

UTM Career Centre

# *CAREERS IN* **CHEMISTRY**



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*Every effort has been made to ensure the accuracy of the information provided in this report. However, job requirements, duties, and compensation change over time and vary between different industries and organizations. In addition, there are many different career paths one can explore in Chemistry. While this report is a good starting point and provides general information of the Chemistry sector, further research may be needed to obtain more detailed information.*

*The report was completed in September 2016.*

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# INDUSTRY OVERVIEW

## INTRODUCTION

Chemistry is essential to our lives - from creating new products and materials to protecting the environment and fighting disease. The industry has contributed greatly to modern life; every product we use is made from chemical elements that occur in nature, and chemists have shaped thousands of products that make our daily lives better. Canada's chemical industry offers many career options for those looking to start a fulfilling journey. Chemical professionals are employed by a wide variety of entities in the manufacturing, research and development, government, pharmaceutical, mineral, paper, education, utilities, health, and other sectors. They can choose a career path suitable for their personality and lifestyle - those who like the indoors can work in labs, offices, hospitals, classrooms, and museum; and those who prefer spending time outdoors can find many possibilities for field work.

According to the American Chemical Society:

- Almost two-thirds of chemical professionals in the US are employed in **private industry**, usually by chemical manufacturing plants or pharmaceutical companies. They work in product development research, formulation and manufacturing, as well as quality control, regulatory affairs, sales and purchasing, marketing, and other non-laboratory careers.
- About one-third of chemical professionals in the US are employed in **academia**. They work for all levels of educational institutions, from primary schools to universities, teaching and counselling students. In addition, college and university faculty members may design and conduct research in a topic of their interest after applying for research funding and hiring student assistants.
- About 10% of chemical professionals in the US are employed in **public sector**. They work for federal agencies, such as the FDA or the National Institute of Standards and Technology, to conduct research, write and edit government regulations, or almost any other area that requires workers with scientific training. In addition, they work for state and local

governments in forensics, environmental control, public policy, or health care. While these jobs may provide a lower compensation than in private industry, they are generally more secure.

The chemical sector also supports a variety of **nontraditional careers** for individuals with interest and education in chemistry and science. These include communications and journalism, law (chemical, environmental, and patent), business development, health and safety, scientific software programming, as well as image creation and art conservation.

### ***Did you know?***

**Employment in the chemical sector is largely concentrated in Ontario (58%), Quebec (31%), and Alberta (12%).**

Primarily concentrated in Ontario, Quebec, and Alberta, the chemical sector is a growing one in Canada. Supported by secure access, low priced raw materials, and good infrastructure, the country's production of chemicals is among the world's top for manufacturing and it is expected to increase in value by 27% by 2020 - a higher rate than in the United States and Western Europe, according to the Canadian Trade Commissioner Service.

This \$53 billion industry greatly contributes to our economy, offering employment to 87,500 people from various occupations in 2015 and supporting over 525,000 jobs in other industries across the country, as indicated by the Chemistry Industry Association of Canada. Over half of these positions are available in Ontario - Canada's largest chemical-producing province.

## **SECTORS OF THE CHEMICAL INDUSTRY**

This report will look at the various careers available in chemistry, the duties involved, the skills and training required to enter the industry, and employment outlook among others. The career fields to be explored in more detail are organized into the following:

- Organic Chemistry
- Inorganic Chemistry



- Analytical Chemistry
- Physical Chemistry
- Biochemistry

All these sectors are part of the **Chemists** National Classification Occupation group (NOC 2112), which includes job titles, such as organic and inorganic chemist, analytical chemist, physical chemist, biochemist, environmental chemist, food chemist, pharmaceutical chemist, research chemist, and 60 more. Chemists NOC is part of a larger occupational group called Physical Science Professionals (NOC 2110). **All labour market information provided in this report will focus on the Chemists NOC group, unless stated otherwise. If there is no detailed information available for the Chemists group, then statistics on Physical Science Professionals NOC group will be provided.**

## LABOUR MARKET INFORMATION

### CANADA

Chemists (NOC 2112) are part of a larger occupational group, called Physical Science Professionals (NOC 211). According to Job Bank's Job Market Report (released on April 15, 2016), approximately 31,900 individuals were employed under the Physical Science Professionals classification in Canada in 2014.

The \$53 billion chemical industry is an important contributor to our country's economy. According to the 2016 edition of the Chemistry Industry Association of Canada's Statistical Review of the Canadian Chemical Manufacturing Sector:

#### ***Did you know?***

**For every job in the chemical industry another 5 indirect jobs are created in other areas of the economy.**

- In 2010 there were 2,734 establishments in Canada in the chemicals and chemical products industry, employing 81,400 people in a wide range of positions, including non-chemistry ones.

- In 2015 such establishments employed 87,500 Canadian residents from various occupations, paying them \$6.3 billion in salary and wages and directly contributing to 5.8% of all manufacturing jobs.
- For every job in the chemical industry another five indirect jobs are created in other areas of the economy. The chemical industry has indirectly employed over 525,000 individuals in other industries across Canada, including automotive and aerospace, food and beverage, construction, forest products, plastics, and electronics.
- Employment is largely concentrated in Ontario (58%), Quebec (31%), and Alberta (12%).

## ONTARIO & TORONTO REGION (GTA)

According to Job Bank's Job Market Report (released on April 15, 2016), approximately 6,350 individuals work in the Chemists occupation (NOC 2112) in Ontario, 62% of which worked in the Toronto region.

Most of these professionals are employed in the manufacturing and the professional, scientific and technical services sectors. Many are also employed by pharmaceutical and medical manufacturing companies, as well as the federal government. However, Chemists can work in almost all industries in Ontario.

### ***Did you know?***

**46% of all Chemists hold a post-graduate degree - the highest proportion among all industries.**

According to the National Household Survey (2011), women made up 41% of the workforce in this occupation. In comparison, the average for all occupations in Ontario is 48%.

As for education, Job Bank's Market Report states that 37% of workers in the Chemists occupation have a bachelor's degree (compared to 18% for all

occupations), and 46% of all workers in the same occupation have a university certificate, degree or diploma above bachelor level (compared to 11% for all occupations). In comparison, only 13% of workers have a college certificate/diploma or university certificate below bachelor's level (compared to 28% for all occupations). These numbers are confirmed by the 2016 Statistical Review report conducted by the Chemistry Industry Association of Canada, which illustrates that the chemical industry has the second highest proportion of employees

with a bachelor's degree (after the computer and electronic products industry) and the highest proportion of employees with post-graduate degrees among all industries.

Ontario's \$22-billion chemistry industry is the largest one in Canada with major operations in Sarnia, the Toronto region (GTA) and throughout the province's eastern regions. The industry ranks 6<sup>th</sup> on the basis of employment when compared to other manufacturing industries. In addition, Ontario is home to 7 of the world's largest chemical companies, according to the 2014 Ontario's Chemistry Industry Snapshot conducted by the Chemistry Industry Association of Canada.

## EMPLOYMENT PROSPECTS

### CANADA

According to the Labour Market Bulletin published in March 2016, employment across Canada in all work fields grew by 10,500 in the first quarter of 2016. The national unemployment rate is currently 7.1% (Statistics Canada Labour Force Survey, April 2016), which is 2.1% higher than United States' rate (Bureau of Labor Statistics, April 2016).

This news is not bad for those who want to work in chemistry because the labour demand and supply are expected to be balanced. The ESDC's Canadian Occupational Projection System (COPS) predicts that job openings and job seekers will be at relatively similar levels between 2015 and 2024. 9,900 new job seekers will be available to fill 10,200 new job openings in the Physical Science Professionals group (NOC 2110).

### ONTARIO

The Ontario Labour Market Bulletin for March 2016 claims that employment in all industries grew consistently for the past year; increasing by 86,700 jobs between the 1<sup>st</sup> quarters of 2015 and 2016. Also, over 36,000 positions were filled in the first quarter of 2016, making it the largest quarterly increase in Ontario for the past 3 years.

### ***Did you know?***

**The unemployment rate for Chemists is 3.2%, compared to 6.6% for all occupations in Ontario.**

As for the Chemists occupation (NOC 2112), Job Bank's analyses of key labour indicators predict that employment will be relatively stable for the 2015-2017 period, rating the employment outlook as Fair (2 out of 3 stars). In addition, Ontario Job Futures lists the current (2013-2017) employment prospect rating for Chemists as Average, compared to Below Average for 2009-2013. Average labour market conditions usually

mean that jobs are easier to find; unemployment is less likely; and wages and salaries have recently increased at a faster pace than in those occupations rated Below Average.

The September 2016 unemployment rate for Chemists is 3.2%, compared to 6.6% for all occupations in Ontario, according to Ontario Ministry of Training, Colleges, and Universities.

The demand for this occupation relies on economic conditions, particularly for chemical manufacturing jobs. Some job opportunities are expected to arise from the growth of Ontario's multi-billion-dollar chemical sector. Other contributors will be the advancements in technology and scientific developments, as well as increased environmental awareness and consumer expectations. However, the likelihood of this growth is difficult to predict, as it is influenced by economic uncertainty and government spending on scientific research and development.

## EDUCATION

Chemical occupations in Canada are almost entirely available to holders of university degrees or college diplomas/certificates. The most common educational requirement sought by employers is a bachelor's degree in chemistry, biochemistry, or a related discipline, as indicated by Service Canada and Career Cruising. Moreover, having technical knowledge and substantial work experience are beneficial for job seekers. Chemists with undergraduate degrees in chemistry can work in most entry-level positions, such as research assistant, product testing, quality control, technical sales, and lab coordinator among others.

According to Job Bank's Job Market Report (released on April 15, 2016):

- 37% of workers in the Chemists occupation in Ontario have a bachelor's degree (compared to 18% for all occupations)
- 46% of workers in the Chemists occupation in Ontario have a university certificate, degree, or diploma above bachelor level (compared to 11% for all occupations)

Job seekers should keep in mind that master's degrees are gradually becoming a standard requirement for most chemical positions, especially in applied research, industrial work, management, and teaching at college/ university level. They can open up a wider variety of options for work. Moreover, a doctoral degree is required for some positions. In addition, some employers also require the Chartered Chemist (C. Chem.) title, granted by the Association of the Chemical Profession of Ontario.

### ***Did you know?***

**Master's or doctoral degrees are becoming increasingly important assets for most chemical positions.**

Those who wish to obtain a certificate instead of a master's degree should keep in mind that this is certainly an option. However, their opportunities might be more limited, as they may have to compete against workers with master's or even doctoral degrees. Such individuals could increase their competitive advantage by gaining as much relevant work experience as they can while expanding their professional network to the best of their abilities.

No chemical degree? No problem. Different experiences and perspectives foster innovation and help the organizations gain competitiveness. Individuals with any degree can work in the chemical industry; some areas to consider are consulting, technical writing, sales and marketing, public relations and media, legal services, supply chain, logistics and transportation, community and social services, accounting, and computer services among others. However, these individuals must demonstrate the required technical knowledge and passion for working in the industry.

Here are a few things you can do to prepare for a career in the chemical industry if you don't have a degree in chemistry:

- Take relevant courses with an emphasis on chemistry.
- Obtain meaningful experience from a relevant internship, volunteer work, or science student clubs or academic societies.
- Expand your network and do your best to get your foot in the door, even in a non-chemical role. This experience may open doors to other opportunities in chemistry down the road.

## GRADUATE DEGREES OFFERED AT UNIVERSITY OF TORONTO

University of Toronto School of Graduate Studies offers several graduate programs that can help individuals gain additional skills and excel in their careers. Those interested in pursuing further education in chemistry can explore some of the following programs offered at the St. George campus:

- **Biochemistry** - MSc, PhD, MD/PhD
- **Chemistry** - MSc, PhD
- **Chemical Engineering and Applied Chemistry** - MAsC, MEng, PhD, HBSoc/MEng
- **Clinical Engineering** - MHSc
- **Medical Radiation Sciences** - MHSc
- **Medical Science** - MSc, MD/PhD, PhD
- **Materials Science and Engineering** - MAsC, MEng, PhD
- **Pharmaceutical Sciences** - MSc, PhD
- **Pharmacology** - MSc (thesis-based), MSc (Applied Clinical Pharmacology), MD/PhD, PhD

For more information, students can visit the University of Toronto School of Graduate Studies website: <https://www.sgs.utoronto.ca/>

## COMMON DESIGNATIONS AND CERTIFICATIONS

While many entry-level positions in chemistry don't require a science degree, obtaining additional training and knowledge is always beneficial, as it can provide professionals with a competitive advantage. Some of the advantages that may be gained are increased marketing exposure, credibility, and higher compensation. While obtaining a professional designation is not mandatory, earning one shows dedication to the career and gives the credibility and specialized knowledge that employers find valuable.

Most certifications require previous work experience and generally involve a combination of coursework, self-study, and examinations. Often, individuals may be able to work full-time while they pursue the designation or certification. Some employers may also provide financial assistance or reimbursement for the completion of related coursework.

### CHARTERED CHEMIST (CCHEM)

Chartered Chemist (CChem) is the most widely recognized title in Ontario's chemical industry. In order to become Chartered Chemists, individuals must become full members of Association of the Chemical Profession of Ontario and satisfy the association's requirements for education and work experience.

For more information on the C. Chem. title, individuals can visit the Association of the Chemical Profession of Ontario website at [http://www.acpo.on.ca/membership/join\\_e.php](http://www.acpo.on.ca/membership/join_e.php).

### PROFESSIONAL CHEMIST (PCHEM)

Professional Chemists (PChem) are chemists who are permitted to offer their professional services directly to the public. Similarly to Chartered Chemists, Professional Chemists must be registered or licensed with Association of the Chemical Profession of Ontario and satisfy the association's requirements for education and work experience.

For more information, visit <http://www.pchem.ca/member-categories>.

### **CERTIFIED CHEMICAL TECHNOLOGIST (CCT)**

The Certified Chemical Technologist (cCT) designation is most often obtained by chemical technologists, such as chemical engineering technologists. This designation is offered by the Canadian Society for Chemical Technology.

For more information, visit <http://www.cheminst.ca/cct>.

### **MEMBER OF THE CHEMICAL INSTITUTE OF CANADA (MCIC)**

Any member of the Constituent Societies of the Chemical Institute of Canada, upon meeting the minimum requirements and paying the appropriate fees, is given the designation of MCIC.

For more information, visit <http://www.cheminst.ca/membership>.

### **FELLOW OF THE CHEMICAL INSTITUTE OF CANADA (FCIC)**

Chemical Institute of Canada Fellowship is a senior class of membership that recognizes the merits of members of the Constituent Societies of the CIC who have made outstanding contributions to the chemical sciences and engineering. Fellows of the Constituent Societies of the CIC are given the designation FCIC.

For more information, visit <http://www.cheminst.ca/membership>.



## **IN-DEMAND SOFT SKILLS IN THE INDUSTRY**

In addition to the educational requirements, technical knowledge, and relevant experience, many employers look for candidates who have the following skills:

### **ANALYTICAL AND PROBLEM SOLVING SKILLS**

Analytical and problem solving skills are essential in the dynamic chemical industry. Many careers in chemistry require the ability to be resourceful and to collect samples, perform qualitative and quantitative analysis, and validate results through calibration and standardization. In addition, those who prepare research reports need the ability to critically evaluate preliminary literature and other resources.

### **COMMUNICATION SKILLS AND TERMINOLOGY UNDERSTANDING**

Chemistry professionals must have the ability to express their technical knowledge with strong speaking and writing skills. For example, they need to know how to convey results and conclusions to other scientists and non-scientists in detailed written reports. Communication skills are particularly important for publishing, teaching, media, sales, and marketing positions.

### **PROFICIENCY WITH TECHNOLOGY**

The ability to navigate and use technology is an important skill for many careers in chemistry. Industry professionals must be familiar with using relevant computer software models, processing data, spreadsheets, and internet communication.

### **ORGANIZATIONAL SKILLS AND ATTENTION TO DETAIL**

In order to be successful in their careers, industry professionals must know how to manage their projects effectively. Some beneficial skills are time management and ability to obtain and analyze necessary information.

### **PERSISTENCE AND CREATIVITY**

Chemists should also be persistent when they have to rethink and execute experiments and other projects. The chemical industry pioneers new products and continuously improves old

ones. Being innovative and adaptable is an important skill for professionals in this industry whose jobs require alternative thinking to develop new ideas.

## COMPENSATION

Compensation for chemistry professionals greatly depends on the position, sector, company performance, location, and the professional's education, skills, and experience among other factors. Overall, the chemical industry is one that is well compensated due to its highly-skilled workforce.

Service Canada classifies the chemical industry under several different occupations. The average annual income measured from Statistics Canada's 2011 National Household Survey for Chemists (NOC 2112) was \$64,260 (median was \$58,876). In comparison, the 2010 average income for all occupations in Canada was \$43,994 (median was \$34,819). The median hourly wage for Chemists was \$31.25 in Canada, \$30.77 in Ontario, and \$31.25 in Toronto region.

According to the 2016 Statistical Review report conducted by the Chemistry Industry Association of Canada, the average salary for manufacturing as a whole was \$54,500 in 2015. In comparison, it was \$72,000 for chemical manufacturing and \$96,400 for industrial chemicals.

The following three pages list salaries for some common occupations in chemistry. The information was obtained from PayScale - an online salary information company that illustrates salary data submitted from individual employees across the globe. Please note that this information can only serve as a general ballpark, as compensation varies widely on the company, location, industry, individual's education and experience, and many other factors.

- **Chemist**
  - Average salary in Canada ranges from \$34,049 - \$76,982 with a median salary of **\$50,406**. (Updated: Mar 2016; individuals reporting: 288). The median salary in Toronto is \$48,543 (individuals reporting: 101).
- **Senior Chemist**
  - Average salary in Canada ranges from \$50,083 - \$102,990 with a median salary of **\$71,135**. (Updated: Mar 2016; individuals reporting: 52).

- **Organic Chemist**
  - Average salary in Canada for employees with a Master of Science degree and 1-4 years of experience is \$42,656. (Updated: Oct 2015; individuals reporting: 5)
  - Average salary in Canada for employees with a PhD and 10-19 years of experience is \$98,264. (Updated: Aug 2015; individuals reporting: 3).
- **Analytical Chemist**
  - Average salary in Canada ranges from \$32,953 - \$67,232 with a median salary of **\$47,299**. (Updated: Mar 2016; individuals reporting: 84).
- **Research Chemist**
  - Average salary in Canada ranges from \$40,359 - \$80,058 with a median salary of **\$58,629**. (Updated: Mar 2016; individuals reporting: 85).
- **Polymer Chemist**
  - Average salary in Canada ranges from \$43,350 - \$86,892 with a median salary of **\$60,000**. (Updated: Sep 2015; individuals reporting: 14).
- **Environmental Scientist**
  - Average salary in Canada ranges from \$42,777 - \$77,922 with a median salary of **\$54,009**. (Updated: Mar 2016; individuals reporting: 481). The median salary in Toronto is \$50,317 (individuals reporting: 68).
- **Environmental Consultant**
  - Average salary in Canada ranges from \$40,763 - \$80,173 with a median salary of **\$52,022**. (Updated: Mar 2016; individuals reporting: 196). The median salary in Toronto is \$45,120 (individuals reporting: 38).
- **Food Scientist**
  - Average salary in Canada ranges from \$36,528 - \$79,473 with a median salary of **\$60,139**. (Updated: Mar 2016; individuals reporting: 60).
- **Biotechnologist**
  - Average salary in Canada ranges from \$28,549 - \$83,480 with a median salary of **\$50,019**. (Updated: Mar 2016; individuals reporting: 17).

- **Assistant Professor**
  - Average salary in Canada ranges from \$50,288 - \$103,412 with a median salary of **\$80,148**. (Updated: Mar 2016; individuals reporting: 305). The median salary in Toronto is \$77,853 (individuals reporting: 67).
- **Associate Professor**
  - Average salary in Canada ranges from \$61,757 - \$143,698 with a median salary of **\$102,895**. (Updated: Mar 2016; individuals reporting: 177).
- **Chemical Laboratory Technician**
  - Average salary in Canada ranges from \$26,289 - \$59,949 with a median salary of **\$16** per hour. (Updated: Mar 2016; individuals reporting: 218).
- **Materials Scientist**
  - Average salary in Canada ranges from \$12,255 - \$88,442 with a median salary of **\$66,128**. (Updated: Mar 2016; individuals reporting: 11).
- **Patent Attorney**
  - Average salary in Canada ranges from \$61,500 - \$248,750 with a median salary of \$92,500. (Updated: Apr 2015; individuals reporting: 14).
- **Technical Writer**
  - Average salary in Canada ranges from \$39,288 - \$87,168 with a median salary of **\$55,423**. (Updated: Mar 2016; individuals reporting: 817). The median salary in Toronto is \$57,436 (individuals reporting: 212).
- **Quality Control Chemist**
  - Average salary in Canada ranges from \$28,914 - \$61,427 with a median salary of **\$42,869**. (Updated: Mar 2016; individuals reporting: 55).
- **Process Development Chemist**
  - Average salary in Canada ranges from \$39,577 - \$136,846 with a median salary of **\$65,003**. (Updated: Sep 2015; individuals reporting: 17).
- **Chemical Engineer**
  - Average salary in Canada ranges from \$46,258 - \$103,833 with a median salary of **\$67,187**. (Updated: Mar 2016; individuals reporting: 332). The median salary in Toronto is \$62,170 (individuals reporting: 84).

- **Biochemist**
  - Average salary in Canada ranges from \$31,027 - \$117,216 with a median salary of **\$50,701**. (Updated: Mar 2016; individuals reporting: 39).
  
- **Toxicologist**
  - Average salary in Canada ranges from \$39,297 - \$89,873 with a median salary of **\$55,000**. (Updated: Mar 2016; individuals reporting: 15).
  
- **Pharmacologist**
  - Average salary in Canada ranges from \$40,268 - \$108,269 with a median salary of **\$60,320**. (Updated: Mar 2016; individuals reporting: 10).
  
- **Clinical Research Associate**
  - Average salary in Canada ranges from \$35,684 - \$84,394 with a median salary of **\$58,233**. (Updated: Mar 2016; individuals reporting: 166). The median salary in Toronto is \$62,170 (individuals reporting: 84).
  
- **Clinical Project Manager**
  - Average salary in Canada ranges from \$50,507 - \$113,996 with a median salary of **\$77,993**. (Updated: Mar 2016; individuals reporting: 48).
  
- **Forensic Scientist**
  - Average salary in Canada ranges from \$40,000 - \$101,360 with a median salary of **\$70,000**. (Updated: Mar 2016; individuals reporting: 13).



# ORGANIC CHEMISTRY

# ORGANIC CHEMISTRY

## GENERAL INFORMATION / AT A GLANCE

Organic chemistry studies the structure and properties of the carbon compounds which make up all living things, and uses this information to create new substances that we use in our daily lives. Whether developing new plastics, medicinal drugs, clothes, fuels, or food, organic chemistry offers a diverse range of career opportunities.

Some of the branches in organic chemistry include medicinal chemistry, polymer chemistry, physical organic chemistry, organometallic chemistry, and stereochemistry.

There are a number of research and development positions available in biotechnology and pharmaceutical companies across Canada. Teaching and research opportunities can be found in educational institutions, and energy and environmental analysis positions are usually offered by government agencies. The American Chemical Society outlines five main industries offering opportunities in organic chemistry:

- **Biotechnology** – used in healthcare, agriculture, environmental applications, and development of crops for non-food uses (such as biofuels and biodegradable plastics).
- **Chemical** – converts raw materials (natural gas, oil, and metals, and others) to products that we use in our daily lives, such as textiles, plastics, food, medicinal drugs, and paper.
- **Consumer products** – over 70,000 consumer products are produced through chemical processes, such as cosmetics, plastic goods, clothes, detergents, fertilizers, and paper.
- **Petroleum** – includes the exploration, extraction, refining, transporting, and marketing petroleum products, such as fuel oil and gasoline. Petroleum also provides the raw material used for various chemical products.
- **Pharmaceutical** – includes the development, production, and marketing of medicinal drugs.

## COMMON OCCUPATIONS

Below is an overview of some common occupations in Organic Chemistry. Please note that this is not an exhaustive list as there are many different options available.

### ORGANIC CHEMIST

Organic chemists study carbon-containing molecules, which are the main components of living organisms, as well as a wide variety of industrial products such as medicines, cosmetics and plastics. Many organic chemists work in applied research and manufacturing, often in the pharmaceuticals industry, where they develop and improve products.

### ORGANIC CHEMISTRY PROFESSOR

Organic chemistry professors work at colleges' and universities' chemistry departments. They conduct scientific research, write fundraising proposals or reports for academic publications, prepare and deliver lectures, and mentor graduates students.

### POLYMER CHEMIST

Polymer chemists study, create, and manipulate polymers to create useful materials with unique properties, such as Teflon and fiberglass. These professionals usually apply their knowledge of organic chemistry, structural patterns of molecules, and even computer modeling to develop products with special characteristics and a very wide range of applications.

### ENVIRONMENTAL CHEMIST

Environmental chemists find ways to develop safety policies and improve the health of the environment. They apply their knowledge of chemistry along with other disciplines (such as biology, soil and water chemistry, toxicology, or hydrology) to ensure newly developed products do not have a negative effect on the environment. Environmental chemists work in labs, offices, and in the field.



## ENVIRONMENTAL CONSULTANT

Environmental consultants offer assessment services and advice to businesses to ensure they follow all environmental regulations. Most environmental consultants are employed by consultancy firms and work with public sector and commercial organizations in construction, agriculture, or manufacturing to help improve conservation and environmental sustainability.

## FOOD SCIENTIST

Food scientists (also known as food technologists) study the physical, chemical, and biological properties of food, beverages, and food ingredients. They develop methods to create new products, improve agricultural and farm productivity, and raise the quality and shelf life of products while ensuring they meet government standards and are safe for consumption. Many food scientists are employed by research universities, private industry organizations, or the federal government.

## POTENTIAL EMPLOYERS

- Roche Canada
- Dow AgroSciences
- Cargill
- BASF Canada Inc
- Bayer
- DuPont Canada
- City of Mississauga
- PPG Industries
- Johnson & Johnson
- L'Oréal
- Pepsico Inc
- Ministry of the Environment and Climate Change
- Toronto Research Chemicals Inc
- University of Toronto
- ExxonMobil Canada
- Pfizer
- Novartis Canada
- GlaxoSmithKline
- AstraZeneca
- Abbott Laboratories

## SAMPLE JOB POSTINGS

### MANUFACTURING TECHNICIAN – POLYMER CHEMISTRY

#### JOB TITLE

**Reagent Manufacturing Technician**

#### COMPANY

Fluidigm, Markham

#### JOB DESCRIPTION

At Fluidigm, we're looking for a Reagent Manufacturing Technician to perform complete polymer production and testing in an organic chemistry laboratory environment. Thoroughness, attention to detail and meticulousness of synthesis and testing of organic polymers are critical. Synthesis and testing protocols and Standard Operating Procedures must be strictly followed. The Technician will also have responsibilities in preparation, quality control and packaging of lanthanide metals, tuning and washing solutions as well as the polymers. Basic operation of analytical equipment including ICP-MS (Elan DRC), and GPC (gel permeation chromatography) will be also required.

Additional responsibilities will include routine lab duties such as maintenance of chemical inventory; ensuring lab equipment is calibrated in a timely manner and maintaining polymer production quality records in the Quality Assurance database. In addition, the successful candidate is responsible for maintaining the facilities Material Safety Data Sheet (MSDS) records and implementing lab safety improvements.

#### REQUIREMENTS

- Bachelor degree in Chemistry or related science field with 2-4 years laboratory or quality control industry experience
- Background in organic or polymer chemistry a definite asset
- Proven ability to do organic or polymer chemistry experiments
- Troubleshooting and analytical skills

- Experience with ICPMS lab equipment would be an asset
- Experience with maintenance/calibration of laboratory equipment and preparation of standard pH buffer solutions
- Strong learning and communication skills
- Ability to switch focus between tasks and eagerness to perform a variety of duties in a small business environment
- Experience maintaining company Material Safety Data Sheets (MSDS) and implementation of chemical safety practices and procedures

## SENIOR SYNTHETIC ORGANIC CHEMIST

### JOB TITLE

**Senior Synthetic Organic Chemist**

### COMPANY

Toronto Research Chemicals Inc., Toronto

### JOB DESCRIPTION

Under the supervision of the Lab Supervisor, the Synthetic Organic Chemist will perform complex organic synthesis and research & development.

Duties and Responsibilities:

- Learn the operating procedures of the company.
- Set up synthetic organic reactions.
- Solve synthetic problems, develop, design and implement new routes as approved by the group leader and production manager.
- Synthesize and purify organic molecules.
- Follow chemical reactions using spectroscopic techniques and chromatographic methodology.
- Develop methodology for separating complex mixers.

- Interpret analytical data from spectroscopic analysis to characterize intermediates and final products.
- Perform process development and research.
- Work on a number of different projects of varying lengths and complexity at the same time and thereby perform chemical reactions and purifications in tandem.

#### **REQUIREMENTS**

- PhD in synthetic organic chemistry
- Advanced knowledge of organic chemical reactions and their mechanisms and the ability to plan complex syntheses
- The ability to characterize products of complex mixtures by interpretation of spectral data
- Advanced purification techniques such as ion-exchange and reverse-phase chromatography, including development of crystallization techniques for the avoidance of such chromatography's; separation of complex mixtures
- Strong knowledge of a wide variety of organic chemical techniques such as; photochemistry, ultra-dry reactions including water and oxygen sensitive chemistry, microscale manipulations, photochemical transformations and radical reactions, modern organometallic synthetic methods as applied to long multistep syntheses; also extraction of natural products.

## INTERVIEWS WITH PROFESSIONALS

### BIOTECHNOLOGIST

Interview obtained from Career Cruising, a Canadian electronic career guide available on <https://cln.utoronto.ca/> under the *Resources* tab.

**1. Tell me about your job. Is what you do different in any way from what others in your occupation do?**

*As a research technician for a large pharmaceutical company, my job has two main aspects. My first priority is to help develop assays (testing methods) used to measure different components in drug products.*

*The second aspect of my job is to use these different tests to analyze samples. The samples I analyze are usually from drug formulation changes or drug production changes related to experimental work.*

*My employer manufactures many pharmaceutical products, including a variety of vaccines and antibodies, as well as a protein that stimulates the production of infection-fighting white blood cells that are depleted by chemotherapy and radiation.*

*Specifically, I work on a human growth hormone (HGH) drug. It's made from a protein that promotes the growth of bones in children with metabolic disorders.*

*People in my position have many different opportunities. For example, you could focus on quality control, where you would be more involved with running testing methods, rather than developing them. Other biotechnologists may work in areas that specialize in proteins, viruses, DNA, RNA, mammalian cell culture, or bacterial cell culture, to name a few options.*

*My job differs from others in my profession because I create and carry out sample testing procedures that involve High Performance Liquid Chromatography (HPLC) and Capillary Electrophoresis (CE). These two methods are extremely good at separating protein mixtures and each method works by different mechanisms. I focus on protein drugs made from bacteria.*

**2. Can you tell me about your background and how you got into this field?**

*I have always been interested in science-related things. In high school I did well in biology and chemistry and found these classes to be the most interesting.*

*I enjoy learning about the world around me—especially nature and animal life. When I was younger, I wanted to be a veterinarian, but my interests changed as I took different courses at university.*

*I started out studying microbiology in university, but finished my degree in biochemistry instead.*

*What attracted me to biochemistry was the focus on the cells. It's absolutely incredible to learn about what goes on inside one tiny cell. One professor once told me that what goes on in one cell is more complex than everything that happens in New York City. It's a fascinating field and I remember classes were so interesting for me because the complexity was awe-inspiring. I gained a whole new appreciation for my body.*

*I also like my work because it can be international in scope. It's possible to work all over the world because Canadian degrees are well-respected and recognized in other countries.*

**3. What personal characteristics are required for someone to be successful in your job?**

*A strong sense of curiosity is very helpful because understanding comes through asking questions. Once a situation is understood from many angles, it provides more opportunities to solve problems.*

*Attention to detail is important. Reporting experiments needs to be detailed because you may have to refer to information months later. It's important to track your methods because the littlest thing, which you may not think is important at the time, can have a huge impact on the overall experiment.*

*Adaptability and flexibility are great assets. You will do many things in a day, and you have to be able to track what you are doing so critical steps are not forgotten.*

**4. How much job security is there for people in your field?**

*Job security is not an issue for me. However, a lot of research is done on a grant basis and some grants are short-term. Depending on where you work, this can have a huge effect on job security.*

*The biotechnology field is growing. I think job security will remain good since there is so much health-related research being done. Biotechnology research involving HIV/AIDS, cancer, new viruses, bio-terrorism, and pharmaceuticals will continue to drive the job market.*

**5. What other jobs could you do with the skills you have gained in this field?**

*Although I work for a pharmaceutical business, I could also work in an academic arena. This could mean doing graduate studies or research at a university. A biotechnologist could also transfer his or her skills into a quality assurance position.*

**6. What do you think the future holds for people in your occupation?**

*This nature of research involves change. Therefore, it's important to have experience with the new instruments being developed because employers look for people with previous knowledge.*

*I believe the nature of the job will stay the same because there are always new drug products being developed - and each product needs testing procedures to identify and quantify what is contained in them.*

**7. What are the biggest challenges in your job?**

*Being patient is a big challenge. An experiment never seems to go as you expect the first time. You can also work on something for a few months and never seem to get anywhere. The real challenge is sorting out what is going on, and figuring out how to work around the obstacles that pop up.*

**8. Are there many opportunities in your field? What should people do to get started?**

*There are a lot of opportunities in this field. Many pharmaceutical companies are looking for technicians, especially in quality control.*

*The best way to secure a position would be to do a co-op program in conjunction with your university degree or college diploma. These programs give you practical experience in the field, which employers look for. Practical experience will also give you a chance to see if this is the right career for you.*

## FRAGRANCE CHEMIST

Interview obtained from the Royal Society of Chemistry website under *Career options*: <http://www.rsc.org/careers/future/all-profiles>

### 1. What is a fragrance chemist?

*Fragrance chemists work in the fragrance industry or in academic research. Their work involves discovering new fragrance chemicals, improving how fragrance ingredients are produced and analyzing fragrances and their ingredients. They can also be involved in the study of smell, which is also known as olfaction.*

### 2. What do you do in your job?

*I have been involved, at one time or another, in every area of fragrance chemistry. I helped improve manufacturing methods by increasing their sustainability, and developed new ways of producing fragrance ingredients and natural extracts. I also searched for new fragrance ingredients that were better over existing ones, in terms of safety, cost, performance and sustainability. I became interested in how chemical structure is linked to smell, and I was involved in a study of how the sense of smell works. I worked with molecular biologists and biochemists investigating how the receptors that sense smell recognize and respond to odorant molecules. Through contact with neuroscientists and sensory scientists, I learnt how the brain uses input from the olfactory receptors to create the mental picture that we call odor. I now act as a consultant in fragrance chemistry and olfaction.*

### 3. What do you enjoy most about your job?

*Fragrance chemistry is exciting because there is immediate feedback. We can make something which has never existed before and smell it to see what effect it has. The sense of smell is extremely complicated and personal. It can easily be shown that we each have a unique sense of smell, and the link between these differences and the practical chemistry is fascinating.*

### 4. What attracted you to becoming a fragrance chemist?

*My PhD researched molecules that are important fragrance ingredients and this was how I entered the perfumery industry. I started doing laboratory work on improving the manufacture of fragrance and flavor ingredients and synthesizing new ingredients. My career then moved on to managing research teams involved in these activities. Designing new odorant molecules made me think about how the nose detects these molecules and how the brain creates a picture based on the signals from the receptors in the nose.*



**5. How did you get in to your job?**

*I studied A-levels in chemistry, physics, mathematics, pure mathematics and applied mathematics, then went onto graduate with a 1st class honors BSc Chemistry degree from Queen's University Belfast. I stayed at Queen's to do my MSc through research in organic chemistry and then moved to the Australian National University, where I did a PhD in organic chemistry. Following this I obtained a Royal Society European Fellowship for postdoctoral research at the Swiss Federal Institute of Technology Zurich (ETHZ), and then worked as an EPSRC Post-doctoral Fellow at University of Warwick. I then joined a company which has now gone on to become part of another company called Givaudan. At one point in my career I spent a year as a visiting scientist at the Massachusetts Institute of Technology.*

**6. What are the opportunities for career progression**

*Fragrance chemists can progress from laboratory work to the management of research and development teams or can move to other areas of management within a company.*

**7. What advice would you give for people wishing to enter your career area?**

*Demonstrate academic excellence in a relevant area of chemistry or biochemistry and a passion for fragrance. Competition can be tough so you will need something that makes you stand out to employers. The fragrance business is multinational and so willingness to travel, to live abroad and to speak one or two foreign languages is also helpful.*



# INORGANIC CHEMISTRY

# INORGANIC CHEMISTRY

## GENERAL INFORMATION / AT A GLANCE

Inorganic chemistry studies the properties of inorganic compounds, such as metals, crystal structures, minerals, catalysts, and other elements. There are a number of opportunities available in various fields. For example, inorganic chemists can find work in academia or the government.

Some of the branches in inorganic chemistry include geochemistry, nuclear chemistry, organometallic chemistry, bioinorganic chemistry, and solid-state chemistry.

The American Chemical Society outlines five main industries offering opportunities in inorganic chemistry:

- **Environmental science** – uses inorganic chemistry to understand how the environment works naturally and what effects different additives, such as pesticides and fertilizers, have on these processes.
- **Fiber and plastics** – fibers are materials that are used in the manufacture of materials, such as paper, carbon fiber, and textiles; plastics are used in a wide range of products, from water bottles to airplanes.
- **Microchip** – integrated circuits are used in almost all electronic equipment today – from computers and cell phones to medical implants and bioelectronics devices.
- **Mining, ore, and metals** – it involves the extraction of geological materials, such as coal, iron, uranium, metals, oil, and others. Any material that cannot be created in a laboratory, factory, or through agricultural processes comes from mining.
- **Paint, pigment, and coatings** – pigments are materials used for adding color to materials like paints, cosmetics, fabric, and food.

## COMMON OCCUPATIONS

Below is an overview of some common occupations in Inorganic Chemistry. Please note that this is not an exhaustive list as there are many different options available.

### INORGANIC CHEMIST

Inorganic chemists study the molecular relationship between physical properties of inorganic elements and how these elements can be used in product applications. For example, these professionals may develop methods to recover and reuse metals from waste streams, research the use of synthetic fertilizers, conduct analysis on rock mining, or work in microchip production and computer manufacturing.

### NUCLEAR CHEMIST

Nuclear chemists determine and analyze the physical and chemical properties of radioactive substances and nuclear processes in order to find solutions to problems from medical treatments to nuclear engineering in power generations and the safe disposal of nuclear waste. Most nuclear chemists are employed in the medical industry and energy sector, and spend the majority of their time working in a lab setting.

### CHEMISTRY LECTURER / PROFESSOR

Chemistry professors give lectures, conduct discussions, and guide students in labs. They are responsible for class preparation, developing and grading tests, and working with students outside of class. In addition, they may conduct and publish scientific research. Chemistry professors are employed by educational institutions.

### OIL CHEMIST

Oil chemists work with crude oil and the products derived from it to develop synthesized products, such as automotive fuel, and improve processes used for oil extraction and refining. Oil chemists may also monitor the quality of new and existing drilling sites, as well as developing methods to replace existing refinery processes with cleaner, safer, and more efficient ones.

## MATERIALS ENGINEER

Materials engineers study the structure of materials such as plastics, metals, composites, and ceramics in an attempt to discover new applications for their properties and create a range of products that meet certain mechanical, electrical, and chemical requirements. Most materials engineers are employed by manufacturing, research, and consulting organizations.

## PATENT EXAMINER

Patent examiners (also called patent attorneys) assess if new products or methodologies are eligible to be patented. These professionals apply their knowledge of intellectual law to help individual inventors or companies obtain a patent and protect the inventions from being used, copied, or sold by other parties.

## POTENTIAL EMPLOYERS

- Dow Chemical Canada
- DuPont Canada
- IBM Canada Ltd
- Texas Instruments Canada Ltd
- Samsung Electronics Canada Inc
- Suncor Energy
- Barrick Gold Corporation
- BHB Billiton
- PPG Industries
- ValsparInc
- Energy Solutions Canada Corporation
- Veolia Water Technologies Canada
- Tetra Tech
- Industry Canada
- Environment and Climate Change Canada

## SAMPLE JOB POSTINGS

### LABORATORY TECHNOLOGIST

**JOB TITLE**

Laboratory Technologist

**COMPANY**

SGS Canada, Lakefield

**JOB DESCRIPTION**

SGS offers market leading geochemical, metallurgical, oil sands, coal and trade services, from 15 locations across the country. Minerals Services is well positioned to serve the mining and energy sectors at every stage, from exploration all the way through to its environmental impact.

This position will conduct a wide variety of testing and analysis on base and precious metal ores, industrial minerals and materials.

**Responsibilities:**

- Use an applied approach in performing moderate technological functions within laboratory or pilot plant operations.
- Design, develop, test, install and operates equipment and systems.
- Conduct applied research and experimental testing.
- Compile and analyze data, and prepare reports.
- Receive, inspect, sort and label client samples.
- Sort, crush, pulverize, split, and screen samples.
- Troubleshoot and repair equipment or components.
- Calibrate and set up equipment prior to analysis.
- Maintain a clean working environment.

- Follow all company Health, Safety and Environmental policies.
- Follow all Quality system protocols and report any discrepancies to the Supervisor.
- Will be assigned and coordinate special or ad hoc projects.
- Designated as Shift Supervisor on an as-required basis.

## REQUIREMENTS

- A post-secondary education in a Science related program (Chemistry, Metallurgical Engineering Technology, etc.) is required.
- A minimum of 1 - 3 years of experience in a laboratory setting is required.
- Good hand/eye coordination when handling samples and various equipment.
- Must be able to read, understand and follow work instructions in a safe, accurate and timely manner.
- Incumbents must be proficient in using various types of computer software (Word, Excel, PowerPoint & Outlook).
- Proven effective time management skills and a strong attention to detail.
- Candidates must be able to communicate effectively in English, in both verbal and written communication. This includes grammar and composition for report writing duties.
- Ability to work well with others & independently.
- Ability to work well under pressure during high (peak) workloads and to balance conflicting demands of high volume versus quality of results.
- Extended hours and shift work may be required from time to time.
- Travel to other SGS locations or client location may be required from time to time.
- Must ensure full compliance with the company's Health & Safety, Code of Integrity, and Professional Conduct policies.

**LABORATORY ANALYST****JOB TITLE****Laboratory Analyst (ICPMS Instrumentation)****COMPANY**

ALS Environmental, Burlington

**JOB DESCRIPTION**

About the Position: Working as part of the Inorganics team, the instrument analyst is responsible for preparing environmental samples for instrumental analysis, and for the daily operation and maintenance of two ICPMS instruments. This analyst will be required to meet established production goals, including quality control and turnaround times

**Responsibilities:**

- Conduct preparation of samples following documented specific methods and procedures;
- Perform analyses for trace metals (ICPMS), data assessment, and preparation of reports;
- Take part in a cross-training matrix for analysis of common ions (IC) and mercury (CVAA);
- Prepare all required reagents, stock solutions, working standards, etc.;
- Perform daily validations/verifications of laboratory equipment and instrumentation;
- Purchase laboratory supplies, and maintain an inventory where applicable/appropriate;
- Carry out all required work scheduling, workflow and planning activities;
- Carry out all required record-keeping & documentation as outlined in SOPs and/or Policies;
- Perform all required quality control procedures;
- Maintain a clean and organized workspace;
- Use correct methods in accordance with the established procedures and schedules while ensuring high analytical quality;



- Observe established safety regulations and comply with all ALS health and safety policies and procedures;
- Other duties as assigned.

## REQUIREMENTS

### Physical Demands:

- Manual dexterity to perform intricate and/or repetitive tasks;
- Ability to lift up to and carry 30 lbs.;
- May be exposed to unpleasant odors;
- Ability to stand for up to a full shift;

### About You:

- The ideal candidate would have:
- Completion of technical diploma or B.Sc. degree in chemistry or related field, or equivalent education;
- Experience with trace metals analysis by ICPMS would be a definite asset.

### You would also have:

- Capable of working independently, with minimal supervision;
- Well organized, and able to work effectively as part of a team, and independently;
- Able to work in a fast-paced environment;
- Strong attention to detail;
- Excellent communication skills with the ability to understand and carry out detailed instructions;
- Intermediate experience with Excel and Microsoft Word would be an asset;

## INTERVIEWS WITH PROFESSIONALS

### MATERIALS SCIENTIST

Interview obtained from the American Chemical Society website under *Chemist Profiles*:  
<https://www.acs.org/content/acs/en/careers/college-to-career/chemists.html>

#### 1. Interviewee introduction:

*Sarah McIntyre joined Sandia National Laboratories as an undergraduate. A classmate was already an intern at Sandia and suggested McIntyre look into the student internship. When she graduated with a Bachelor's degree in chemistry, she was offered a full-time position at Sandia as a technician. After four years as a technologist (Sandia lingo for "technician"), McIntyre says, she began her master's program while still working full time. "A few months prior to completing my MS, I was promoted to the staff scientist position I currently hold, and I've been in this job for just over a year and a half."*

*McIntyre is a materials scientist at Sandia National Laboratories.*

#### 2. What's a typical day on the job like?

*There's really no such thing as a typical day on the job for me! I specialize in materials characterization in a group that uses a wide array of materials on a day to day basis. When a colleague is using a new material, I may be asked to characterize it. If a colleague is having a problem with an existing material, I might be asked to analyze it in order to determine the origin of the problem. I spend a substantial amount of time (50-75%) analyzing data, and discussing the results with my colleagues via meetings, or written reports. My instrumentation is highly automated, so I don't spend as much time in the lab. The time I do spend in the lab typically involves preparing samples for analysis, and then setting up the analysis. I'm also involved in mentoring.*

#### 3. Are there any apps/software/instrumentation/tools that you can't live without?

*I can't live without my x-ray photoelectron spectrometer and its associated software.*

#### 4. Describe your work environment.

*My office space is in a cubicle, in a "cube farm" area with the rest of my immediate coworkers. Although the cube farm tends to lack on the privacy side, it provides excellent opportunities for collaborative sharing of information when we hear each other chatting*

*with others about various projects, etc. I also have a laboratory, which I share with one other person. We have a few shared spectrometers, with our own workspaces in the lab.*

**5. Does your job follow a typical 9-to-5 schedule?**

*For the most part, things are pretty relaxed, and I basically work 40-44 hours per week. However, occasionally we'll get hit with a busy week or an extremely high-priority project that requires 50-60 hours in the week to finish.*

**6. What is your best productivity trick?**

*Making lists!! Every morning, I make a list of what I need to accomplish that day—it's easy to track things as I cross them off the list throughout the day, and also lets me visually track my progress and feel good about getting stuff done!*

**7. What's the best career advice you've received?**

*Good things come to those who work hard to improve their skills and patiently seek out new opportunities.*

**8. Do you have any special talents or traits that make you a great fit for your job?**

*Although I truly value all of the technical training and academic work I've completed, I think the personal talent that makes me a great fit for my job is actually my communication skills. As a materials scientist specializing in materials characterization, I see a wide array of materials, and work with many different people on a day-to-day basis. It is important for me to be able to build strong, trust-based relationships with my colleagues, and to be able to communicate the results of my analyses to them in a manner that is clear and easily understood.*

## PATENT EXAMINER

Interview obtained from the American Chemical Society website under *Chemist Profiles*: <https://www.acs.org/content/acs/en/careers/college-to-career/chemists.html>

### 1. Interviewee introduction:

*Emily Berkeley is a patent examiner with the U.S. Patent and Trademark Office. She received her Ph.D. in inorganic chemistry in 2013, and began working at the USPTO shortly thereafter.*

*In her first job after receiving her bachelor's degree, family and friends helped her look for available science positions for recent graduates, eventually helping her find a position as a technician at the Johns Hopkins School of Public Health. She was unsure of the direction she wanted to pursue, and the technician job was an opportunity for her to gain some work experience.*

*Regarding her decision to leave her technician position to attend graduate school, Berkeley says, "I liked the big picture aspects of lab tech work, which motivated me to want to continue my education in a scientific area. I wanted to learn more."*

*After she completed graduate school, she found her current position on USAJOBS, the central clearinghouse for the federal government's job listings, "although the path felt more circuitous than that," she notes. "I knew that I wanted to take a more nontraditional path, and I looked at several different tracks — law, government agency work, policy fellowships, and intellectual property. It was important for me to explore the options." A friend suggested that she apply for a position at the Patent Office. Berkeley describes her current position as having a good level of challenge — stimulating, but not overwhelming.*

### 2. What is your major responsibility in your current position?

*I review and examine patent applications to determine if they are patent-eligible; for example, whether they are "novel and non-obvious". When you begin work at the U.S. Patent and Trademark Office, you are assigned to a specialty, based on your knowledge and capabilities. I'm working on analytical testing methods, mostly instrumentation for chemistry, physics, and biotechnology, or new applications for existing technologies.*

**3. What's a typical day on the job like?**

*During the first year there is a lot of training time. New examiners spend four months learning the legal and technical aspects of what is and is not patent-eligible. For the first few years, we work on actual patent examinations in a supervised environment.*

*A typical day starts out by getting a patent application to review, thoroughly analyzing it, and then searching for related technology. Throughout this time, there are discussions with colleagues and supervisors related to the patent application and technology at hand. Then I write up a report based on the final analysis. I generally work on one application at a time, but there may be some overlap due to the rapid nature of the examination process. Most cases are generally responded to within two or three days after first looking at it.*

**4. Are there any apps/software/instrumentation/tools that you can't live without?**

*I use Microsoft Word, Google, and in-house search engines. For the first level of analysis, I use the USPTO's specialized search tools. For the next level, I go to Google and journal publications. There are no restrictions on what search tools I can use, and I can look anywhere.*

**5. Describe your work environment.**

*I work only in an office, and I share space with one other person. The work space mostly consists of a desk, drawers, and a computer with multiple monitors.*

**6. Does your job follow a typical 9-to-5 schedule?**

*A typical week is 40 hours. Currently, no overtime is required. The pace moves quickly, and the environment is geared toward flexibility and productivity.*

**7. What do you like most about your job?**

*I get to be at the cutting edge of technology. Even just starting, I'm in awe of the amount I've learned through the patent examining process. Doing a search is like solving a puzzle.*

*In graduate school, I was very focused on my area of research. I really enjoy pursuing the breadth of knowledge available in the scientific community, and my current position is a very good place for that. Not only do I get to read about technology, I also get to learn a lot about the legal side, including the history of how the laws developed. I like that I can tie it all together and feel connected to the legal system.*

**8. What's your best productivity trick?**

*Just start somewhere. If the obvious starting place feels too hard, pick a different way to begin.*

**9. Do you have any special talents or traits that make you a great fit for your job?**

*I have the ability to focus on the task at hand and enthusiasm for seeing what's next on the plate.*

**10. Is there anything else you would like to mention about your career?**

*My job is a way great to be surrounded by scientists and engineers without being in the lab.*

**11. What essential habit do you have now that you wish you'd started much earlier?**

*I wish that I had developed the ability to take criticism or feedback constructively sooner.*



# ANALYTICAL CHEMISTRY

# ANALYTICAL CHEMISTRY

## GENERAL INFORMATION / AT A GLANCE

Analytical chemistry involves the quantitative and qualitative analysis of matter, as well as the development of tools used for such analysis. Analytical chemists are employed in almost all industries to solve problems from various areas of chemistry. For example, their measurements can be used to assess the quality of food and water, the compliance with environmental regulations, or to support legal processes.

Some of the areas using analytical chemistry include environmental science, forensic science, and bioanalytical chemistry.

The American Chemical Society outlines seven main industries offering opportunities in analytical chemistry:

- **Industry** – the chemical industry is involved in the conversion of raw materials (natural gas, oil, and metals, and others) to products that we use in our daily lives, such as textiles, plastics, food, medicinal drugs, and paper.
- **Consumer products** – over 70,000 consumer products are produced through chemical processes, such as cosmetics, plastic goods, clothes, detergents, fertilizers, and paper.
- **Agriculture and food** – involves the performance of tests and analyses to ensure the quality of food products.
- **Forensic labs** – such labs are generally run by governing bodies that need analytical scientists' help when dealing with chain of custody issues.
- **Oil and petroleum** – the petroleum industry includes the exploration, extraction, refining, transporting, and marketing petroleum products, such as fuel oil and gasoline. Petroleum also provides the raw material used for various chemical products.
- **Pharmaceutical** – includes the development, production, and marketing of medicinal drugs.



- **Universities and government labs** – these focus on research and development, as well as teaching and writing publications.

## COMMON OCCUPATIONS

Below is an overview of some common occupations in Analytical Chemistry. Please note that this is not an exhaustive list as there are many different options available.

### ANALYTICAL CHEMIST

Analytical chemists use a diverse range of methods to investigate the structure and composition of substances in order to understand how their properties change in different conditions. They can work in almost all areas of chemistry and for all kinds of industries including toxicology, pharmaceuticals, quality control, environmental chemistry, or forensics.

### CONSUMER PRODUCTS TECHNICIAN

Consumer product technicians use their chemical knowledge to develop cheaper and higher quality consumer products of all types – cosmetics, adhesives, household products, clothing, and more. Most technicians are employed by manufacturing companies in all industries.

### MEDICINAL / PHARMACEUTICAL CHEMIST

Medicinal chemists (also called pharmaceutical chemists) are employed in academic environments, pharmaceutical companies, or government agencies to create new drugs or improve the processes by which existing ones are made. These professionals work to develop effective medicine while simultaneously reducing the risk of side effects.

### ENVIRONMENTAL RESEARCH SCIENTIST

Environmental research scientists study the sources and effects of pollution or other forms of environmental degradation and develop plans for environmental protection. Most of these professionals are employed by government departments or private mining, construction, land development, or consulting companies and may work in the office, lab, and field.

## TECHNICAL COMMUNICATOR

Technical communicators include scientific journalists and technical writers who may create marketing materials, grant proposals, articles, technical reports, instruction manuals, and other documents. Science journalists take complex scientific information and deliver it in a clear language that can be understood by the general public. Technical writers work with scientists to create documents that will be used by other professionals in the field, ensuring the subject, style, and level of detail are appropriate.

## SALES AND MARKETING REPRESENTATIVE

Sales and marketing representatives are a key link between chemical producers and the end consumers. They are knowledgeable of the products they promote and are able to recommend the right products or services for the customers' needs. Sales and marketing representatives may work with laboratory equipment and instrumentation, medical equipment, pharmaceuticals, industrial products, computing software, and scientific publications.

## POTENTIAL EMPLOYERS

- Bayer
- Celanese Corporation
- DuPont Canada
- Johnson & Johnson Inc
- Mitsubishi Chemical Corporation
- Kraft Canada
- PepsiCo Canada
- General Mills Canada
- Alphora Research
- ExxonMobil Chemical
- Shell Chemicals
- Almirall Canada
- Pfizer Canada
- Novartis Canada
- GlaxoSmithKline
- AstraZeneca Canada Inc
- Canadian Dairy Commission
- Canadian Food Inspection Agency
- Maxxam Analytics

## SAMPLE JOB POSTINGS

### ANALYTICAL CHEMIST – QUALITY CONTROL

#### JOB TITLE

**Analytical Chemist - Quality Control**

#### COMPANY

Alphora Research Inc.

#### JOB DESCRIPTION

Description of Department: The Quality Control group is responsible for providing analytical support to our cGMP Manufacturing groups.

#### Major Responsibilities:

- Responsible for testing of raw materials, in process controls, intermediates and finished products in support of our cGMP manufacturing operations.
- Interpret and report all test results, tabulate data and generate reports.
- Assist in maintaining the lab in a state of compliance by performing calibration checks and preventive maintenance of laboratory equipment.
- Work in accordance with established cGMP and safety requirements.

Instrumentation: HPLC, GC, UV, IR, KF (volumetric and coulometric), TLC

#### REQUIREMENTS

You are a team player, with an understanding of the key role that an Analytical Chemist plays in the field of Quality Control in support of manufacturing activities in a cGMP research environment. You are comfortable in a modern, state of the art analytical laboratory, and proficient in the operation of HPLC's and GC's in support of manufacturing. Your attention to detail, strong organizational skills with the ability to multitask and meet tight timelines in a fast paced dynamic environment as well as a willingness to work the day and afternoon shifts makes you the ideal candidate to become a member of our team.

### Education and Experience Requirements

- B.Sc. in a related field with a minimum of 3 years relevant experience in providing analytical support in a pharmaceutical research environment.
- Sound working knowledge of HPLCs, GCs, KF (volumetric and coulometric), UV, IR.
- Ability to troubleshoot HPLCs, GCs.
- Knowledge of cGMP requirements in the API industry.
- Excellent verbal and written English communication skills.

**RESEARCH ASSOCIATE – FORMULATION CHEMISTRY****JOB TITLE****Research Associate – Formulation Chemistry****COMPANY**

NutriAg Ltd

**JOB DESCRIPTION**

The successful candidate will report to V.P Research & Development and will be primarily involved in the research and development of new materials and product development at NutriAg. This individual will also have minor responsibilities in Quality Control and Technical Support function, including analytical equipment operation, product testing and reporting, development of new test methods and analytical procedures and materials management in the laboratory.

**Responsibilities:**

- Investigation of new formulations and the continuous improvement of current foliar fertilization formulations.
- Accurately recording all results and maintaining documentation through laboratory notebooks and formal reports
- Scale-up production of agricultural formulations including: pilot scale reactions in the laboratory and development of production records for scale-up to factory
- Develop, improve and customize products, formulas, processes and analytical methods for product development and Quality Control including authoring accurate documents and procedures.
- Analyze plant nutrient complexes and chelate structures compounds to determine chemical and physical properties, composition, structure, relationships and reactions utilizing chromatography, spectrophotometry and classical chemical techniques.
- Ordering and maintaining supplies of raw materials and consumables in the laboratory
- Assist in analytical instrument maintenance, inventory management and general laboratory responsibilities

- Identify and recommend changes and improvements to internal processes where appropriate.

## REQUIREMENTS

### Knowledge, skills, and abilities:

- Knowledge of inorganic formulation and metal chelate complexes including structure, and properties of substances and of the chemical processes and transformations.
- Expertise in emulsions and surfactant technologies
- Scientific principles and methods to solve problems; ability to identify complex problems and review related information to develop and evaluate options and implement solutions
- Basic knowledge of analytical and spectroscopic instrumentation
- Reading and interpreting results within guidelines and drafting scientific and general reports
- Adept at managing numerous parallel projects, meeting accelerated timelines and multiple project deadlines
- Flexibility within the job role, taking on tasks outside of primary function
- Proficient PC skills; Microsoft Office applications (Word, Excel, PowerPoint, Outlook); and other applicable applications
- Heavy lifting will be required (50 lbs)

### Minimum requirements:

- BSc or MSc in chemistry or related field from a recognized University.
- Comprehension of standard lab skills, safety, and basic knowledge of working components in an industrial research and development laboratory
- Experience performing analytical procedures and basic laboratory experiments, applying operational policies and procedures, documenting technical and test results, and calculating and reviewing technical chemistry formulas

## INTERVIEWS WITH PROFESSIONALS

### ANALYTICAL CHEMIST

Interview obtained from Career Cruising, a Canadian electronic career guide available on <https://cln.utoronto.ca/> under the *Resources* tab.

**1. Tell me about your job. Is what you do different in any way from what others in your occupation do?**

*Chemists play many different roles. Some work in research and development, while others are analytical chemists who determine the absence or presence of particular chemicals in substances. Quality control chemists make sure that pharmaceuticals are manufactured according to precise specifications. Synthesis chemists isolate and synthesize chemicals.*

*I am an analytical chemist in a drug abuse testing lab. I analyze urine specimens for the presence of drugs. I am also a certifying chemist responsible for approving, releasing, and reporting all negative results to clients. My role at the lab is similar to quality control because I ensure the accuracy of the lab results before sending the results back to the client.*

**2. Can you tell me about your background and how you got into this field?**

*I enjoyed science in high school, especially chemistry. I liked working with all the lab instruments. After I graduated from high school, I earned a bachelor's degree in chemistry.*

*I really wanted to work in an analytical lab because I found it more interesting than other areas of chemistry. We can analyze anything from DNA to food.*

*I got my job the usual way; I sent out many resumes before graduating from university. I was lucky. I got a job after my first interview.*

**3. What personal characteristics are required for someone to be successful in your job?**

*Chemists must be meticulous. We need good communication skills, both oral and written. We have to be industrious to work in a fast-paced environment, and organized to handle many different tasks at once.*

**4. How much job security is there for people in your field?**

*Job security for chemists is good so long as they keep up to date with advances in the industry and so long as they produce good results.*

*Chemists who work for private companies are subject to the financial health of that company. But even if one company lays off chemists, there will always be another wanting to hire good chemists.*

**5. What other jobs could you do with the skills you have gained in this field?**

*Many of the skills chemists have, including working with instruments and in a lab, provide experience that can open up many different opportunities. For example, many chemists work in research and development for pharmaceutical companies.*

**6. How do you think your job will change in the future?**

*I think the demand for chemists will increase. There is a solid demand for chemists in many industries.*

**7. What are the biggest challenges in your job?**

*The most challenging part of my job is simply getting all the work done in a day. Also, we must be able to concentrate in a fast-paced environment as well as multitask.*

**8. Are there many opportunities in your field? What should people do to get started?**

*Yes, there are opportunities for people who want to become chemists. Prepare yourself by getting your Bachelor of Science degree and securing great references.*

*Many universities have good co-op programs that allow students to get experience in the field.*



## ENVIRONMENTAL CHEMIST

Interview obtained from the Royal Society of Chemistry website under *Career options*: <http://www.rsc.org/careers/future/all-profiles>

### 1. What is an environmental chemist?

*Environmental chemists try to understand how chemicals move through the environment and their effects on human health and the environment itself. This is done through field and laboratory work, including measurements, data interpretation and computer modelling.*

### 2. What do you do in your job?

*I work as part of the contaminated land team at Wardell Armstrong, an environmental consultancy. We mainly work for clients that want planning permission for the redevelopment of land.*

*My role involves giving advice on the movement and outcome of contaminants in soil and groundwater, assessing the risk to long term human health and agreeing corrective strategies with the Regulatory Authorities. My role also involves classifying soil as waste, in line with waste legislation, and being on site to supervise corrective works. For example, if the amount of chemical contaminants is high enough to be a significant risk to long-term human health, then the source of the chemical contaminant may have to be removed or treated to reduce the risk. I often have to travel to local and national contaminated land sites to do field work, as well as having meetings with clients and regulators at their offices.*

### 3. What do you enjoy most about your job?

*I enjoy solving problems using techniques from different areas of science and working outdoors, even in all weathers. I also enjoy being part of the Royal Society of Chemistry Environmental Chemistry Group committee; previously as the Contaminated Land Representative and now as the Honorary Secretary, which has allowed me to meet environmental chemists working in other areas.*

### 4. What attracted you to becoming a fragrance chemist?

*I found that organic chemistry research in a laboratory and working by myself wasn't really me. So I was keen to find a science based job where I could apply my chemistry knowledge to lots of different problems. I also wanted to be outdoors and to work with clients, regulators and sub-contractors, working in a team more than I did in the lab.*

**5. How did you get in to your job?**

*During my A-levels, I did as much research as I could to try and find out what job I should do, including talking to my chemistry tutors at school. From this I decided to study a BSc (Hons) in Chemistry at the University of Bradford, with the idea of working in the chemical industry. There weren't many local job opportunities where I was from and I thought a chemistry degree would give me more national employability. After graduating I wanted a career in synthetic organic chemistry, as that was my favourite degree subject, so I started postgraduate research at the University of St Andrews, working in the laboratory doing "hands on" chemistry. Unfortunately I didn't enjoy this as much as I originally expected, so I decided to finish the research and get into the work place. After a spell of voluntary work I was recruited by a small environmental consultancy, using my chemistry and analytical skills to help develop my knowledge of chemical risk assessment (particularly contaminated land). I then moved onto my current employer, Wardell Armstrong.*

**6. What are the opportunities for career progression**

*The main employers in my area of work are the Regulatory Authorities, (e.g. Councils, Environment Agencies), environmental consultancies with some opportunities in remediation (clean-up of contamination), contractors and academic positions. The main opportunities are with the consultancies. A typical career path would be moving up to a management/business development position, or something specifically technical, which is more likely in a larger organization. Alternatively some people move between all of the main employer types taking on a different role in the contaminated land sector.*

**7. What advice would you give for people wishing to enter your career area?**

*I would recommend working in contaminated land for a career. Although the financial benefits may not be as great as in other professions, it is multidisciplinary and there is variety in the job which I think is a big advantage. For example, you could be working on a site anywhere in the world and then you could move onto another site somewhere completely different, with a different contamination problem to assess and solve.*



# PHYSICAL CHEMISTRY

# PHYSICAL CHEMISTRY

## GENERAL INFORMATION / AT A GLANCE

Physical chemistry combines the field of physics to chemistry. It studies the structure and behavior of molecules in order to understand how chemical reactions occur. Physical chemists mostly work in the research and development of new products and materials, often using theories of physics and mathematical analysis.

Some of the branches in physical chemistry include photochemistry, chemical kinetics, quantum chemistry, spectroscopy, and surface chemistry.

There are a number of positions available in physical chemistry where professionals can use their skills to discover, test, and analyze the fundamental physical characteristics of materials. The American Chemical Society outlines four main industries offering opportunities in physical chemistry:

- **Materials** – includes the development of materials like plastics, batteries, ceramics, and electronics.
- **Finance and law** – companies in these industries hire physical chemists for their scientific knowledge and significant statistical and mathematical understanding.
- **Pharmaceuticals** – includes the development, and prediction of how new materials will function.
- **Universities and government labs** – these focus on research and development, as well as teaching and writing publications. In addition, physical chemists are hired at national labs to ensure the safety and security of nuclear weapons.

## COMMON OCCUPATIONS

Below is an overview of some common occupations in Physical Chemistry. Please note that this is not an exhaustive list as there are many different options available.

### PHYSICAL CHEMIST

Physical chemists apply their knowledge of chemistry, physics, and math to discover and analyze the physical properties of materials. They often work with large laboratory equipment and powerful data analysis software, and are employed in almost every industry to create materials and products with new desirable properties.

### CHEMICAL ENGINEER

Chemical engineers combine the duties of chemists and industrial engineers. They are mainly involved in: the design, construction, and management of production facilities and machinery; the development of products ranging from food, toiletries, and cleaning materials to textiles, solvents, and plastics; and the research of new technologies, such as hydrogen power and nanotechnology. Chemical engineers can work in various industries, including industrial and chemical production, metallurgy, energy and utilities, and pharmaceuticals.

### CHEMICAL ENGINEERING TECHNICIAN

Chemical engineering technicians assist chemical engineers with the research, development and improvement of equipment, processes, and products. For example, they may prepare flow charts and diagrams, observe and test operational processes, write technical reports, perform preventative and corrective maintenance of equipment, and take samples or prototypes. Chemical engineers technicians can work in various industries, including industrial and chemical production, metallurgy, energy and utilities, and pharmaceuticals.

### DRUG SCIENTIST / DEVELOPER

Drug scientists (also called drug developers and pharmaceutical scientists) can be involved in any step of the drug development process. Some common duties include developing new disease-treating compounds, assessing the body's reaction to disease and response to medications, determining a safe and effective composition and dosage, establishing a

production process, and obtaining regulatory approval. Most drug scientists are employed by government agencies, pharmaceutical companies, hospitals, and universities.

## **MATERIALS SCIENTIST**

Materials scientists study the structures and chemical properties of various materials, including metals, alloys, rubber, ceramics, semiconductors, polymers, and glass. They use their knowledge to develop new and improved products and to test the quality of manufactured goods or specific properties for use in a variety of products and applications.

## **PRODUCT DEVELOPMENT CHEMIST**

Product development chemists (also called consumer product development scientists) are involved in the study and development of new materials, such as metals, rubber, plastics, and polymers, which are used for creating a wide range of consumer products. These professionals may also be involved in overseeing the production process, supervising technicians, as well as presenting scientific findings to clients or supervisors. Product development chemists are generally employed by manufacturing facilities.

## **RESEARCH SCIENTIST – PHYSICAL SCIENCES**

Physical scientists conduct experiments on non-living matter to better understand how the physical world operates. These professionals generally specialize in a single discipline, such as chemistry, materials science, physics, astronomy, mathematics, or others, and often work in teams with other scientists to develop new products and ways of applying new methodology.

## **POTENTIAL EMPLOYERS**

- BASF Canada Inc
- GlaxoSmithKline
- Ford Motor Company of Canada
- Goldman Sachs Canada Inc
- Pfizer Canada
- Novartis Canada
- Borden Ladner Gervais LLP
- AstraZeneca Canada
- Bayer
- Environmental Protection Agency
- Canadian Human Rights Commission
- Canadian Museum of Nature
- Sony of Canada Ltd

## SAMPLE JOB POSTINGS

### UNIVERSITY PROFESSOR – PHYSICAL CHEMISTRY

#### JOB TITLE

**Assistant Professor – Computational Biophysics**

#### COMPANY

University of Toronto – Department of Chemical and Physical Sciences, Mississauga

#### JOB DESCRIPTION

The Department of Chemical and Physical Sciences (CPS) at the University of Toronto Mississauga (UTM) invites applications for a tenure-stream appointment at the rank of Assistant Professor in the area of Computational Biophysics.

The successful candidate, who will have membership in the Graduate Department of Physics at University of Toronto, will be part of a growing cluster of biophysics, biochemistry and medicinal chemistry researchers at UTM, including the new Centre for Cancer Stem Cell Therapeutics. There will be opportunities to collaborate with UTM physicists, chemists and biologists, as well as with researchers at the other two campuses of the University of Toronto and at the research institutes and the hospitals affiliated with the University Health Network (UHN). The candidate's research program will benefit from access to Canada's largest supercomputer centre, SciNet.

#### REQUIREMENTS

- The successful candidate must have a Ph.D. in physics or chemistry, high profile post-doctoral experience in computational biophysics, a strong academic background, an excellent research record and excellence in teaching.
- Applicants must have demonstrated expertise in applying numerical methods and computer simulations to explore and understand biological problems at the molecular and cellular levels and possess a publication record of excellence with regard to these criteria.

- The successful applicant will be expected to develop and maintain an active and innovative externally funded program of research and to contribute to the core undergraduate courses in the CPS physics programs, as well as to the education and training of graduate students enrolled in the tri-campus University of Toronto Physics Graduate Program.
- Evidence of excellence in teaching is demonstrated through teaching accomplishments, letters of reference and teaching materials submitted with the application.
- Excellence in research is demonstrated by publications in top-ranked and field-relevant academic journals, presentations at major conferences, awards and accolades, and strong endorsements by referees.

## PRODUCT DEVELOPMENT – TECHNOLOGIST

### JOB TITLE

**Technologist, New Product Launch**

### COMPANY

Apotex

### JOB DESCRIPTION

Job Summary:

Responsible and accountable for the supervision of, and providing technical support assistance with projects for the improvement of new and current product formulations and processes, to ensure the manufacture of high quality products; and the use of efficient manufacturing processes at all Apotex OSD sites. In addition, works at a more senior performance level as a technologist in all areas of responsibilities within the department. The technologist may also be required to work off-shift, weekend and holidays as needed by the business.

Job Responsibilities:

- Investigates formulation and process deficiencies for current products being manufactured in order to determine the causes and to recommend solutions for improvement.



- Plans, schedules, determines and establishes individual priorities on a short-term basis and adheres to and is accountable for the long-term goals set by senior staff. Assists junior staff with time management and priority skills.
- Attends to a broader range of activities in the department with minimal direction and can accurately judge time required to complete each task and meet timelines.
- Executes and provides technical support to experimental trials in order to evaluate and recommend changes in formulations, raw materials, and manufacturing processes.
- Accountable for the monitoring and supervision of full-scale manufacture of products, as required, to provide technical support and/or technology transfer support to the manufacturing departments.
- Writes detailed investigational reports, project summaries, project updates, and provides recommendations, as required. Reviews reports written by junior staff members prior to sending to supervision for review.
- Assists junior members of the staff as required to meet all published timelines.
- Works as a member of a team to achieve all outcomes.
- Performs all work in support of our Corporate Values of Pride, Accountability, Integrity and Diligence; Demonstrates strong and visible support of our values.
- Performs all work in accordance with all established regulatory and compliance and safety requirements.
- All other duties as assigned.

#### **REQUIREMENTS**

- College/University degree in Chemistry, Pharmacy, Pharmaceutical Technology, Chemical Engineering or related science.
- Minimum of three to five years successful working experience in the pharmaceutical industry with related experience in the formulation development of solid dosage forms, scale up and/or technology transfer.
- Extensive knowledge and experience in pharmaceutical processes & equipment.
- Strong verbal and written English communication skills.
- Excellent organization, troubleshooting and report writing skills.

- Intermediate to advanced level of computer skills in Microsoft Office (Word, Excel, PowerPoint and Outlook).
- Well-developed interpersonal and team skills.
- Well-developed multi-tasking and project/time management skills.
- Ability to work independently and make responsible and accountable decisions.
- Capable of issuing an investigation of Quality Notifications and CCFs in SAP (Master Formulae, SAP Recipes and Certificates of Analyses).
- Thorough understanding and knowledge of cGMPs, GLP, SODs, SWPs, USP, BP, EP, SUPAC, FDA and HPFBI guidelines.

## INTERVIEWS WITH PROFESSIONALS

### CHEMICAL ENGINEER

Interview obtained from Career Cruising, a Canadian electronic career guide available on <https://cln.utoronto.ca/> under the *Resources* tab.

**1. Tell me about your job. Is what you do different in any way from what others in your occupation do?**

*I work in a manufacturing plant that produces paint products. It is my job to optimize the chemical production process. This means I have to make sure the plant's equipment is working properly and, if possible, find ways in which it can be made to work even better.*

*In all my projects, I must consider not only efficiency (including quality and costs) but also safety, health, and environmental concerns. For example, I recently coordinated a project in which we switched from small chemical storage tanks to large ones. The move made sense from both an economic and an environmental perspective.*

**2. Can you tell me about your background and how you got into this field?**

*While studying chemical engineering at university, I was able to take part in a co-op, or work-study, program. It was a very valuable experience. It allowed me to experience a wide variety of work settings and possible employers. I found out very quickly that I did not want to work for the government or in the area of product development.*

*The company that I work for now was one of my co-op placements. I felt comfortable with the people and the working atmosphere, so I decided to accept their offer over several others.*

**3. What personal characteristics are required for someone to be successful in your job?**

*Chemical engineers must have strong practical and technical skills. It is not enough just to understand how things work in theory. You have to know how to apply them on a very concrete, real-world level.*

*It is also important to be organized. Chemical engineers often have to play the role of coordinator, bringing together large numbers of people to work on issues ranging from production problems to sales strategies.*

*Finally, you must have good communication skills. Chemical engineers work closely with everyone from factory workers to sales representatives. It is not a good job for uncooperative or uncommunicative people.*

**4. How much job security is there for people in your field?**

*This profession offers excellent job security. You can easily pursue a career in chemical engineering for life. Still, individual jobs are not as secure as they used to be. Most engineers can expect to change companies every 5 or 10 years.*

**5. What other jobs could you do with the skills you have gained in this field?**

*Many experienced chemical engineers rise to the level of manufacturing line manager or technical manager. Others move into the sales and marketing end of the business. Chemical engineers make good technical sales representatives because they have an in-depth understanding of the products they sell.*

**6. What are the biggest challenges in your job?**

*Chemical engineers will continue to make use of advanced tools. However, the basic ideas that we use will probably not change quickly (at least not as quickly as they do in more dynamic fields like computer engineering).*

**7. Are there many opportunities in your field? What should people do to get started?**

*There are opportunities. Most of the new jobs will appear near densely populated, industrialized areas (cities).*

*Aspiring chemical engineers should do research to find job openings. For example, you might look through the employment records that universities and engineering associations keep to find out which companies are hiring.*

## RESEARCH SCIENTIST – ART CONSERVATION

Interview obtained from the American Chemical Society website under *Chemist Profiles*: <https://www.acs.org/content/acs/en/careers/college-to-career/chemists.html>

### 1. Interviewee profile:

*The interviewee helps art conservators preserve the priceless works of art at New York's Metropolitan Museum of Art. He studies the ways that various art materials age and degrade, and he consults with the museum's building engineers to produce an environment that helps prevent damage to everything from modern artwork made from polymers to ancient pieces made from metal. His work requires him to use a variety of instruments to perform organic analysis, but he also gives tours to classes and other members of the public. He enjoys the collegial, collaborative environment, working with capable, motivated colleagues.*

### 2. How did you find your first chemistry-related job after you graduated?

*I got my first chemistry job at General Electric's R&D center through an on-campus recruiter, and I worked there for nine years after graduate school. I did research and development of thin films and coatings, which is indirectly related to what I do now. I hadn't considered going into art, but I saw a job posting in 2007, when I was looking to relocate to New York City. I didn't have the background to get into the art museum field right away, so I took a fellowship to get that experience. Afterward, I worked full-time at the Smithsonian and the Library of Congress in Washington, DC, for about five years before receiving my current job at the Met. Doing fellowships is very common, since there are few job openings in this field.*

### 3. What are your primary responsibilities in your current position?

*I work on the science that helps to preserve art. I determine how artists' materials degrade, with a focus on effects due to atmospheric and physical environment. The materials I work on include nearly all modern and historic materials, from polymers to ancient metals. I consult with conservators and forensics experts, but my work is more about the analysis methods than the conservation work itself. I help conservators understand what they have, in terms of layer structures, for example, and how the layers are made. Most of my work involves organic analysis.*

**4. List any activities that you may have in a typical day:**

- *Consulting with professionals, from manufacturers to research scientists at academic institutions, to understand technical aspects of materials or their production.*
- *Discussing degradation issues with art conservators.*
- *Discussing building design issues with curators and building engineers.*
- *Running materials analysis (GC/MS, Ion Chromatography, GPC, optical microscopy, infrared analysis, etc.) to identify chemical or physical properties of either artist materials or storage and building materials, as well as their effect on artist materials.*
- *Grant writing.*
- *Report writing.*
- *Literature searching and reading.*
- *Equipment maintenance.*
- *Equipment construction or redesign/building.*
- *Significant collaboration building.*

**5. What apps/software/instrumentation/tools can't you live without?**

*GC/MS, Microsoft Office, Optical Microscopy, and Infrared Spectroscopy.*

**6. What is your work environment like?**

*I have an office and dedicated lab, but I also have access to shared labs and equipment. Typical equipment in this field includes GC/MS, XRF, IR, XRD, Raman, microscopy (SEM and optical), UV-Vis, HPLC or LCMS, and accelerated aging chambers. Sometimes we work with GPC, nano-indentation, DSC, and TGA. Most of my group works together in the basement of the museum, which provides a more stable base for the instruments. Some scientists are scattered throughout the museum, close to the storage or conservation areas for the material types they've specialized on (textiles, photographs, etc.).*

**8. What do you like most about your job?**

*I like the ability to work with creative, thoughtful people, where my hallways are filled with beautiful objects. I also like the freedom to explore solutions to technical problems applied to art through collaborations with both academia and industry.*

**9. What advice would you give students who are interested in following in your footsteps?**

*Find a lab in a museum early on in your academic career and volunteer there. If the museum in your area does not have a science lab (most don't), find a scientist or other professional expert (in chemistry, physics, statistics, math, computer science, etc.) on campus who might be interested in collaborating with your local museum's conservation department or collections care manager. Essentially, get involved. Apply for internships at cultural heritage institutions (libraries, museums, archives). Archives and libraries also employ conservation scientists and some of the major institutions have paid summer internships.*

**10. Is there anything else you would like to mention about your career?**

*My move to New York City was motivated by personal reasons — I wanted to live and work in New York City. The job at the Met helped me do that. Many jobs with chemical companies are in port cities, so you have to take location into account when you decide on a career path.*

*You will likely end up in a larger city if you choose to work with an art museum, and there are not many jobs in this field. Be sure to get a solid science background so that you have options in case you are not able to find a job in a museum. I wouldn't recommend going into a conservation science program at school, unless you also obtain a degree in hard science (physics, chemistry, materials science, biology, etc.).*

*You'll likely need a Ph.D. to get a job in a museum, and you'll certainly need experience in a museum (internship, fellowship, volunteer) before you'll get that job. Chemistry professors can incorporate art conservation and related topics into their coursework, so you may be able to get involved at your local university. Spending time in a museum, archive, or library handling and working with objects is equally important.*

*Be sure to network and show excitement for this field if you want to get into it. As with most jobs, you have to know how to work with people, as a collaborator, interacting with the public, and as an employee to the administration. I deal with art conservators, building engineers, and a lot of nonscientists. At GE, you also had to work well with others, but it was primarily with people inside the company.*



# BIOCHEMISTRY



# BIOCHEMISTRY

## GENERAL INFORMATION / AT A GLANCE

Biochemistry combines the fields of biology and chemistry. It studies the chemical processes within living organisms. Biochemists work in academic and government institutions, as well as private sector corporations, to create new food products, agricultural techniques, and medicinal drugs.

Some of the branches in biochemistry include molecular biology, pharmacology, genetics, toxicology, clinical biochemistry, and agricultural biochemistry.

There are a number of positions available for biochemists, including in medicine, dentistry, food science, agriculture, and pharmacology. The American Chemical Society outlines three main industries in biochemistry:

- **Biotechnology industry** – includes the cultivation of plants and is used in health care, crop production and agriculture, and the development of products like biofuels and biodegradable plastics.
- **Pharmaceuticals** – includes the development, production, and marketing of new medicinal drugs.
- **Universities and government labs** – these focus on research and analysis of food, medicinal drugs, water, and waste.

## COMMON OCCUPATIONS

Below is an overview of some common occupations in Biochemistry. Please note that this is not an exhaustive list as there are many different options available.

## **CLINICAL BIOCHEMIST**

Clinical biochemists (also called biomedical scientists or healthcare scientists) work with medical and health professionals in hospitals and pathology laboratories. They analyze samples from patients' bodily fluids to detect health problems and advice clinical staff on the appropriate treatment plan.

## **FORENSIC BIOCHEMIST**

Forensic biochemists (also called forensic scientists) work alongside crime scene investigators to produce chemical analyses of materials associated with crimes. These professionals can work with all types of organic and inorganic matter, such as human and animal hair, blood and other body fluids, soil, clothing fibers, glass fragments, fire substances, and shoeprints. The analyses conducted by forensic biochemists provide unbiased evidence for use in courts.

## **NUTRITIONAL BIOCHEMIST**

Nutritional biochemists examine how different foods and diets affect the human body. They measure and analyze the nutrients in food products, such as vitamins, minerals, proteins, and fiber, and advice clinicians on the most suitable diet for their patients' medical conditions. Nutritional biochemists may also apply their knowledge to support global health and nutrition programs.

## **ENZYMOLOGIST**

Enzymologists study the chemical properties and actions of enzymes in human and animal metabolism. These professionals work in academic institutions and pharmaceutical research companies to develop disease treatments and prevention strategies. Most enzymologists specialize in one area of enzymes.

## **CLINICAL RESEARCH ASSOCIATE**

Clinical research associates test new and existing medications for their effectiveness, risks, and side effects to ensure that they are safe to use. They are usually employed by pharmaceutical companies or research organizations and are typically involved in all phases of the clinical trial.

## MEDICAL ILLUSTRATOR

Medical illustrators (also called biomedical communicators) combine art with medicine to communicate medical concepts through visual media. They create photographic images, illustrations, and videos to help students, educators, researchers, and health care professionals clarify complex technical information in ways that words alone cannot. Medical illustrators work for publishing companies, medical schools, research establishments, advertising agencies, pharmaceutical companies, and health care institutions.

## TOXICOLOGIST

Toxicologists carry out laboratory and field experiments to identify toxic substances and radiation, and evaluate their impact on environmental and human health. For example, they may study how pesticides affect ecosystems or whether a new drug is safe to be tested on humans. Toxicologists may specialize in a specific area such as forensic, clinical, occupational, environmental, pharmaceutical, regulatory, medical, ecotoxicology, and others.

## PHARMACOLOGIST

Pharmacologists assist in the discovery and development of new and existing drugs. They try to identify substances that can be used in new medications and investigate how they affect biological systems, so that drugs can be safe and effective. Some of the main responsibilities of pharmacologists are conducting research studies on animals and humans, analyzing data, developing standardized drug doses, applying for research grants, and following safety and regulatory procedures.

## POTENTIAL EMPLOYERS

- Cargill
- Amgen Canada Inc
- Pfizer Canada
- Life Labs
- Baxter Canada
- SGS Environmental Services
- Novartis Canada
- Bayer
- GlaxoSmithKline
- Roche Canadian Food Inspection Agency
- Fluidigm
- Boston Scientific Canada

## SAMPLE JOB POSTINGS

### BIOCHEMISTRY SCIENTIST

#### JOB TITLE

**Biochemistry Scientist**

#### COMPANY

Sanofi Pasteur Limited, Toronto

#### JOB DESCRIPTION

Sanofi Pasteur Limited is accepting applications for a talented and results driven Scientist to join the Biochemistry Platform of our Analytical R&D (ARD) Department. The incumbent develops, qualifies, and validates test methods for new vaccine product characterization, stability, and release testing. The incumbent additionally manages the transfer of analytical test methods from and to internal and external laboratories. The incumbent will also be responsible for providing project support, scientific expertise, and supervision of staff where required.

Key accountabilities will include:

- Develop new or improved test methods for new vaccine entity characterization, stability testing and release. Understand requirements for test methods and project milestones by interacting with Project Teams, analytical working groups and Platform directors. Recommend and lead implementation of next steps in projects relative to product testing and characterization. Maintain GMP compliance, where required, in all testing programs. Review and approve test method technical reports.
- Qualify/Validate analytical test methods in support of characterization, release, and stability testing. Design and lead the qualification/validation strategy and review and approve qualification/validation protocols. Present results to Project Team, Platform director or regulatory agencies upon request. Review and approve qualification/validation reports.
- Oversee the transfer of analytical test methods in support of release and stability testing into receiving departments. Design and approve transfer protocols. Ensure the training of

analysts who receive the assay. Review and approve method transfers from external and internal labs to design method transfer plans. Review and approve test transfer reports.

- Participate and contribute to analytical working groups as required to support project milestones and provide strategic review and direction, including detailed plans and risk assessments. Author key regulatory documents, position/strategy papers as required.
- Review scientific literature for application to vaccine development and characterization and make recommendations. Contribute to development of new platform technologies. Communicate research findings to the scientific community and to Senior Management by attending international scientific meetings, presenting research results, writing papers for publications in scientific journals, preparing patent applications.
- Supervise and monitor compliance with employment and health & safety legislation to ensure that employees are trained and work within the policies, procedures and regulations. Supervisory responsibilities include experimental design and execution of tests to support release of clinical lots and product characterization following GLP and GMP requirements.

## REQUIREMENTS

- Ph.D. in Biochemistry or closely related field, with a minimum of two (2) years of relevant work experience in vaccine development or relevant field.; or, M.Sc. with a minimum of four (4) years relevant work experience.
- Specific experience in the development and execution of biochemical/biophysical characterization methods for vaccines or other biomolecules is required.
- Expertise in the development and implementation of mass spectrometry (Q-TOF and triple quadrupole) based assays (e.g. protein identification, post-translational modification, protein or small molecule quantitation by MRM/AQUA) is required.
- Experience in Agilent 6500 series Q-TOF, Waters Xevo TQS and Synapt, and Thermo Q-Exactive is highly desirable.
- Experience in protein sample preparation/cleanup is highly desirable.
- Proven supervisory/leadership, verbal and written communication, organizational, networking and team skills.
- Experience in maintaining laboratories and equipment in cGMP compliance is an asset.

- Familiarity in analytical instrument qualification/validation is an asset.
- Expertise in one or more of the following technologies is an asset: SDS-PAGE, HPLC, UPLC, CE, spectroscopy (e.g. CD, FTIR, UV), particulate analysis (e.g. DLS, MFI, AUC), calorimetry.

## UNIVERSITY PROFESSOR - BIOCHEMISTRY

### JOB TITLE

**Assistant Professor – Eukaryotic Cell Biology**

### COMPANY

University of Toronto – Faculty of Medicine, Toronto

### JOB DESCRIPTION

The Department of Biochemistry invites applications for a tenure-stream position at the rank of Assistant Professor.

We seek a scientist applying molecular or chemical biological approaches to fundamental properties of the eukaryotic cell. This search is in partnership with Medicine by Design ([www.mbd.utoronto.ca](http://www.mbd.utoronto.ca)) so research should focus on, or be relevant to stem cells or regenerative medicine. The candidate should also complement existing research strengths in the core Biochemistry department.

### REQUIREMENTS

Applicants must have a Ph.D. or equivalent and postdoctoral research experience with a strong background in cell biology. Evidence of excellence in research must be demonstrated through publications in top journals, competitive scholarships (or other research funding), as well as strong endorsements from referees of high international standing. The successful candidate will be expected to mount an original, innovative and independently-funded research program of high international caliber. A commitment to excellent teaching and student mentorship in the undergraduate and graduate Biochemistry programs is required. Candidates will be identified and ranked on the basis of these criteria. The successful candidate will rank at the top of a short list on the basis of a research seminar and meetings with faculty and students.

## INTERVIEWS WITH PROFESSIONALS

### CHEMIST – PHARMACEUTICAL FIELD

Interview obtained from Career Cruising, a Canadian electronic career guide available on <https://cln.utoronto.ca/> under the *Resources* tab.

**1. Tell me about your job. Is what you do different in any way from what others in your occupation do?**

*I am a chemist for a large pharmaceutical manufacturer. I am responsible for the day-to-day operation of the quality control part of the lab. I make sure that all products, ingredients, empty bottles, raw materials, and finished products meet proper specifications.*

*I schedule the testing that analysts perform and conduct investigations into any issues that arise (such as equipment malfunctions, incorrect settings, or unknown errors). I write and revise testing and operating procedures, and conduct validation of instruments and procedures. These responsibilities are fairly standard for a chemist in a pharmaceutical facility.*

*My job is different because of the industry in which I work. I work with a variety of pharmaceutical products, including anti-depressants, hypertension drugs, and pain relievers.*

*Other chemists could work in research and development, for government or university labs, or for medical facilities. However, each facility has their own way of designating jobs. "Chemist" is a very broad term and job descriptions may vary greatly, depending on the employer.*

**2. Can you tell me about your background and how you got into this field?**

*I've always had a love for science and although I didn't necessarily know where I would end up, I knew it would be in a scientific field of some sort.*

*I graduated from university with a double major in biology and biochemistry. After graduating, I wanted to work in a lab and was excited to move from theory in university to a practical real-life application in a workplace environment.*

*My first job out of university was at Canadian Blood Services. I have worked as a chemist for my current employer for almost 5 years.*

**3. What personal characteristics are required for someone to be successful in your job?**

*You need to be flexible because the job of a chemist changes from minute to minute.*

*You need to have a good understanding of the theory behind the tests you conduct to be able to investigate problems that arise.*

*The ability to work well - within a team or individually - is important.*

**4. How much job security is there for people in your field?**

*There is a lot of job security in the pharmaceutical field because this industry is always developing new drugs to meet the growing demand for better health care. As long as the company you are working for continues to develop new drugs, you will have security.*

*A chemist should be able to count on employment in the field until retirement, even if it means changing employers. There are a number of pharmaceutical and government organizations that require chemists, in addition to the food industry and private companies.*

**5. What other jobs could you do with the skills you have gained in this field?**

*With the education and skills a chemist develops, you could work in any laboratory setting, including those in the food industry, in paint or steel, in research and development, or in a variety of government positions.*

*A chemist could also get involved in the quality assurance area, which offers jobs in most industries that require ISO (International Organization for Standardization) certification.*

**6. What do you think the future holds for people in your occupation?**

*Technology continually changes the way a chemist works. In the pharmaceutical industry, many technological changes occur due to the ever-changing quest for better drug products. Chemists continuously look for better ways to perform testing, which in turn increases the quality of finished products.*

**7. What are the biggest challenges in your job?**

*The job is very fast paced and it can be difficult to get a job done with a limited time frame. My priorities change from minute to minute and it can be a challenge to concentrate on one task and stick to it.*



**8. Are there many opportunities in your field? What should people do to get started?**

*There are many opportunities for those interested in laboratory work. For example, you could work at a pharmaceutical company. There are also many government and industry jobs that require laboratory work of some type.*

*After you obtain the appropriate education (Bachelor of Science degree), the best way for you to secure an entry-level position is either through a co-op program or by submitting your resume to the company for which you are interested in working.*

## FORENSIC SCIENTIST

Interview obtained from Career Cruising, a Canadian electronic career guide available on <https://cln.utoronto.ca/> under the *Resources* tab.

**1. Tell me about your job. Is what you do different in any way from what others in your occupation do?**

*There are many different kinds of forensic scientists. Our specialties can include biology, toxicology, handwriting, photography, and firearms.*

*My specialty is in chemistry, particularly in glass. In other words, I examine broken windows or other glass shards that are found at crime scenes.*

*I help investigators with cases that involve injury or death under unusual circumstances. I also present objective testimony to the courts and conduct research in the area of forensic science.*

**2. Can you tell me about your background and how you got into this field?**

*After high school, I completed a 4-year bachelor's degree in applied chemistry. As a student, I read an article about the forensics field and decided right way that it was what I wanted to do.*

*After completing my Bachelor of Science (BSc) degree, I tried to get a job as a forensic scientist, but no one was hiring. I spent 2 years working in an industrial lab testing raw materials. I also worked as a tour guide at the Centre of Forensic Sciences. Eventually a position opened up and I took it.*

**3. What personal characteristics are required for someone to be successful in your job?**

*Forensic scientists should be objective. It's important that analysts have no preconceived notions or ideas when starting their examinations. They should be logical and able to follow scientific methodology.*

*They need to be good communicators so they can present scientific findings to a judge and jury in terms that are easily understood.*

**4. How much job security is there for people in your field?**

*To become a good forensic scientist, you must have extensive and ongoing training, as well as experience. Both training and experience require time, and because of this investment, a scientist cannot be easily replaced.*

**5. What other jobs could you do with the skills you have gained in this field?**

*Forensic scientists can move into many other fields related to their specialty. For example, since my specialty is chemistry, I could go into any chemistry-related job in industrial, environmental, or health and safety labs, as well as research and development. I can also teach.*

**6. What do you think the future holds for people in your occupation?**

*I think there will be an increase in the demand for forensic scientists because of the increasing awareness of forensic science. The cost of technology is decreasing and lab instruments are more accessible. As equipment becomes less expensive, private companies may enter the field and hire more forensics experts.*

*As the technology changes and new methods are developed for performing analyses, the nature of the job may also change. Forensic scientists must stay on top of these changes to remain competitive in the field.*

**7. What are the biggest challenges in your job?**

*Testifying in court is the most challenging aspect of this job. You must be able to present your findings clearly and concisely, while ensuring that the findings do not get over or understated. This often requires thinking on your feet and answering questions while under stress.*

**8. Are there many opportunities in your field? What should people do to get started?**

*You can improve your chances by getting a master's degree or PhD. Get as much lab experience as you can, build contacts, and be persistent with employers.*

# INSUSTRY-SPECIFIC WEB RESOURCES

## CAREER DIRECTORIES

- **Career Cruising**
  - Accessible to UTM students and recent grads through <https://cln.utoronto.ca/>
- **The Directory of Careers & Employment in Canada**
  - Accessible to UTM students and recent grads through <https://cln.utoronto.ca/>
- **Vault**
  - Accessible to UTM students and recent grads through <https://cln.utoronto.ca/>
- **WetFeet**
  - <https://www.wetfeet.com/>
- **Career Profiles**
  - <http://www.careerprofiles.info/>

## PROFESSIONAL ASSOCIATIONS

Each industry has affiliated associations. There are many benefits of becoming a member of association(s), such as developing a network of contacts, learning about industry trends, accessing industry-related job postings, reading online literature, and stating your affiliation on your resume. Below is a list of some popular professional associations in chemistry.

- Chemical Institute of Canada (CIC)
- Chemistry Industry Association of Canada
- Canadian Association of Petroleum Producers (CAPP)
- Canadian Institute of Food Science and Technology (CIFST)
- Rx&D – Canada’s Research-Based Pharmaceutical Companies
- Canadian Society for Medical Laboratory Science (CSMLS)
- Canadian Society of Clinical Chemists
- Royal Society of Chemistry
- Federation of Canada's Professional Chemists
- Association of the Chemical Profession of British Columbia
- Association of the Chemical Profession of Alberta
- Association of the Chemical Profession of Ontario
- Association of the Chemical Profession of Saskatchewan
- Ordre des chimistes du Québec
- Nova Scotia Chemists' Society
- Engineers Canada
- American Chemical Society
- BioTalent Canada
- Adhesives and Sealants Manufacturers Association of Canada (ASMAC)
- Canadian Association of Chemical Distributors (CACD)
- Canadian Chlorine Chemistry Council
- Canadian Cosmetic, Toiletry and Fragrance Association
- Canadian Fertilizer Institute (CFI)
- Canadian Consumer Specialty Products Association
- Canadian Paint and Coatings Association (CPCA)
- CropLife Canada
- Pulp and Paper Technical Association of Canada (PAPTAC)

## LABOUR MARKET INFORMATION

- **City of Mississauga** – <http://www.mississauga.ca/portal/business/keysectors>. This website provides an overview on the major sectors operating in Mississauga including links to other helpful resources such as educational programs and job prospects.
- **Professional Associations** – <http://www.canadiancareers.com/sector.html>. This website lists industry and professional associations organized by sector.
- **Government of Ontario** – <http://www.tcu.gov.on.ca>. This website provides the latest information on jobs across Ontario, including skills requirements and graduate experience.
- **Working in Canada** – <http://www.workingincanada.gc.ca>. This website link to Job Bank, where individuals can explore careers, wages, and outlook. There is information on local employment prospects, salaries, skills requirements, local industries, employers and job descriptions.

# HOW THE CAREER CENTRE CAN HELP

## RESOURCES FOR STUDENTS AND RECENT GRADS

The UTM Career Centre offers a variety of useful resources for students and recent grads (for up to 2 years after convocation) who need additional information.

### ONLINE RESOURCES

- **Career Cruising** – a Canadian electronic career guide, which contains information on over 1,000 career profiles. To access it, students and recent graduates can visit <https://cln.utoronto.ca> and click on the *Resources* tab.
- **Careers by Major: Chemistry** – the Careers by Major database helps students and recent grads gain knowledge about career fields related to different programs of study. Students and recent grads can find information on common occupations, major employers, ways of obtaining experience, and additional resources. Available here: <https://www.utm.utoronto.ca/careers/careers-by-major>.
- **Career Panel Packages and Videos** – this resource helps students and recent grads explore different fields, career options, and ways to gain relevant experience. Available here: <https://www.utm.utoronto.ca/careers/career-panel-packages-and-videos>.
- **Career Development e-Book Collection** – the collection covers a range of subjects such as grad school, interviews, making connections, resumes, work-life balance, and more. To access it, students and recent grads can visit <https://cln.utoronto.ca> and click on Career Resources e-Book Guide under the *Resources* tab.
- **Vault Guide to Chemistry Jobs** - to access Vault career guides, students and recent graduates can visit <https://cln.utoronto.ca> and click on the *Resources* tab.

## PRINT RESOURCES

- **Career Centre Resource Library** – the library holds a variety of career related books and the latest information on topics ranging from job searching and further education to career planning. Located in DV 3094, it contains detailed career exploration binders on Chemistry, as well as books, such as:
  - Great Jobs for Chemistry Majors
  - Nontraditional Careers for Chemists
  - Put Your Science Degree to Work
  - Resume Preparation – Tips for Chemical Professionals
  - Interviewing Skills for Chemical Professionals
  - Job-Search Strategies for Chemical Professionals
  - Employment Guide for Foreign-Born Chemical Professionals
  - What You Can Do with a Science Degree

## IN-PERSON CAREER EXPLORATION RESOURCES

- **Extern Job Shadowing Program** – this career exploration program offers students and recent grads the opportunity to meet with people working in their preferred career area and gain knowledge about what the career entails.
- **In the Field Program** – this program connects a group of students or recent grads with professionals working in a variety of occupations within one organization. During on-site company visits, participants have the opportunity to ask questions and learn about the work environment, daily tasks, skills, and education required for each occupation.
- **Information Interview** – talking to professionals who work in their fields of interest allows student and recent grads to gather valuable, industry-specific information about a career area that would otherwise be difficult to find in books or online.
- **Alumni Profiles** – this webpage, available on UTM Career Centre’s website, includes profiles of UTM alumni who work in chemistry. You may read about their career path and how their experiences have affected their career direction.



## EVENTS AND WORKSHOPS

The UTM Career Centre hosts a variety of workshops, networking events, career panels, employer info sessions, and career fairs that cover a wide range of topics.

### PAST EVENTS INCLUDE (NOT AN EXHAUSTIVE LIST):

- Smart Job Hunting Conference
- Fairs
  - Get Experience Fair
  - Get Hired: Summer and Full-Time Job Fair
  - Graduate and Professional Schools Fair
- Networking Nights
- Career Panels
- Employer Info Sessions
- Extern Job Shadowing Program
- In the Field Program

### PAST WORKSHOPS INCLUDE (NOT AN EXHAUSTIVE LIST):

- First Year Students: Career Planning
- Careers and the Power of Your Personality
- Finding Part-Time Work
- LinkedIn Essentials for Job Search
- Get Ready for Fall Recruitment
- Learn to Network
- Resume & Cover Letter Workshop
- Effective Interviews
- Stand Out and Succeed at Work
- Now That I'm Graduating, What's Next?
- Mastering the Personal Statement

## APPOINTMENTS

- **Career Counselling** – these confidential one-on-one appointments with experienced career counsellors help students and recent grads explore themselves and figure out what career options might work for them. Appointments may be booked in person at the UTM Career Centre (DV 3094) or by calling (905) 828-5451.
- **Employment Advising** – these confidential one-on-one appointments with experienced employment advisors help students and recent grads determine a personalized job search plan with an experienced professional, and receive ongoing coaching to keep them motivated and focused. Appointments may be booked in person at the UTM Career Centre (DV 3094) or by calling (905) 828-5451.
- **Resume and Cover Letter Critiques** – students and recent grads can receive objective feedback and advice on improving their resumes and cover letters. Individuals can sign up online on <https://cln.utoronto.ca/> under *Appointments* or by calling (905) 828-5451 on days when critiques are offered.

# GET STARTED

## START PREPARING FOR A CAREER IN CHEMISTRY

If you decide to pursue a career in Chemistry, there are several things you can do to get started:

- Conduct further research on your career(s) of choice, as this report only covers the basics. Read relevant books and check reputable online sources for more information.
- Talk to professionals who work in the field to get additional information about the industry. This may also help you develop your networking skills and help you build valuable connections in the field.
- Read the science sections of print/online newspapers and magazines to get industry knowledge and learn some of the commonly used terminology.
- Discuss your options with a career counsellor and an academic advisor. These professionals can provide advice and guide you in achieving your academic success and career goals.
- Gain some experience in the field through a summer or part-time job, internship, or volunteer work. This experience will give you exposure to the industry, which can later increase your chances of finding a job after graduation while helping you decide what area might be most suitable for you.
- Participate in some extracurricular activities, such as joining a student club or an academic association, because they give academic, emotional and social benefit. Extracurricular involvements can also provide you with additional experience and skill development, which can be great additions to your resume.

# SOURCES

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