
Year 2	
BTEC 2P09 **BTEC 2P63**	Introduction of Biotechnology Introduction to Biophysical Chemistry
BIOL 2P02 **BIOL 2P03**	Introduction to Molecular Biology Cell Biology
CHEM 2P20 **CHEM 2P21**	Principles of Organic Chemistry I Principles of Organic Chemistry II
one of BIOL 2P05 Evolution, 2P92 Principles of Zoology, 2P94 Plant Biology: Growth and Development, 2P96 Human Physiology, 2P98 Principles of Microbiology (recommended), 2Q04 Principles of Ecology	
one of CHEM 2P12 Introduction of Modern Physical Chemistry, 2P32 Principles of Inorganic Chemistry, 2P42 Introduction to Analytical Chemistry	
Humanities context credit or Social Sciences credit (not taken in year 1)	
Year 3	
BTEC 3P09 **BTEC 3P50**	Bioreactor Processes Molecular Genetics
BTEC 3P62 **BTEC 3P93**	Bio-organic Chemistry Protein and Nucleic Acid Chemistry
BCHM 3P01 **BCHM 3P02**	Metabolic Biochemistry Protein Structure and Function
CHEM 3P20	Structure and Reactivity of Organic Molecules

one credit from BTEC 3P43 Applied Microbiology, BCHM 3P25 Wine Chemistry, BIOL 3P28 Developmental Biology, 3P51 Neurobiology, CHEM 3P21 Transition Metal Chemistry, 3P40 Spectroscopy Techniques for Structure Elucidation, 3P41 Instrumental Methods for Quantitative Analysis, 3P60 Industrial Chemistry	
one elective credit	
Year 4	
BTEC 3P62 **BTEC 3P93**	Bio-organic Chemistry Protein and Nucleic Acid Chemistry (not taken in year 3)
BTEC 4F90 **BTEC 4F91**	Research Project Thesis
one credit from BTEC 4P06 Bioinformatics, 4P08 Topics in Plant and Microbial Biotechnology, 4P11 Theory of Techniques in Biochemistry and Molecular Biology, 4P20 Synthetic Biology, 4P41 Human Molecular Genetics, 4P42 RNA World, 4P51, 4P57 Bacterial Genetics, 4P58 Fungal Genetics, BIOL 4P10 Microbial Pathogenesis, 4P53 Immunology	
BTEC 4P27 **BTEC 4P67**	Enzymes and Co-enzyme Mechanisms or Biophysical Techniques
one elective credit	

Program Change Request

Date Submitted: 02/12/25 8:43 am

Viewing: **HBS-6K : ~~Biochemistry and~~ Biotechnology B.Sc. Honours**

Last approved: 04/25/24 10:37 am

Last edit: 02/12/25 8:43 am

Last modified by: sarahanneszabototh

Changes proposed by: sarahanneszabototh

In Workflow

1. **BIOC ChairDir UG**
2. **SCI Dean**
3. **SCI FCC**
4. **SCI FBoard**
5. **PRE SCCASP**
6. SCCASP
7. SQAPC
8. Senate
9. PRE CalEditor
10. CalEditor

Approval Path

1. 02/11/25 1:26 pm Veronic Bezaire (veronicbezaire): Rollback to Initiator
2. 02/12/25 11:39 am Veronic Bezaire (veronicbezaire): Approved for BIOC ChairDir UG
3. 02/13/25 9:23 am Maria Doria (mariadoria): Approved for SCI Dean
4. 02/21/25 10:03 am Maria Doria (mariadoria): Approved for SCI FCC
5. 03/03/25 3:48 pm Maria Doria (mariadoria): Approved for SCI FBoard

History

1. Mar 13, 2014 by sandra
2. Feb 11, 2015 by ruthhilllapensee
3. Jan 5, 2016 by ruthhilllapensee
4. Jan 23, 2017 by laurathomas

5. Jan 3, 2018 by laurathomas
6. Apr 16, 2019 by Mike Labreque (mikelabreque)
7. Feb 7, 2020 by SarahAnne Szabototh (sarahanneszabototh)
8. Mar 24, 2021 by SarahAnne Szabototh (sarahanneszabototh)
9. Apr 14, 2022 by SarahAnne Szabototh (sarahanneszabototh)
10. May 31, 2023 by Natalie Phelan (nataliephelan)
11. Jul 6, 2023 by Natalie Phelan (nataliephelan)
12. Apr 24, 2024 by SarahAnne Szabototh (sarahanneszabototh)
13. Apr 25, 2024 by Natalie Phelan (nataliephelan)
14. Apr 25, 2024 by Natalie Phelan (nataliephelan)

Calendar Pages Using this Program	Biotechnology Biochemistry

Effective Date	2026-27
Workflow	majormod ~~minormod~~
Program Code	HBS-6K
Level	Undergraduate
Faculty	Faculty of Science
Academic Unit	Institute of Biochemistry
Degree	Bachelor of Science Honours
Title	~~Biochemistry and~~ Biotechnology B.Sc. Honours

Program Requirements

~~Biochemistry and~~

Biotechnology
B.Sc. Honours (20.0 credits)

A. Credits Included in the Major CGPA (11.0 credits)

~~**1. 4.0 credits in:**~~		~~4.0~~
1. 2.0 credits in:		2.0
BTEC 2301 [0.0]	Biotechnology I	
BTEC 3301 [0.0]	Biotechnology II	
BTEC 3302 [0.0]	Regulations and Intellectual Property	
BTEC 3303 [0.0]	Quality Control and Quality Assurance	
2. 1.0 credit from:		1.0
~~BIOC 4907 [1.0]~~	~~Honours Essay and Research Proposal~~	
~~or BIOC 4908 [1.0]~~	~~Research Project~~	
BTEC 4908 [0.0]	Research Thesis	
BTEC 4909 [0.0]	Practicum	
BTEC 4910 [0.0]	Consulting Project	
3. 2.0 credits from:		2.0
BTEC 3501 [0.0]	Agrifood Technologies	
BTEC 4501 [0.0]	Food Bio-Innovation	
BTEC 4601 [0.0]	Regenerative Medicine	
BTEC 4602 [0.0]	Biotherapeutics and Vaccines	
BTEC 4701 [0.0]	Environmental Bioremediation	
BTEC 4702 [0.0]	Industrial Microbiology	
4. 1.5 credits from:		1.5
~~**8. 3.5 credits in:**~~		~~3.5~~
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2002 [0.5]	Plants: Form and Function	
CHEM 2204 [0.5]	Organic Chemistry II	
CHEM 2501 [0.5]	Introduction to Inorganic and Bioinorganic Chemistry	
CHEM 2800 [0.5]	Foundations for Environmental Chemistry	
FOOD 2002 [0.5]	Food Processing	
5. 1.5 credits from		1.5
BIOC 3103 [0.5]	Experimental Biochemistry I: Principles and Practices	
BIOC 3104 [0.5]	Experimental Biochemistry II: Research Experience	
BIOC 3203 [0.5]	Biochemical Pharmacology	
BIOL 3201 [0.5]	Cell Biology	
BIOL 3205 [0.5]	Plant Biochemistry and Physiology	
BIOL 3303 [0.5]	Experimental Microbiology	
~~BIOL 3305 [0.5]~~	~~Human and Comparative Physiology~~	
~~BIOL 4109 [0.5]~~	~~Laboratory Techniques in Molecular Genetics~~	
~~**4. 0.5 credit in** BIOL 3000-level or higher~~		~~0.5~~
~~**5. 4.0 credits in:**~~		~~4.0~~
~~BIOC 1500 [0.5]~~	~~Biochemistry in a Modern Society~~	
CHEM 3201 [0.5]	Advanced Organic Chemistry I	
~~**9. 0.5 credit from** BIOL or CHEM at the 2000-level or above~~		~~0.5~~
CHEM 3205 [0.5]	Experimental Organic Chemistry	
CHEM 3800 [0.5]	The Chemistry of Environmental Pollutants	
FOOD 3001 [0.5]	Food Chemistry	
FOOD 3002 [0.5]	Food Analysis	
FOOD 3003 [0.5]	Food Packaging and Shelf Life	

FOOD 3005 [0.5]	Food Microbiology	
FOOD 3006 [0.5]	Upcycling and Sustainable Food Systems	
6. 1.0 credit in BIOC, BIOL, BTEC CHEM, FOOD at 4000 level		1.0
7. 1.5 credits in:		1.5
BUSI 1800 [0.5]	Introduction to Business	
BUSI 2800 [0.5]	Entrepreneurship	
PHIL 2408 [0.5]	Bioethics	
8. 0.5 credit from:		0.5
BUSI 2301 [0.5]	Introduction to Supply and Operations Management	
BUSI 3119 [0.5]	Business and Environmental Sustainability	
BUSI 3600 [0.5]	Entrepreneurial Strategies	
BUSI 3810 [0.5]	Business Development	
B. Credits Not Included in the Major CGPA (9.0 credits)		
~~**10. 0.5 credit from:**~~		~~0.5~~
9. 2.5 credits in:		2.5
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 2104 [0.5]	Introductory Genetics	
~~BIOL 2301 [0.5]~~	~~Biotechnology I~~	
BIOL 2303 [0.5]	Microbiology	
BIOL 3104 [0.5]	Molecular Genetics	
~~BIOL 3301 [0.5]~~	~~Biotechnology II~~	
~~BIOL 4301 [0.5]~~	~~Current Topics in Biotechnology~~	
10. 1.5 credits in:		1.5
BIOC 2200 [0.5]	Cellular Biochemistry	
BIOC 3101 [0.5]	Unlocking Metabolism: Pathways, Enzymes, and Control	
BIOC 3102 [0.5]	Biochemical Signals and Structures: The Molecular Language of Cells	
11. 2.0 credits in:		2.0
~~**13. 0.5 credit in** free elective.~~		~~0.5~~
CHEM 1001 [0.5]	General Chemistry I	
CHEM 1002 [0.5]	General Chemistry II	
CHEM 2203 [0.5]	Organic Chemistry I	
CHEM 2303 [0.5]	Analytical Chemistry II	
12. 1.5 credits in:		1.5
MATH 1007 [0.5]	Elementary Calculus I	
MATH 1107 [0.5]	Linear Algebra I	
PHYS 1007 [0.5]	Elementary University Physics I	
13. 0.5 credit from:		0.5
BIOL 1105 [0.5]	Introduction to Biological Data	
BIOC 2500 [0.5]	Research Methods and Skills in Biochemistry	
~~BIOC 2300 [0.5]~~	~~Physical Biochemistry~~	
~~or CHEM 2103 [0.5]~~	~~Physical Chemistry I~~	
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
14. 1.0 credit in free electives		1.0
Total Credits		20.0

New Resources	No New Resources

Summary	Edits made to entire program structure, as laid out in executive summary.
Rationale for change	We are proposing to rename the BSc. Honours in Biochemistry and Biotechnology to BSc. Honours in Biotechnology to signal the stronger Biotechnology focus. We are modifying the curriculum and its learning outcomes to increase the entrepreneurial and biotechnology focus of the program. In alignment with the interdisciplinary nature of Biotechnology, the BSc Honours in Biotechnology program structure is built on foundational science courses across the Institute's contributing units of Biology and Chemistry.
Transition/Implementation	Resources requested as laid out in the Executive Summary.

Program reviewer comments	**veronicbezaire (02/11/25 1:26 pm):** Rollback: 4601, 4602

Key: 675

Course Change Request

New Course Proposal

Date Submitted: 02/25/25 11:52 am

Viewing: BTEC 4908 : Research Thesis

Last edit: 02/25/25 11:52 am

Changes proposed by: sarahanneszabototh

Programs referencing this course	Biotechnology B.Sc. Honours

In Workflow

1. **BIOC ChairDir UG**
2. **SCI Dean**
3. **SCI FCC**
4. **SCI FBoard**
5. **PRE SCCASP**
6. SCCASP
7. SQAPC
8. Senate
9. PRE CalEditor
10. Banner

Approval Path

1. 02/10/25 1:12 pm Veronic Bezaire (veronicbezaire): Approved for BIOC ChairDir UG
2. 02/21/25 10:04 am Maria Doria (mariadoria): Approved for SCI FCC
3. 02/25/25 6:14 am Angel Wagner (angelwagner): Rollback to Initiator
4. 02/25/25 11:53 am SarahAnne Szabototh (sarahanneszabototh): Approved for BIOC ChairDir UG
5. 03/03/25 11:15 am Maria Doria (mariadoria): Approved for SCI Dean
6. 03/03/25 3:48 pm Maria Doria (mariadoria): Approved for SCI FCC
7. 03/03/25 3:49 pm Maria Doria (mariadoria): Approved for SCI FBoard

Effective Date	2026-27

Workflow	majormod
New Resources	Other
Level	Undergraduate
Course Code	BTEC
Course Number	4908
Title	Research Thesis
Title (short)	Research Thesis
Faculty	Faculty of Science
Academic Unit	Institute of Biochemistry
Credit Value	1.0
Special/Selected Topics	Not Applicable
Significant Experiential Learning	Applied Research Project
Course Description	Students carry out a research project approved by the Director, under the supervision of a faculty member of the Institute, in either the Biology or Chemistry departments. Evaluation based on a written thesis and presentation.
Prerequisite(s)	Fourth-year standing in Honours Biotechnology program.
Class Format	Schedules may vary depending on research project.
Precluded Courses	
Also listed as	
Piggybacked Courses	
Grade Mode	Standard Letter Grade
Schedule Type	*Capstone *May constitute a major modification under Carleton's IQAP. Please consult https://carleton.ca/viceprovost/major-minor-modifications/ for more details.
Unpaid Placement	No
Summary	New course.
Rationale for new course	This new course supports the major modifications for the Biotechnology program. Full rationale is described in the executive summary.

Course reviewer comments	**angelwagner (02/25/25 6:14 am):** Rollback: Requested by S.A. Szabototh.

Key: 11272

Preview Bridge

Course Change Request

New Course Proposal

Date Submitted: 02/25/25 11:52 am

Viewing: BTEC 4909 : Practicum

Last edit: 02/25/25 11:52 am

Changes proposed by: sarahanneszabototh

Programs referencing this course	Biotechnology B.Sc. Honours

In Workflow

1. **BIOC ChairDir UG**
2. **SCI Dean**
3. **SCI FCC**
4. **SCI FBoard**
5. **PRE SCCASP**
6. SCCASP
7. SQAPC
8. Senate
9. PRE CalEditor
10. Banner

Approval Path

1. 02/10/25 1:13 pm Veronic Bezaire (veronicbezaire): Approved for BIOC ChairDir UG
2. 02/21/25 10:04 am Maria Doria (mariadoria): Approved for SCI FCC
3. 02/25/25 6:14 am Angel Wagner (angelwagner): Rollback to Initiator
4. 02/25/25 11:53 am SarahAnne Szabototh (sarahanneszabototh): Approved for BIOC ChairDir UG
5. 03/03/25 11:16 am Maria Doria (mariadoria): Approved for SCI Dean
6. 03/03/25 3:48 pm Maria Doria (mariadoria): Approved for SCI FCC
7. 03/03/25 3:49 pm Maria Doria (mariadoria): Approved for SCI FBoard

Effective Date	2026-27

Workflow	majormod
New Resources	Other
Level	Undergraduate
Course Code	BTEC
Course Number	4909
Title	Practicum
Title (short)	Practicum
Faculty	Faculty of Science
Academic Unit	Institute of Biochemistry
Credit Value	1.0
Special/Selected Topics	Not Applicable
Significant Experiential Learning	Practica or Placements (including Clinical Placements)
Course Description	Field placement in private sector providing practical experience in a biotechnology-related field. Sites may vary each year. Evaluation based on a written report and presentation.
Prerequisite(s)	Fourth-year standing in Honours Biotechnology program.
Class Format	Schedules may vary depending on placement.
Precluded Courses	
Also listed as	
Piggybacked Courses	
Grade Mode	Standard Letter Grade
Schedule Type	*Capstone *May constitute a major modification under Carleton's IQAP. Please consult https://carleton.ca/viceprovost/major-minor-modifications/ for more details.
Unpaid Placement	No
Summary	new course.
Rationale for new course	This new course supports the major modifications for the Biotechnology program. Full rationale is described in the executive summary.
Course reviewer comments	**angelwagner (02/25/25 6:14 am):** Rollback: Requested by S.A. Szabototh.

New Course Proposal

Date Submitted: 02/25/25 11:52 am

Viewing: BTEC 4910 : Consulting Project

Last edit: 02/25/25 11:52 am

Changes proposed by: sarahanneszabototh

Programs referencing this course	Biotechnology B.Sc. Honours

In Workflow

1. **BIOC ChairDir UG**
2. **SCI Dean**
3. **SCI FCC**
4. **SCI FBoard**
5. **PRE SCCASP**
6. SCCASP
7. SQAPC
8. Senate
9. PRE CalEditor
10. Banner

Approval Path

1. 02/10/25 1:13 pm Veronic Bezaire (veronicbezaire): Approved for BIOC ChairDir UG
2. 02/21/25 10:04 am Maria Doria (mariadoria): Approved for SCI FCC
3. 02/25/25 6:13 am Angel Wagner (angelwagner): Rollback to Initiator
4. 02/25/25 11:53 am SarahAnne Szabototh (sarahanneszabototh): Approved for BIOC ChairDir UG
5. 03/03/25 11:16 am Maria Doria (mariadoria): Approved for SCI Dean
6. 03/03/25 3:48 pm Maria Doria (mariadoria): Approved for SCI FCC
7. 03/03/25 3:49 pm Maria Doria (mariadoria): Approved for SCI FBoard

Effective Date	2026-27
Workflow	majormod

New Resources	Other
Level	Undergraduate
Course Code	BTEC
Course Number	4910
Title	Consulting Project
Title (short)	Consulting Project
Faculty	Faculty of Science
Academic Unit	Institute of Biochemistry
Credit Value	1.0
Special/Selected Topics	Not Applicable
Significant Experiential Learning	Industry/Community Research Projects
Course Description	This course is designed to give students practical experience as a biotechnology consultant by working on a concrete issue brought forward by a biotechnology partner. Evaluation based on a written report and presentation.
Prerequisite(s)	Fourth-year standing in Honours Biotechnology program.
Class Format	Schedules may vary depending on the partnership.
Precluded Courses	
Also listed as	
Piggybacked Courses	
Grade Mode	Standard Letter Grade
Schedule Type	*Capstone *May constitute a major modification under Carleton's IQAP. Please consult https://carleton.ca/viceprovost/major-minor-modifications/ for more details.
Unpaid Placement	No
Summary	New course.
Rationale for new course	This new course supports the major modifications for the Biotechnology program. Full rationale is described in the executive summary.
Course reviewer comments	**angelwagner (02/25/25 6:13 am):** Rollback: Requested by S.A. Szabototh.

Key: 11270

Associated Minors

Course Code	Course Title	Action
BTEC 2301	Biotechnology I	Added
BTEC 3301	Biotechnology II	Added
BTEC 3302	Regulations and Intellectual Property	Added
BTEC 3303	Quality Control and Quality Assurance	Added
BTEC 3501	Agrifood Technologies	Added
BTEC 4501	Food Bio-Innovation	Added
BTEC 4601	Regenerative Medicine	Added
BTEC 4602	Biotherapeutics and Vaccines	Added
BTEC 4701	Environmental Biomediation	Added
BTEC 4702	Industrial Microbiology	Added

Program Change Request

Date Submitted: 04/07/25 10:02 am

Viewing: HBS-7Y : Chemistry and Earth Sciences B.Sc. Combined Honours

Last approved: 04/25/24 12:41 pm

Last edit: 04/07/25 10:02 am

Last modified by: sheilathayer

Changes proposed by: sheilathayer

In Workflow

1. **ERTH ChairDir UG**
2. **CHEM ChairDir UG**
3. **SCI Dean**
4. **SCI FCC**
5. SCI FBoard
6. PRE SCCASP
7. SCCASP
8. SQAPC
9. Senate
10. PRE CalEditor
11. CalEditor

Approval Path

1. 03/26/25 9:28 am Tim Patterson (timpatterson): Approved for ERTH ChairDir UG
2. 04/03/25 3:36 pm David Brock (DAVIDBROCK3): Approved for CHEM ChairDir UG
3. 04/04/25 1:04 pm Julia Wallace (juliawallace): Rollback to Initiator
4. 04/07/25 10:18 am Tim Patterson (timpatterson): Approved for ERTH ChairDir UG
5. 04/07/25 10:18 am David Brock (DAVIDBROCK3): Approved for CHEM ChairDir UG
6. 04/10/25 9:32 am Maria Partington (MariaPartington): Approved for SCI Dean

History

1. Mar 21, 2014 by sandra

2. Aug 26, 2014 by vicki
3. Feb 11, 2015 by Sheila Thayer (sheilathayer)
4. Jan 5, 2016 by Sarah Adams-Aston (sarahadamsaston)
5. Jan 25, 2017 by Sarah Adams-Aston (sarahadamsaston)
6. Apr 4, 2017 by Sandra Bauer (sandrabauer)
7. Jan 4, 2018 by Sarah Adams-Aston (sarahadamsaston)
8. Apr 24, 2018 by Mike Labreque (mikelabreque)
9. Feb 7, 2020 by Kristin Allen (kristinjallen)
10. Apr 25, 2024 by David Brock (DAVIDBROCK3)
11. Apr 25, 2024 by Natalie Phelan (nataliephelan)

Calendar Pages Using this Program	Chemistry Earth Sciences

Effective Date	2025-26
Workflow	majormod ~~minormod~~
Program Code	HBS-7Y
Level	Undergraduate
Faculty	Faculty of Science
Academic Unit	Department of Chemistry Department of Earth Sciences
Degree	Bachelor of Science Honours
Title	Chemistry and Earth Sciences B.Sc. Combined Honours

Program Requirements

Chemistry and Earth Sciences B.Sc. Combined Honours (20.0 credits)

A. Credits Included in the Major CGPA (13.5 credits)

1. 4.0 credits in: 4.0

CHEM 1011 [0.5] Enriched General Chemistry 1

CHEM 1012 [0.5] Enriched General Chemistry 2

CHEM 2103 [0.5] Physical Chemistry I
CHEM 2104 [0.5] Physical Chemistry II
CHEM 2302 [0.5] Analytical Chemistry I
CHEM 2303 [0.5] Analytical Chemistry II
CHEM 2501 [0.5] Introduction to Inorganic and Bioinorganic Chemistry
CHEM 3503 [0.5] Inorganic Chemistry I

2. 1.0 credit in CHEM at the 4000-level 1.0

~~**3. 1.0 credit in:**~~ ~~1.0~~
~~ERTH 1006 [0.0] Course ERTH 1006 Not Found~~
~~ERTH 1009 [0.0] Course ERTH 1009 Not Found~~

~~**4. 3.0 credits in:**~~ ~~3.0~~

3. 0.5 credit in: 0.5
~~ERTH 3203 [0.0] Course ERTH 3203 Not Found~~
~~ERTH 3206 [0.0] Course ERTH 3206 Not Found (See Note, below)~~
ERTH 1002 [0.5] The Earth and Life Odyssey: A Journey Through Billions of Years

4. 3.5 credits in: 3.5
ERTH 2102 [0.5] Mineralogy to Petrology
~~ERTH 2104 [0.0] Course ERTH 2104 Not Found~~
ERTH 2105 [0.5] Geodynamics
ERTH 2106 [0.5] Geochemistry
ERTH 2314 [0.5] Sedimentation and Stratigraphy
~~ERTH 2406 [0.0] Course ERTH 2406 Not Found~~
ERTH 2407 [0.5] Structural Geology
ERTH 2419 [0.5] On the Origin of Planets
ERTH 2802 [0.5] Field Geology I

5. 2.0 credits in: 2.0
~~ERTH 3003 [0.0] Course ERTH 3003 Not Found~~
ERTH 3004 [0.5] Igneous Petrology
ERTH 3204 [0.5] Mineral Deposits
ERTH 3207 [0.5] Metamorphic Petrology and Processes
~~ERTH 3806 [0.0] Course ERTH 3806 Not Found~~
ERTH 3703 [0.5] Isotope geochemistry and geochronology

6. 0.5 credit from: 0.5
ERTH 4006 [0.5] Field Environmental Geobiology
ERTH 4209 [0.5] Mineral Exploration Field Geology
ERTH 4807 [0.5] Field Geology II

7. 1.0 credit in ERTH at the 4000-level 1.0

8. 1.0 credit from: 1.0
CHEM 4907 [1.0] Honours Essay and Research Proposal
CHEM 4908 [1.0] Research Project and Seminar
ERTH 4908 [1.0] Honours Thesis
~~ERTH 4909 [0.5] Research in Earth Sciences (and 0.5 credit in ERTH at the 4000-level)~~

B. Credits Not Included in the Major CGPA (6.5 credits)

9. 1.0 credit in: 1.0
MATH 1004 [0.5] Calculus for Engineering or Physics
MATH 1107 [0.5] Linear Algebra I

10. 0.5 credit from:		0.5
MATH 1005 [0.5]	Differential Equations and Infinite Series for Engineering or Physics	
MATH 2007 [0.5]	Elementary Calculus II	
11. 0.5 credit in:		0.5
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
12. 0.5 credit in:		0.5
ERTH 2004 [0.5]	Maps, Satellites and the Geospatial Revolution	
13. 1.0 credit from:		1.0
PHYS 1003 [0.5] & PHYS 1004 [0.5]	Introductory Mechanics and Thermodynamics Introductory Electromagnetism and Wave Motion	
PHYS 1007 [0.5] & PHYS 1008 [0.5]	Elementary University Physics I Elementary University Physics II	
14. 0.5 credit in:		0.5
BIOL 1104 [0.5]	Foundations of Biology II	
15. 0.5 credit in Science Faculty Electives (not CHEM or ERTH)		0.5
16. 0.5 credit in:		0.5
~~NSCI 1000 [0.0]~~	~~Course NSCI 1000 Not Found (or approved course outside the faculties of Science and Engineering and Design)~~	
ISAP 1000 [0.5]	Seminar in Science	
17. 1.5 credits in approved courses outside the faculties of Science and Engineering and Design		1.5
Total Credits		20.0

~~Note: for Item 5 above, ERTH 3203 is required if prerequisite conditions are met.~~

New Resources	No New Resources
Summary	Revise to accommodate course availability. Deletion of ERTH 4909, no longer offered and updated courses into section 7) The pair of first year courses ERTH 1006, 1009 is replaced by one first year course ERTH 1002; we accommodate this by adding 0.5 credit of ERTH at the 2000-level. ERTH 2406 and ERTH 3806 are both deleted and only one course ERTH 2407 is available to replace them, so we have added ERTH 2419 Origin of Planets to the pick list of courses ERTH 3203 and ERTH 3206 are both deleted. Geochemistry ERTH 3003 is moved to second year as ERTH 2106.
Rationale for change	Lack of teaching resources (retirements without replacement) and restrictions on class sizes forced us to remove one of the large first year courses, eliminate some of our Sedimentology offerings, and cut back on 4000-level courses with low enrolment. By condensing our 4000-level offerings into a set of 4 mandatory courses we ensure higher student numbers in each class and reduce the number of teaching assignments. Loss of third year Sedimentology content is compensated by making 4th year Sedimentology mandatory.
Transition/Implementation	ERTH already does individual counselling each semester with all students in our programs by printing audits and offering to meet with students to ensure they stay on track. Any students affected by cancellation of courses they intended to take will be advised on which courses remain and when they can take them.

Program reviewer comments	**angelwagner (03/24/25 3:08 pm):** Note removed, no longer relevant. **juliawallace (04/04/25 1:04 pm):** Rollback: by request

Key: 570

Program Change Request

New Program Proposal

Date Submitted: 09/30/24 9:48 pm

Viewing: TBD-2290 : M.Sc. Earth Sciences Accelerated Pathway

Last edit: 04/11/25 12:29 pm

Last modified by: robyngreen

Changes proposed by: sheilathayer

In Workflow

1. **ERTH ChairDir GR**
2. **SCI Dean**
3. **SCI GFCC**
4. **SCI JFBoard**
5. **PRE SCCASP**
6. **SCCASP**
7. **SQAPC**
8. Senate
9. PRE CalEditor
10. CalEditor

Approval Path

1. 10/01/24 3:07 pm Tim Patterson (timpatterson): Approved for ERTH ChairDir UG
2. 10/11/24 1:18 pm Maria Doria (mariadoria): Approved for SCI Dean
3. 10/22/24 1:59 pm Maria Doria (mariadoria): Rollback to ERTH ChairDir UG for SCI GFCC
4. 11/12/24 11:55 am Tim Patterson (timpatterson): Approved for ERTH ChairDir GR
5. 11/13/24 9:18 am Maria Doria (mariadoria): Approved for SCI Dean
6. 11/19/24 11:08 am Maria Doria (mariadoria): Approved for SCI GFCC
7. 12/09/24 11:23 am Maria Doria (mariadoria): Approved for SCI JFBoard
8. 01/14/25 12:16 pm Natalie Phelan (nataliephelan):

Approved for PRE SCCASP
9. 01/21/25 10:40 am Erika Strathearn (erikastrathearn): Approved for SCCASP

Effective Date	2025-26
Workflow	majormod
Program Code	TBD-2290
Level	Graduate
Faculty	Faculty of Science
Academic Unit	Department of Earth Sciences
Degree	
Title	M.Sc. Earth Sciences Accelerated Pathway

Program Requirements

Accelerated Pathway

The accelerated pathway in the Department of Earth Sciences is a flexible and individualized plan of graduate study. Students in the final year of the B.Sc. Honours degree in Earth Sciences may apply with the agreement of their B.Sc. Honours supervisor, within the deadline of January 15th of the year the B.Sc.H. will be completed.

Students may receive advanced standing with transfer of up to 1.0 credit which will reduce their time to completion. The M.Sc. thesis may include results from the honours thesis but must contain significant additional research.

Accelerated Pathway Requirements

1. 1.0 credit in ERTH courses at the 5000-level with a grade of B+ or higher.

2. Minimum overall and Major CGPA of A-.

New Resources	No New Resources
Summary	The MSc accelerated pathway allows BScH students a chance to fast track their MSc studies, enabling them to reach their academic and career goals faster. Candidate applies during the last year of their BScH, in January at the latest. The student writes their BScH thesis, graduates with the BScH as usual, and continues research in the MSc accelerated pathway. Work and experienced gained from the student's BScH projects reduces the time required to complete their MSc research programs to 1 year (3 terms). Therefore, students will be completing both BSc and MSc degrees in five years, instead of six. Hanika Rizo, Director of OCGC has reached out to University of Ottawa for their approval.
Rationale	The MSc accelerated pathway will help students achieve academic and career goals faster (students complete both BSc and MSc degrees in 5 years, instead of 6). There will be a better

	chance to get their BScH work published. The MSc accelerated pathway will increase HQP numbers, and will facilitate the recruitment of talented undergraduates, as well as retaining excellent students by extending BScH projects into a 1-year MSc.
Transition/Implementation	Students who have completed all other requirements may register part time for 1 more term if required, to complete thesis submission. Student requiring an extension to the program, they are automatically transferred to the standard 2-year MSc. However, additional financial support from the supervisor is not guaranteed. Transfer to the regular 2-year MSc is also permitted before, or during the MSc accelerated pathway, with the consent and financial support of the supervisor. The supervisor must declare their willingness to continue support beyond the one year at least 2 months before the MSc accelerated pathway program is due to be completed. Upon transfer, the requirements of the standard MSc program must be fulfilled. Direct transfer to a PhD program (PhD fast-track) is not possible from the MSc Accelerated Pathway.

Program reviewer comments	**nataliephelan (10/03/24 9:56 am):** Changed to graduate workflow. **mariadoria (10/22/24 1:59 pm):** Proposed revisions: -delete (cross-listed with 4000-level) from Program Requirements -revise the language ‘3 course units’ to reflect the necessary course credits -remove the first paragraph of the Transition/Implementation section (regarding funding) -please update the summary or rationale section to include approval of the new program from the University of Ottawa (for the Ottawa-Carleton Geoscience Centre) **mariadoria (10/22/24 1:59 pm):** Rollback: Proposed revisions: -delete (cross-listed with 4000-level) from Program Requirements -revise the language ‘3 course units’ to reflect the necessary course credits -remove the first paragraph of the Transition/Implementation section (regarding funding) -please update the summary or rationale section to include approval of the new program from the University of Ottawa (for the Ottawa-Carleton Geoscience Centre) **nataliephelan (10/24/24 8:57 am):** Editorial: a few language and style clean-ups while waiting for content revisions requested by SCI GFCC. **nataliephelan (11/20/24 10:14 am):** H. Maddin confirmed that the graduate director at uOttawa has been apprised of this change, and is in agreement with its introduction. **nataliephelan (11/20/24 2:29 pm):** In consultation with H. Maddin, rephrased the paragraphs for clarity.

Key: 2290