Biotechnology
We are in the midst of a biotechnological revolution, powered by our ability to identify and manipulate genes, change their expression and transfer them between organisms.

Wheat, cotton and other agricultural plants can be made pest resistant and more tolerant of drought or extremes in temperature. Plants and animals can be used to produce drugs and medicines for the treatment of diseases such as stroke, AIDS and cancer.

Recent cloning successes with a number of mammalian species have profound implications for reproductive technologies and the fabrication of replacement organs and tissues. Micro-organisms can be used to clean up oil spills and degrade toxic chemicals and alternative sources of energy can be produced from biomaterials such as sugar cane or corn.

The determination of the complete DNA sequence of humans, as well as more than 1,000 other organisms, has accelerated the pace of development of specific tests for disease diagnosis. It has unlocked the potential for the tailoring of drug therapies to the specific genetic make-up of each one of us.

This vast database of information will continue to yield new opportunities for biotechnologists for decades to come. We need to understand these new technologies in order to maximize their benefits. In addition, we need the expertise to be able to critically assess both the needs of new technologies and the ethical responsibilities of biotechnologists.

Some of the current areas of research in Biotechnology at Carleton include:

- molecular carcinogenesis;
- bioremediation;
- fungal genetics;
- plant biotechnology;
- antibiotic development and resistance;
- detection of food-borne pathogens;
- cryopreservation of organs and tissues; and
- development of liposomes for the delivery of drugs.

**Hands-on laboratory experience**
A high proportion of our Biotechnology courses feature instructional laboratories, providing you with extensive opportunities for hands-on laboratory work. Because of this training, Carleton graduates are widely recognized for their excellence in technical laboratory skills.

In addition, all Honours students in Biotechnology have the opportunity to develop a research project in an area of special interest, working alongside a faculty advisor.

Not only will you graduate with exceptional experience with some of the most up-to-date methodology, but you will also have a defined area of expertise.

**Excellent research facilities**
As a student in Biotechnology, you will be working in a laboratory for many of your courses.

Carleton University is well equipped with the latest technology, including a scanning electron microscope; fluorescence and light microscopes; cell, tissue and bacterial culture facilities; a wide range of modern molecular biology equipment; computer laboratories; and controlled-environment rooms and chambers.

Carleton students also have access to modern spectrophotometers, a mass spectrometer, automated gas chromatographs for chemical analyses and nuclear magnetic resonance facilities.

**Co-op opportunities**
A flexible co-operative education (co-op) option is available in Biotechnology, allowing you to gain practical work experience in settings such as government laboratories and agencies, as well as biotechnology companies.

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**The Carleton advantage**

**Leading-edge curriculum**
What you learn in the classroom has its foundations in active biotechnology research by our faculty and graduate students. Professors integrate some of the results of their research into course material. In third- and fourth-year courses, students have the opportunity to interact with biotechnology professionals from the Ottawa region.

Collaborative research programs exist between Carleton University and Agriculture and Agri-Food Canada, the Canada Food Inspection Agency, Environment Canada, Health Canada and the National Research Council Canada.
The capital advantage
Due in part to Carleton’s location in Ottawa, the nation’s capital, our programs and faculty have developed strong links with government departments, world-class hospitals, medical research facilities and high-tech organizations. You will have access to faculty members involved directly in the scientific community. As well, our location provides unparalleled access to science-related employers such as Environment Canada, National Research Council Canada and Agriculture and Agri-Food Canada.

Choosing the right program
Bachelor of Science (Combined Honours)
Carleton University offers you two programs in Biotechnology: a Combined Honours program in Biology and Biotechnology, and a Combined Honours program in Biochemistry and Biotechnology.

Both programs emphasize the fundamentals of organism structure and function, physiology, biochemistry and genetics.

If you choose the Biology/Biotechnology program, you will follow a course of study that places emphasis on the cell and organism level. You will be focusing on areas such as animal and plant physiology, cell biology, microbiology, ecology, industrial biochemistry and molecular genetics, in addition to your Biotechnology electives.

If you choose the Biochemistry/Biotechnology program, your focus will be on the subcellular and molecular levels in areas such as biochemistry, molecular biology, microbiology, biomacromolecules and industrial biochemistry, as well as Biotechnology electives.

Individual faculty supervisors help tailor your fourth year around your research thesis with advanced courses in:

- Methods in Molecular Genetics (BIOL 4106)
- Immunology (BIOL 4200)
- Animal Cell Culture: Methods and Applications (BIOL 4201)
- Mutagenesis and DNA Repair (BIOL 4202)
- Applied and Environmental Microbiology (BIOL 4300)
- Current Topics in Biotechnology (BIOL 4301)
- Industrial Biochemistry (BIOC 4004)
- Advanced Bioinformatics (BIOC 4008)
- Biochemistry of Disease (BIOC 4009)

Your first-year experience
The Combined Honours programs in Biology/Biotechnology and Biochemistry/Biotechnology have a common first year, which provides a basic grounding in chemistry and biology. The department also offers a number of combined programs.

A sample first year
- 1.0 credit in Foundations of Biology I (BIOL 1103) and Foundations of Biology II (BIOL 1104)
- 1.0 credit in General Chemistry I (CHEM 1001) and General Chemistry II (CHEM 1002)
- 1.0 credit in Elementary University Physics I (PHYS 1007) and Elementary University Physics II (PHYS 1008)
- 1.0 credit in Elementary Calculus I (MATH 1007) and Linear Algebra I (MATH 1107)
- 0.5 credit in Seminar in Science (NSCI 1000)
- 0.5 credit in an approved arts and social sciences elective

First-year Seminar in Science
First-year science students are encouraged to enrol in our unique seminar course Seminar in Science (NSCI 1000), designed specifically to introduce you to the latest scientific issues and to help you develop the kind of communication, analytical thinking and research skills you will need for your science studies and your career. If you choose this elective, you will attend several special lectures given by prominent Canadian researchers, as well as small group seminars led by a professor who acts as both your mentor and teacher. With no more than 30 students in each seminar, you will have plenty of opportunity to debate and discuss topics with your professor and fellow students, as well as be exposed to a variety of teaching styles, concepts and research opportunities usually reserved for upper-year students.

Future opportunities
The workplace
Biotechnology is one of the fastest growing sectors in the world economy.

Graduates find career opportunities in many areas including biotechnology companies, medical research...
and DNA diagnostic facilities, government agencies and laboratories, the pharmaceutical industry and the agricultural sector.

**Graduate studies**
Graduates of our program are well qualified to go on to graduate studies in a variety of fields including biotechnology, biochemistry, toxicology and genetic engineering.

If you think that you may wish to pursue an advanced degree, you are encouraged to investigate graduate programs early to ensure that your program meets the relevant requirements.

**Professional programs**
Many professional programs, including medicine and teaching, are interested in attracting well-rounded applicants from a variety of backgrounds.

Biotechnology provides a strong foundation for such programs, and you are encouraged to pursue interests you may have in these fields after completing your undergraduate degree.

**FAQs**

1. **Why would I choose an Honours program?**
   Honours or four-year programs have many advantages including offering more courses in your chosen field and access to co-op and internship opportunities where available, as well as preparing you for graduate studies, professional programs and employment.

2. **When do I have to declare a major?**
   You will need to choose a major by the end of your first year. Course registration is generally easier for students who have declared a major, so even if you are not 100 per cent certain, it is best to choose a major upfront and change it later if you need to.

3. **Where can I go for academic advice?**
   Once you are studying at Carleton, our Student Academic Success Centre offers a range of services including academic advising and free study-skill development workshops. Friendly academic advisors are available by appointment year-round to assist you with your educational planning needs. carleton.ca/sasc

**Admission requirements**
For admission to Carleton Biotechnology programs, you must have the Ontario Secondary School Diploma (OSSD) or equivalent, including a minimum of six 4 U/M courses.

Your six 4 U/M courses must include Advanced Functions and two of Biology, Chemistry, Earth and Space Sciences, or Physics. (Calculus and Vectors is also strongly recommended.)

It is Carleton University policy to consider your best performance in any eligible course in the admissions assessment.

Since the number of qualified applicants may be greater than the number of available spaces, cut-off averages and required marks may vary. Please refer to our website at admissions.carleton.ca/requirements for the current admission requirements.

**For more information**
...about the Biotechnology programs at Carleton, please visit our website at carleton.ca/biochem or carleton.ca/biology or consult the Carleton University Undergraduate Calendar website at carleton.ca/cuuc.
Do you want more information? Please contact us at:

Department of Biology
Carleton University
209 Nesbitt Biology Building
1125 Colonel By Drive
Ottawa ON K1S 5B6
Tel: 613-520-2478
Fax: 613-520-3539
Email: biology@carleton.ca
Website: carleton.ca/biology

Institute of Biochemistry
Carleton University
209 Nesbitt Biology Building
1125 Colonel By Drive
Ottawa, ON K1S 5B6
Tel: 613-520-2478
Fax: 613-520-3539
Email: biochem@carleton.ca
Website: carleton.ca/biochem

Undergraduate Recruitment Office
Carleton University
315 Robertson Hall
1125 Colonel By Drive
Ottawa ON K1S 5B6
Canada
Tel: 613-520-3663
Toll-free in Canada: 1-888-354-4414
Fax: 613-520-3847
Email: liaison@carleton.ca
Website: carleton.ca/admissions

More information you might be interested in:

Canada's Capital University