

Winnipeg is a medium sized city known for its cultural amenities. The Chemistry Department is on the Fort Garry campus, situated on the Red River at the south side of the city of Winnipeg and is well connected by public transport. Good accommodation is readily available at a reasonable cost (one of the lowest in Canada). The spacious well-treed campus offers all reasonable facilities for students, with extensive tunnel interconnection of departments, facilities, libraries and gymnasiums.

The Chemistry Department at the University of Manitoba is a medium sized department, but offers a vibrant and high quality research program in all the major areas of Chemistry and Biochemistry, in a friendly collegial atmosphere of faculty members, support staff and graduate students. The department provides long established M.Sc. and Ph.D. programs of high reputation, with an excellent selection and depth of graduate courses in all of the major areas of chemistry and ancillary subjects. The program involves researchers within the department plus Adjunct professors from other universities in Manitoba and other departments within the University. In the 80 years that the M.Sc. program has been offered, more than 300 students have obtained Masters degrees. Since the Ph.D. program was introduced in the late 1940's more than 125 students have obtained their doctoral degree.

Program Information

A M.Sc. or Ph.D. in the chemical sciences is a gateway to an exciting, challenging and frequently high-paying career. M.Sc. and Ph.D. chemists work in areas such as industrial research and development (particularly the pharmaceutical, energy, advanced materials and biotechnology sectors), medical research, environmental and pollution monitoring, and technical consulting. Ph.D. chemists and biochemists in academia have the opportunity both to teach and to pursue independent basic and applied research.

Graduate students work in close cooperation with faculty as they pursue their own thesis research projects. There are fascinating project opportunities available in several research groups within the department. Graduate courses are typically informal, and encourage small groups of students to discuss topics of current interest, in a supportive environment. The Department of Chemistry also hosts seminars throughout the year, bringing researchers from university and industrial laboratories in Winnipeg, across Canada, and abroad, to share their latest discoveries with students and faculty. The Armes Lectureship and Betts Lectureship programs provide for extended lecture series by world-renowned chemists, who are able to interact with faculty and graduate students during their visit to the department.

Graduates of the Chemistry M.Sc. and Ph.D. programs are currently employed in industry, research institutes, government laboratories and agencies, and tenured academic positions. Some have even founded their own chemical companies! Alumni of the department's graduate program now work for companies such as Apotex Fermentation, Medisure, Novopharm Biotech, Philips Paints and Border Chemicals in Winnipeg, Biovail (Steinbach), Anormed (Richmond, BC), Allelix (Mississauga), Uniroyal (Guelph), and Genzyme (Cambridge MA). Several have undertaken additional training with prominent scientists at such places as the Scripps Institute, MIT, the Howard Hughes Medical In-

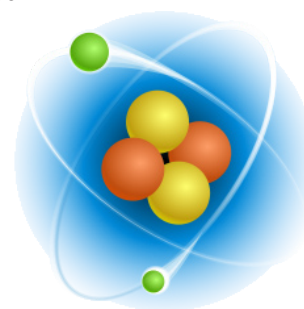
stitute, the universities of Alberta, British Columbia, Calgary, Montreal, Sherbrooke, and Toronto. Some have gone on to academic careers, at such universities as Alberta, Calgary, Cornell, Guelph, Dalhousie, Northern British Columbia, Queen's, Saskatchewan, Tufts as well as Manitoba.

Fields of Research

Analytical Chemistry, Asymmetric Organic Synthesis, Biochemistry, Cell Biology, Chromatography, Environmental Chemistry, Inorganic Chemistry, Mass Spectrometry, Macromolecular Chemistry, NMR Spectroscopy, Organometallic Chemistry, Protein Structure and Dynamics, Synthetic Carbohydrate Chemistry, Theoretical Chemistry, X-Ray Biocrystallography

Research Facilities

The department has modern instrumentation and technical support for research and teaching with good library support, including on-line connections to medical libraries and major journals. The computer services have a central core of UNIX and NOVELL servers with Internet access. Department NMR facilities consist of a Bruker Avance300 system, the Prairie Regional Bruker AMX 500 MHz instrument and a Varian Unity INOVA 600 system. Both NMR spectrometers can perform modern gradient-enhanced experiments, and the AMX 500 is also equipped for solid-state work. The INOVA 600 is used for solid-state and protein work. Mass spectrometric facilities consist of a two-sector high-resolution instrument with electron impact, chemical ionization and FAB sources, operational in positive and negative ion modes, a Quattro-LC triple quadrupole instrument equipped for electrospray ionization (ESI), and a Bruker Biflex IV MALDI-TOF instrument for the analysis of large biological molecules. Through the Physics department, Chemistry researchers also have access to experimental time-of-flight instruments. Crystallography facilities are comprised of a precession camera and a computer controlled single-crystal diffractometer, equipped for structural analysis via PC and SGI



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computers. Other major instrumentation consists of a 15W argon laser with a 14018 double monochromator for Raman spectroscopy, and with a coherent dye laser for intracavity photoacoustic spectroscopy, plus a Nicolet Nexus 870 FT-IR system. The department also has a STAR HPLC system, as well as routine HPLC, FT-IR, CD and stopped flow equipment. There is a full-time glassblower in the department who can produce specialized glassware as required.

Funding Opportunities

All graduate students in the Department of Chemistry receive a stipend (currently a minimum of \$14,000 per year for M.Sc. and \$16,000 per year for Ph.D. students), which includes 4 teaching assistantship positions. University of Manitoba Fellowships of \$12,000 for Master's and \$16,000 for Ph.D. students are available, regardless of nationality, through annual competitions. The Department also has Anderson, Betts, and Bock Graduate Scholarships available on a competitive basis to supplement the basic graduate stipend. The Campbell-Charlesworth and Lee & Bert Friesen Graduate Bursaries in Chemistry are available for students in financial need.



Periodic Table of the Elements

Key	Symbol	Atomic Number	Name	Important Oxidation Numbers	Relative Atomic Mass
essential in humans	B	5	Boron	+3	10.81
	C	6	Carbon	+4, -4	12.01
	N	7	Nitrogen	+5, +3, -3	14.01
	O	8	Oxygen	+2, -2	16.00
	F	9	Fluorine	-1	18.99
	Ne	10	Neon		20.18

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
												III	IV	V	VI	halogens	noble gases	
												p ¹	p ²	p ³	p ⁴	p ⁵	s ²	
												B	C	N	O	F	He	
												boron	carbon	nitrogen	oxygen	fluorine	helium	
												5	6	7	8	9	10	
3	3s	1s ²	3p	2s ²	1s ²	2s ²	3s	3p	4s	1s ²	2s ²	3d	3s	3p	4s	3d	4p	
	Na	Mg																
	11	12																
	22.990	24.305																
	Na	Mg																
	sodium	magnesium																
	+1	+2																
	39.098	40.078	44.956	47.867	50.942	51.996	54.938	55.845	58.933	58.933	58.933	58.933	58.933	58.933	58.933	58.933	58.933	
	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
	potassium	calcium	scandium	titanium	vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	gallium	germanium	arsenic	selenium	bromine	krypton
	+1	+2	+3	+4	+5	+6, +3	+7, +4, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2
	39.098	40.078	44.956	47.867	50.942	51.996	54.938	55.845	58.933	58.933	58.933	58.933	58.933	58.933	58.933	58.933	58.933	58.933
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	potassium	calcium	scandium	titanium	vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	gallium	germanium	arsenic	selenium	bromine	krypton
	+1	+2	+3	+4	+5	+6, +3	+7, +4, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2
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	+1	+2	+3	+4	+5	+6, +3	+7, +4, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2
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	+1	+2	+3	+4	+5	+6, +3	+7, +4, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2	+3, +2
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