UTM CAREER CENTRE

INDUSTRY PROFILE:

BIOTECHNOLOGY

CONTENT

What Do Biotechnology Professionals Do?

> *If you're **scientifically minded**, enjoy **problem-solving** and want to have a genuine **impact on people and the planet**, consider a career in biotechnology.*

Overview - What is Biotechnology?

Simply defined, biotechnology uses living organisms, including their genes and proteins, to solve problems and make products. Biotechnology provides products and technologies to fight diseases, reduce our environmental footprint, develop drought and pest-resistant crops, use less and cleaner energy, and have safer, cleaner and more efficient manufacturing processes.
One of our fastest-growing industries, Canada's bioeconomy is largely divided into four subsectors: Bio-health, Bio-energy, Bio-industrial and Agri-biotech. Within each of these subsectors, there are a number of areas of specialization.

What do Biotechnology Professionals Do?

The knowledge and skills required to work in biotechnology are highly transferable between industry sectors. Jobs can be performed in a laboratory, in a field, or in a manufacturing facility. Because the industry is experiencing rapid growth, the demand for skilled workers is high.

Following are just a few of the many roles to be found in biotechnology:

Microbiologist

research bacteria, viruses, fungi, algae and parasites. Most microbiologists focus on studying just one type of microorganism. In the context of biotechnology, microbiologists might work in the manufacturing side of the industry, making sure that products are not contaminated, but they may also be involved in research and development. For example, they may study the use of microbes to clean up areas contaminated by heavy metals or study how microbes could aid crop growth.

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What Do Biotechnology Professionals Do? (cont.)

Microbiology Quality Control (QC) Technicians

are responsible for assuring quality of the product through all day-to-day operations. In a biomanufacturing plant, they evaluate raw materials, other supplies and the finished, packaged product, ensuring compliance with common Good Manufacturing Practices. Microbiology QC technicians calibrate and maintain laboratory equipment, compile and analyze data for documentation and prepare reports. They also revise and update Standard Operating Procedures. Professionals in these positions need to be detail-oriented, keep excellent records and have good communication skills.

Compliance Specialists

manage their organization's need to obey regulations such as grant requirements, or local, provincial or federal laws regulating the industry. This role may be responsible for preparing regulatory submissions for drugs, biologics and medical devices. Compliance specialists may spend time meeting with scientists, writing and reviewing documents, presenting information about updates to regulations and discussing strategies to ensure compliance.

Biotechnology Research Assistant

A Biotechnology Research Assistant's duties will vary with the area of the industry in which they are employed. A research assistant at a health biotech firm might gather information on scientific studies and clinical trials to treat a specific disease. Research assistants who have clinical duties may perform molecular biological techniques such as preparing and purifying proteins, DNA, and RNA, and supervising DNA cloning processes. In addition to their research duties, biotechnology research assistants may also help with maintaining laboratories and equipment.

Agricultural Biotechnologist

Biotechnology is used in many ways in agriculture. Agricultural biotechnology companies supply farmers with tools to increase the yield of plant and animal products, while lowering the costs of production. Agricultural biotechnology also includes production of ornamental plants and plants used to produce biofuels. Through genetic modification, Agricultural Biotechnologists develop products to protect animals and crops from diseases and help farmers identify the best animals and seeds to use in selective breeding programs. Their daily tasks may include designing and carrying out experiments on living or dead matter, applying scientific methodologies, information technology and laboratory equipment, recording and measuring results, including analysis, and processing data for senior researchers and decision makers.

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What Do Biotechnology Professionals Do? (cont.)

Aquaculture Technician

In marine biotechnology, products are derived or developed from marine animals and plants. This area also includes aquaculture, where aquatic organisms are grown in culture and used for food, fuel, cosmetics, pharmaceuticals, and other products. Some biotechnology researchers investigate methods for genetic engineering of fish to increase their growth rate. Other companies make vaccines for fish to protect them from diseases. An Aquaculture Technician's duties may include live-feed, algae, larval rearing, nutrition and fish health trials as well as maintenance of recirculation systems, water quality testing, sample weighing, feeding, dissections and other experimental requirements. The aquaculture technician may draft standard operating procedures and help prepare reports on the observations and findings of research projects.

Education Requirements

Although some roles in biotechnology require advanced degrees, it is possible to get a foot in the door with biotechnology companies with a Bachelor of Science degree, especially through programs for recent graduates, such as those offered through BIOTalent Canada. (See more information in the Employment Outlook section below). Other entry-level positions can be found in areas such as Sales and Marketing and Administration. These include roles in finance, purchasing, logistics, information technology, human resources, public relations and communications.

Ontario Colleges offer two- or three-year diplomas in Biotechnology, including Centennial, Durham, Humber and Seneca in the Greater Toronto Area. These programs offer similar courses, with the difference being the depth of learning, length of work placements and the addition of specialized courses in longer programs. One-year post-graduate programs are also available in Quality Assurance and Quality Control at Conestoga, Seneca and Sheridan.

Fast Facts

The global market...
is estimated to be $500 billion, according to the Smart Prosperity Institute.

Bio-based products...
are expected to make up 50% of consumer products by 2050.

Biofuel Industry...
in Canada generates $3.5 billion worth of annual economic activity and has created more than 14,000 jobs.

80% of Canadian...
biotechnology companies are privately owned.

The majority...
of the sector in Canada is made up of small to medium-sized enterprises: 50% of biotechnology companies have fewer than 20 employees, and 80% have fewer than 100 employees.

The propotion of Canadian...
biotech companies expecting to spend more than $5 million on research and development grew from 16% in 2017 to 23% in 2018, and a projected 50% in 2021.

Approximately 4,950 people...
are employed as Biologists and related scientists in Ontario and 94% work full time; 54% are female and 46% are male.

About 1,900 people...
work as Biological technologists and technicians in Ontario and 87% are employed full time.

Industry Trends

Canada is a world leader in biotechnology, with numerous ground-breaking innovations.

Ground-Breaking Discoveries

Researchers in Vancouver were the first to sequence the genome of the virus that caused the SARS outbreak in 2003, leading to the development of potential vaccines, says Andrew Casey, president of industry association, BIOTECanada. In 2014, Canadian microbiologists developed an experimental vaccine, now in use, to prevent the Ebola virus infection.

Renewable Energy

In renewable energy, Canada's Agrisoma Biosciences developed and markets a biofuel from an oilseed crop, Carinata, that was used in the world's first biofuel jet flight in Ottawa in 2012. Its biofuel is an environmentally sound alternative to petroleum fuels.

Canadian Inventions and Innovations

The world's first genetically modified animal approved for human consumption is also a Canadian invention. The Food and Drug Administration and the Canadian Food Inspection Agency have both approved AquaBounty Technologies' fast-growing genetically-modified Atlantic salmon for sale in Canada and the U.S.A. Although some opponents to the GM salmon have dubbed it "Frankenfish", AquaBounty says it has sold several tons of fillets to unnamed customers in Canada, despite major grocery chains such as Costco and IGA stating they would not carry the fish. The salmon is scheduled to hit the U.S. market in fall 2020.

Another Canadian biotechnology food innovation is the non-browning Arctic Apple. Developed by B.C.-based Okanagan Specialty Fruits, the apple does not brown when cut or bruised, reducing wastage.

Yet another example is Acorn Biolabs, which collects live stem cells from human hair and freezes them for future use to potentially treat people's health conditions through regenerative medicine.

These scientific discoveries and innovative products all point to Canada's expertise in biotechnology. According to BIOTEC's Casey, Canada has a "thriving biotech ecosystem, with clusters in every province, which bring together world-class universities and research institutes, biotech entrepreneurs, large multinational players, and a highly educated workforce."
He explains that many of the early-stage biotech companies can trace their roots to Canadian universities and that established companies are relying on their expertise for future employees.

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Industry Trends (cont.)

Biotechnology Industry Survey

Because of a lack of current data on the Canadian life sciences industry, in early 2018, BIOTECanada and Deloitte collaborated on the Biotechnology Industry Data Survey which was sent to Canadian life sciences companies involved in research and development. Some 208 companies responded, from the health, medical technology and devices, research and development (R&D), agriculture and veterinary biotechnology sectors.

According to the survey report, 77 per cent of respondents had a product in the R&D stage, followed by close to half with a product in early clinical trials, 30 per cent with a marketed product, and 29 per cent with a product in late clinical trials or awaiting regulatory approval.

Most of the organizations in Canada's biotechnology sector are small and medium-sized companies that are expecting to create new high-paying jobs over the coming five years. A majority of the surveyed companies (53%) employed 0-9 people, and the median employment was 8.5. Median company employment is projected to grow to 20 by 2021. In particular, the number of companies with 25 or more employees is expected to increase from 20 per cent in 2017 to 45 per cent in 2021.

Raising Additional Capital

Most biotechnology companies are expecting to raise additional capital in the coming years to support growth and identified lack of access to capital as the biggest issue facing the sector, according to the report. It states that by the end of 2017, Canadian biotechnology companies had raised $554 million CAD in venture capital. In the same period, American life sciences companies raised over $12 billion USD. Canadian biotechnology companies are underserved by Canadian capital markets, and face challenges attracting the funding they need from international sources.

The majority of companies indicated that funding and tax incentives from government programs such as the Scientific Research & Experimental Development Program (SR&ED), and the Industrial Research Assistance Program (IRAP) are critical to their operations.

Casey says that talent and capital are both getting harder to access because of competition from emerging economies and countries with established biotechnology industries. "The United States has the most successful biotechnology clusters in the world, in San Francisco, Boston and North Carolina's Research Triangle, while the United Kingdom, Belgium, Australia and Israel are among the countries with strategies to commercialize the fruits of their robust biotech industries," said Casey as quoted in an industry publication.

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Industry Trends (cont.)

Optimisn for Future Growth

The BIOTECanada survey found that the Canadian sector has high expectations for bringing new products to market over the coming five years. By the end of 2018, the number of companies expecting to be in the growth phase grew 12 percentage points to 34 per cent. This suggests a high level of optimism for future growth.

Biotechnology is also becoming more central to supporting the transformation of Canada's traditional job-intensive industries -- forestry; energy; mining, agriculture, aerospace; manufacturing and resource
management.

The process of bringing a biotechnology innovation from idea to commercial product is complex and costly with a long regulatory approval stage, often taking several years. Many partners must play a role, including researchers, business incubators, universities, government, investors and large enterprises.

Canada's Bioeconomy

Canada is competing with other countries to attract investors and talent to the sector. If Canada is unable to attract investors and people then the innovations discovered here will go to where the investment and people are. We will ultimately get the innovation back in its finished form but will have lost out on the economic benefits associated with commercialization.

In 2019, Bioindustrial Innovation Canada published a National Bioeconomy Strategy, based on consultations with 400 industry representatives across Canada.

To realize the opportunities of Canada's bioeconomy, the strategy says the industry needs: "a modern government regulatory system that provides certainty to industry and enables the bioeconomy; a business climate that supports the scaling up of Canadian companies in the bioeconomy and makes Canada a top country in which to invest; and a strong bioeconomy ecosystem with an emphasis on value chain creation, job training and skills development."

Employment Outlook for Professionals in Biotech

According to the most recent Ontario government labour market report, the employment outlook is above average for Biologists and related scientists (NOC 2121) in Ontario up to 2021. The employment outlook is average for Biological technologists and technicians (NOC 2221) in Ontario up to 2021.

Overview

Biologists and related scientists work across various industries with the highest share in public administration, particularly the federal government, and in scientific and technical consulting, and research and development services. Other key employers include hospitals, and pharmaceutical and medicine manufacturers. Public sector grants and program spending strongly influence employment prospects for these professionals. Recently-announced federal budget commitments for science and research may create some work in this field over the forecast period. This occupational group includes various specializations that fall under two broad categories: biologists, and microbiologists and cell and molecular biologists.

Biologists

Biologists mainly perform duties related to the environment and animal and plant production. The agricultural industry is one of the key markets these professionals serve. Over the next few years, advances in agricultural innovation in areas such as plant yields, disease detection, and biosecurity in animal production will help support job prospects. Initiatives to address climate change, sustain water resources, and improve research related to the aquatic ecosystem should also be a source of work for biologists and scientists. Further, greater public awareness and advancement of strategies for wildlife management may create a need for biologists to participate in these plans and policies. Biologists will likely also need to be involved in environmental impact assessments given the large number of construction projects underway in Ontario. Some opportunities may also arise from the growing cannabis industry in Canada.

Microbiologists and Molecular Biologists

Microbiologists and cell and molecular biologists undertake research related to fields such as bacteria, genetics, pharmaceuticals and animal and plant cells. Public and private investments to support research aimed at understanding, monitoring, treating, and curing diseases could potentially create job opportunities for microbiologists and molecular biologists. Efforts to understand and address antimicrobial resistance could provide opportunities for microbiologists with a specialization in this field.

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Employment Outlook for Professionals in Biotech (cont.)

Education and Experience Requirements

Although biologists and related scientists often hold at least a bachelor's degree in agriculture, biology, environmental science, or a related discipline, a master's degree and/or five or more years of work experience are often preferred. A doctoral degree and/or post-doctoral experience is usually required to work as a research scientist or in an academic institution.

3-Year Research Project

In 2018, BioTalent Canada, a human resources organization for the biotechnology sector, launched a three-year research project to produce updated and accurate labour market information for the Canadian bioeconomy. The Bioeconomy Labour Market Information (LMI) Study (2018-2021) is researching the labour market supply and demand to help the industry address current and future skills shortages.

The organization states that the majority of Canada's biotech companies are focused on research and development and more than 80 per cent are small- or medium-sized enterprises when measured both by number of full-time employees and by total gross revenue. For new graduates wishing to enter the sector, the organization says it can be difficult to identify and connect with companies that are hiring.

Hiring Recent Graduates

To address this challenge, BioTalent Canada's Career Focus Program, funded by the federal Youth Employment Strategy, helps bioeconomy employers hire the talent they need and recent graduates gain work experience by subsidizing a portion of the salary of a recent graduate. Under the program, from 2013–2017, 168 companies hired 556 graduates from post-secondary institutions across Canada. Post-program employment data for 2013–2016 show that the typical graduate participated in the Career Focus Program for 6.3 months and had an 84.7 per cent chance of continued full-time employment.

BioTalent Canada has a number of programs to help students and recent graduates gain experience in the industry.

What You Need To Succeed

As experts in the scientific method, biotechnology professionals must display exceptional critical thinking, problem solving and decision-making skills. Besides being competent in conducting research and experiments, analyzing and documenting results and developing standard operating procedures, equally important are soft skills such as maintaining a high level of professional integrity, demonstrating attention to detail, managing data and information and adapting to change in the work environment. Biotech professionals must also have well-developed interpersonal and communication skills to work in teams, as well as sensitivity to cultural and social diversity. And while knowledge of laboratory procedures is essential, continuous technological advances mean these professionals need to keep current with field-specific software.

In-Demand Jobs and Salary Ranges

Job Title	Salary Range
Biotechnologist	$ 37,500 – $ 92,086
Compliance Specialist	$ 31,327 – $ 83,106
Microbiologist	$ 33,150 – $ 121,542
Quality Control Technician	$ 25,838 – $ 58,500
Research Assistant	$ 23,069 – $ 66,300

Where the Jobs Are

These industries show the strongest demand professionals in biotechnology:

- Bioresearch facilities
- Biotechnology companies
- Chemical companies
- Environmental consulting organizations
- Federal, provincial and municipal governments
- Hospitals
- Manufacturing and production plants
- Pharmaceutical companies
- Plant nurseries
- Private laboratories
- Resource and utilities companies
- Universities and research organizations

Industry Associations

Industry Associations	Website Link
BioTalent Canada	https://www.biotalent.ca/
BIOTECanada	http://www.biotech.ca/
Biozone – Biotechnology Links	https://www.thebiozone.com/biolinks/biotechnology/
Canadian Council of Technicians and Technologist	http://www.cctt.ca/
Canadian Society of Microbiologists	https://www.csm-scm.org/
Clinical Research Association of Canada	http://www.craconline.ca/
Life Sciences Ontario	https://lifesciencesontario.ca/
Ontario Agri-Food Technologies	http://www.oaft.org/

Where to Find More Information

Sources:

- BioTalent Canada
- BIOTECanada
- Biozone
- Smart Prosperity Institute
- The Balance

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- DV3094
- (905) 828-5451
- careers.utm@utoronto.ca
- @UTMCareerCentre

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