



Doctor of Philosophy (PhD) in Applied Bioscience

Submission to the Ontario Council on Graduate Studies
September 2008

Volume I:

The Program

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1. INTRODUCTION

1.1 Brief listing of program

The doctoral program leads to the degree of Doctor of Philosophy (PhD) in Applied Bioscience. This is a new program to be offered at the University of Ontario Institute of Technology (UOIT) with the Faculty of Science as the home faculty. The program is planned to be launched in the Fall of 2009 or as soon as possible after all necessary approvals have been granted.

In addition to the proposed PhD program in Applied Bioscience, the Faculty of Science is currently the home Faculty for MSc degrees in Applied Bioscience, Materials Science and Modelling and Computational Science (All were initiated in fall 2007.)

1.2 Background

UOIT accepted its first undergraduate students in the fall of 2003, and enrolment has grown to more than 5000 as of fall 2008. UOIT launched its first MSc program in fall 2005, and has 8 approved Master's programs and 1 PhD program as of fall 2008.

The Faculty of Science offered its first undergraduate programs in Physical Science (with specializations in Physics, Chemistry and Mathematics) and Biological Science (with specializations in Pharmaceutical Biotechnology and Environmental Toxicology) in the fall of 2003. UOIT subsequently received Ministerial consent to offer honours baccalaureate science degrees in Applied and Industrial Mathematics, Biological Science, Chemistry, Computing Science, Forensic Science, and Physics. In addition to comprehensive programs in each area, specializations within the programs include the following: *Biological Science*: Environmental Toxicology, Life Sciences, Pharmaceutical Biotechnology; *Chemistry*: Biological Chemistry, Pharmaceutical Chemistry; *Computing Science*: Digital Media, Digital Forensics; *Physics*: Energy and the Environment, Forensic Physics, Medical Physics. The Faculty of Science also offers a large number of service and elective courses to other Faculties in the University.

UOIT is very rare as a university that was launched with a mandate of becoming both research intensive and student centric from its inception. Indeed, the Faculty of Science has been very successful in establishing and expanding its research capacity; faculty have received significant funding from many agencies, including NSERC, CIHR, and CFI. This success includes the award of two Canada Research Chair positions, both of whom are participants in this proposal. As the research capacity grew, the Faculty initiated the development of graduate programs.

The MSc program in Applied Bioscience received OCGS approval in December 2006 and enrolled its first students in September 2007. There were initially two fields in the program: Biomolecular Science, and Environmental Science and Health (since changed to Ecosystem Health). A new Field of Forensic Bioscience has been approved to commence in fall, 2008. As evidence of its appeal, the Applied Bioscience MSc program has experienced significant enrolment success and has 22 students enrolled as of fall, 2008 (all of whom are Domestic students). In addition, both domestic and international student applications are strong both in number and

quality and have increased each year. With our capacity to offer additional graduate positions and to provide the opportunity for currently enrolled MSc students to proceed to a PhD degree, the Faculty of Science is ready and capable of offering a PhD program in Applied Bioscience. The timing of the PhD program's planned start in September 2009 will provide the first graduates of the Applied Bioscience MSc program the opportunity to continue their studies towards the PhD level.

Although Science is the home faculty for the program, members of the university's Faculty of Health Sciences have also contributed to the development of this proposal, and will participate in its implementation. Health Sciences currently offers an Honours Bachelor of Science in Nursing, an Honours Bachelor of Health Science (BHSc) with a Comprehensive stream and a Health Information Management stream, a Bachelor of Allied Health Sciences, and a unique Honours BHSc in Medical Laboratory Science. An MSc program based in this faculty is scheduled for review by OCGS consultants in September 2008.

1.2.1 Other Ontario graduate programs

As of 2005, there were 10 Universities in Ontario offering PhD degrees in Biological Science-related fields (classified as Biology/Botany/Zoology) and 8 offering degrees in Chemistry. The only life science-related program in Ontario that is classified as interdisciplinary is Trent University's Watershed Ecosystem MSc/PhD program¹.

The proposed PhD program in Applied Bioscience is truly a unique graduate program for Ontario. The program has an interdisciplinary focus that is offered by both biology and chemistry faculty in a "department-free" Faculty of Science. The graduate students, who come from various academic backgrounds and disciplines, will work closely with one another and complete their degree requirements in a single research wing within the Science building. The program, while interdisciplinary, is built on a solid foundation of high-quality research that is relevant to the needs of society.

1.2.2 Graduate program demand

Knowledge has become the critical basis of competitive advantage among many industries and world economies. About a third of the growth rate in per-capita income is attributable to technological innovation. The source of most technological advances is university research, which generates the knowledge that leads to eventual breakthroughs. In Canada, universities are responsible for 34% of the research and development activity in the country¹. This figure is likely to increase as our knowledge based economy continues to grow. To maintain its competitiveness, Canada will need to build on its intellectual resources by increasing its efforts in the area of science education and training. Part of these efforts will be to create and expand graduate training in areas where there is strong industry demand and economic need. The current and future labor force in the biotechnology and pharmaceutical industries, environmental impact characterization and forensic science will require more individuals with interdisciplinary research skills².

¹Ontario Council on Graduate Studies (OCGS) Macroindicator Data 2004-2005

²Organisation for Economic Co-operation and Development. Main Science and Technology Indicators (MSTI): 2004/2 edition

Servicing Ontario

A recent report by the Ontario Council of Universities¹ stressed the need to increase graduate student enrollment in Ontario to enhance its research capabilities, to replace aging university faculty and to address private- and public-sector human resource needs. However, Ontario currently produces only one-half the number of Masters Degrees and two-thirds the number of PhDs compared to the U.S on a proportional population basis¹.

In order to realize the potential benefits of increased graduate student training, the Ontario Government implemented a “Reaching Higher Plan” to improve the quality and access of university graduate student positions. This plan includes a goal to increase graduate enrolment by 12,000 by 2007-08 and by 14,000 by 2009-10 over the 2002-03 level of 24,000 FTEs (full-time enrolments)¹. The Applied Bioscience PhD program at UOIT is a prime candidate to assist the Government of Ontario in reaching this goal.

Servicing the Durham Region

The Durham Region, with a population of 561,258, is one of the fastest growing regions in Ontario. From 2001-2006 the population has grown 10.7% (compared to 6.6% growth in Ontario)². The population of Durham is projected to increase to 829,839 by 2021, and to 1,034,245 by 2031³. UOIT is the only university directly servicing this region. Therefore, it is expected that UOIT and its programs will play an increasingly important role in servicing the education demand not only for Ontario, but also for the rapidly growing Durham Region.

Increased demand for Biology and Chemistry graduate programs

It is expected that over the next decade the overall demand for graduate student positions in Biology and Chemistry will increase considerably in Ontario. This is supported by a recent projection that Ontario’s graduate student pool (the 22- to 29-year-old cohort) of 1.37 million will increase by 210,000 by 2019¹. In addition, overall enrolments in Biology and Chemistry PhD programs have increased by 24 and 37%, respectively; between 2000-2005 (see Table 1-1). With the anticipated growth in Ontario’s graduate student applicant pool and the increasing demand for Biology/Chemistry-related graduate programs, the Applied Bioscience PhD program is in a strong position to help fill the demand for high-quality graduate student positions. Furthermore, the program proposed by UOIT will allow Ontario to expand graduate programs in areas that interface biology and chemistry; this has become increasingly important over the past several decades. UOIT is well-positioned to make an important contribution in view of its interdisciplinary emphasis.

¹2008 Provincial Pre-Budget Submission. Ontario Universities: Strategic Partners in Provincial Prosperity. Ontario Council of Universities, January 2008

²www.statscan.ca

³http://www.greatertoronto.org/investing_demo_03.htm, Accessed June 17, 2008

Table 1-1: PhD Enrolment in Biology and Chemistry graduate programs in Ontario Universities 2000/2001 to 2004/2005

Program	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005	Growth (%)
						2000 to 2005
Biology	497	522	559	553	614	24
Chemistry	396	402	414	507	541	37

Source: Ontario Council on Graduate Studies (OCGS) Macro indicator Data 2004-2005

1.2.3 Societal Need

A PhD program in Applied Bioscience has the potential to make significant contributions to the needs of society. Indeed, knowledge and innovations that emerge from bioscience research can have economic and social benefits to both Ontario and the rest of Canada. This is reflected in a recent report by the Organization for Economic Co-operation and Development (OECD)¹ which considered the design of a bioeconomy policy agenda for governments.

The OECD uses the term “bioeconomy” to reflect a set of economic operations in a society that use the value found in biological products and processes that ultimately lead to new growth and social benefits for citizens and nations. These diverse benefits may include agriculture productivity gains, improvements in health (human and ecosystem) and nutrition, the development of alternative energy sources and benefits from more eco-efficient and sustainable use of natural resources. These economic benefits are made possible by the recent and continuing surge in the scientific knowledge and technical competencies which can be used to harness biological processes for practical applications. Modern techniques in biotechnology, genomics, genetics, and proteomics will continue to converge with other technologies, resulting in potentially large scale changes to global economies in the next thirty years¹. The Applied Bioscience PhD program involves many research initiatives that could potentially contribute to many of these economic and social benefits for Ontario and the rest of Canada.

Forensic bioscience research also has the potential to yield significant societal benefits by focusing on important national and international issues such as security, bioterrorism, and global pandemics. Increased crime rates, while causing economic burdens on a nation, will also negatively impact society, as it reduces community mobilization and leads to a negative perception of community safety. By improving the technologies with which crimes are investigated, national and global investigations can be resolved quickly and with fewer resources, thus improving the public perception of community safety and reducing the incidences and fear of crime in society.

¹OECD International Futures Programme: Designing a Policy Agenda: the Bioeconomy to 2030 (2006)

While the research outlined in the proposed program is “applied” by nature of its end-user focus, it is driven by the underlying goal of gaining fundamental new knowledge about chemical and biological processes, which is the core foundation that ultimately leads to breakthroughs that benefit society.

1.2.4 Institutional Appropriateness

The Applied Bioscience PhD program is an expansion of the current MSc program of the same name. This unique program will combine the research expertise of biologists and chemists in a single unit that will guide graduate students through their courses and research projects. The Faculty of Science as a ‘department-free’ unit has been specifically designed to facilitate and expose students to interdisciplinary education and training. This program will provide a unique interdisciplinary education in chemistry and biology, allowing students to develop a broad scientific perspective. At the same time, students will gain a depth of knowledge in their chosen areas of research specialization.

The program is expected to attract many students from outside the university, but also some of UOIT’s undergraduate students and the MSc students that will be graduating in 2009.

The unique environment of the Faculty of Science has attracted excellent faculty who are driving a growing research capacity. The Faculty of Science is well equipped with the research funding and infrastructure that is essential for PhD-level research (see section 3-1).

The interdisciplinary educational experience is exemplified by our current MSc program in Applied Bioscience, which includes the following:

- Courses team-taught by chemists and biologists
- Advisory committees consisting of chemists and biologists
- The implementation of an interdisciplinary program review committee, designed to continuously monitor and enhance the program and maintain its interdisciplinary nature.
- Chemistry and Biology research laboratories are located in physical proximity to enhance interdisciplinary interaction

1.3 Objectives of the program

Life science research today is increasingly interdisciplinary. This trend has been driven in part by a greater reliance on chemical techniques in biological research; indeed, techniques that were once strictly the domain of chemists are now also part of the repertoire of many biologists. Given the success and new research opportunities that this approach has demonstrated, the interdependence of chemistry and biology can only be expected to increase in the future. However, in contrast to this general trend, graduate science education in biology has lagged behind, and most other graduate programs do not provide training to students in *both* biology and chemistry.

The primary objective of the Applied Bioscience program is to train students to become high-quality researchers at the interface between chemistry and biology, with competence in both subjects and the ability to tackle interdisciplinary problems

and to work independently and successfully within collaborative networks. The program will equip students with a wide array of both practical and conceptual scientific skills that will prepare them for leadership roles in the life sciences.

It is expected that the graduates from this program will have a breadth of knowledge in the life sciences, a depth of knowledge in their chosen field and the scientific and technical skills that are essential for a career in research. It is also expected that graduates will continue to make significant contributions to the advancement of knowledge in their field and become lifelong scholars, with an appreciation of the impact of science on society. In addition, in keeping with the UOIT's strategic plan, research will be aimed at creating innovations that will improve the lives of Canadians.

We intend to capitalize on our current research expertise which is reflected in the three fields in the program. The fields of Biomolecular Science, Ecosystem Health and Forensic Bioscience are interdisciplinary in nature and require students to rely on both chemistry and biology research methods in order to answer specific research questions.

We expect that our graduates will be prepared for a variety of careers such as in academia, industry (pharmaceutical or biotechnology) or government. In addition to research and scientific skills, these graduates will have strong communication and interpersonal skills and the ability to effectively engage the public. Furthermore, because of the interdisciplinary nature of this program, our students will see the value in diverse approaches and interpretations, which are important skills for any career.

The objectives of the PhD program will be achieved through a combination of advanced course work, independent research, research seminars, workshops, peer-reviewed publications, and a research dissertation. The research dissertation must constitute a new contribution to the field of study.

A comprehensive list of program outcomes is provided in Section 4.1.4.

1.4 Method used for the self-study

This proposal was prepared by the Applied Bioscience Graduate Program Review Committee of the Faculty of Science. The proposal has undergone thorough reviews by the Curriculum Committee and the Faculty Council of the Faculty of Science as well as by the Dean of Graduate Studies, the UOIT Graduate Studies Committee, and the Academic Council of UOIT.

1.5 Fields in the program

The PhD program comprises the following fields:

- Biomolecular Science
- Ecosystem Health
- Forensic Bioscience

1.5.1 Rationale for the fields

The above fields reflect the research strengths of the faculty and the overall teaching and research directions of the Faculty of Science, and are at the forefront of bioscience research directions globally. They also complement the undergraduate bioscience-oriented specializations within the Biological Science and Chemistry programs currently offered in the Faculty: Pharmaceutical Biotechnology, Environmental Toxicology, Life Sciences, Forensic Science and Chemistry. The Faculty of Science has chosen not only to focus on these fields in their undergraduate teaching programs, but to expand research and graduate program initiatives in these areas.

1.6 Review of concerns from previous appraisal

As this is an application for a new program, this section is not applicable.

1.7 Special matters and innovative features

1.7.1 Special matters

The MSc program in Applied Bioscience admitted its first students in September 2007; 11 students began their studies. As of September 2008, program enrolment has doubled to 22 students. In light of this demonstrated demand, a PhD program in the same area is a logical next step that will provide opportunities to students desiring more advanced research training in Applied Bioscience. In addition, through its research funding success and planned new faculty hiring, the capacity to offer graduate student positions is continuously increasing and can support a PhD program.

If the program is approved and implemented by the fall of 2009 as planned, it will provide a continuation option for graduates of the initial cohort of the Applied Bioscience MSc program who will graduate that same year.

The Faculty of Science has assembled an impressive group of well-qualified faculty members who conduct research in a wide variety of areas of potential interest to doctoral candidates in the discipline (see section 2.1.1). Our professors have solid records of success in securing research grants. Details are provided in the faculty CVs provided in Volume II.

1.7.2 Innovative features

The proposed Applied Bioscience PhD program has a number of unique features which make it attractive for prospective students, which are outlined below.

A strong research capacity

The University of Ontario Institute of Technology has quickly built a reputation for research excellence, which has already attracted high-quality graduate students and this reputation is expected to continue to accelerate in the future. UOIT faculty members have received high-profile recognition for their work in a number of areas.

Within its current complement of around 100 core faculty members, UOIT has been awarded five prestigious Canada Research Chair positions, two of which are held by Science faculty members involved in fields of the proposed PhD program.

Dr. Douglas Holdway was awarded a Tier 1 Canada Research Chair in Aquatic Toxicology in November, 2004. He will receive a total of \$1.65 million in research funding over seven years, including a \$125,000 infrastructure grant from the Canada Foundation for Innovation (CFI) and \$125,000 in matching funds from the Ontario government. Dr. Holdway's research focuses on the impact that very brief, or "pulse" exposure to toxic compounds has on aquatic life. His research will help drive the Ecosystem Health field within the program.

Dr. Shari Forbes was awarded a Tier II Canada Research Chair in Decomposition Chemistry in September, 2007. She will receive a total of \$750,000 in research funding over five years, including a \$125,000 infrastructure grant from the Canada Foundation for Innovation (CFI) and \$125,000 in matching funds from the Ontario government. Her research has direct applications to both forensic science and the food science industry. Dr. Shari Forbes' will play an integral role in the Forensic Bioscience field within the program

It is our goal to obtain and fill a new Research Chair position within the Biomolecular Science field. Such a position would help further increase the research capacity within this field.

Interdisciplinary Focus

Major advances in fundamental knowledge often result from interdisciplinary research approaches and collaborations. The interdisciplinary research environment underlying the proposed program has the potential to result in important advances and practical applications, and will provide our students with a unique research perspective to foster their scientific training and outlook. The proposed program is significant in that it brings together a network of chemists and biologists who will continue to strive to focus their research interests on jointly pursued problems. This interdisciplinary focus will help students to understand and appreciate the connections between biology and chemistry and to appreciate the value of diverse interpretations, methods and disciplines in identifying and solving research problems in the biosciences.

Our current approved MSc program in Applied Bioscience exemplifies this interdisciplinary theme. The courses within the program are team-taught by biologists and chemists, and many of the graduate student advisory committees are interdisciplinary. We have implemented an Applied Bioscience graduate program review committee, whose members come from different disciplines, and represent each of the fields in the proposed program. This committee is a crucial mechanism for maintaining and strengthening the interdisciplinary nature of the program.

The unique synergies in the Applied Bioscience PhD program will provide many benefits to its graduate students, including:

- benefits of graduate supervision by both chemists and biologists
- a small, closely interactive & multidisciplinary research community

- state-of-the-art technology & research infrastructure
- exposure to and critical appraisal of ecosystem health issues
- exposure to mixed research designs and methodologies (qualitative and quantitative)

Leading-Edge Facilities and Equipment

Faculty within the Applied Bioscience program aim to provide graduate students at UOIT with access to the most advanced and current technology that will facilitate discovery. With this in mind, new equipment and technology (in addition to that described in section 3.1) will provide UOIT with research capacity that is competitive both nationally and internationally. The faculty of the Applied Bioscience program have been successful over the years in obtaining significant infrastructure grants (from CFI and NSERC).

Table 1-2 lists the infrastructure awards received by faculty in the program since 2004.

Table 1-2 Infrastructure and Equipment Grants Awarded to Faculty in the Applied Bioscience Program since 2004		
Award Title	Agency/Type	Amount
Facility for Nematode Ion Channel Research	CFI Leaders Opportunity*	\$76,258
Electrochemical Materials Lab	CFI Leaders Opportunity*	\$78,620
Laboratory infrastructure for characterization of Resistance-Nodulation-Cell Division efflux pumps from <i>Pseudomonas aeruginosa</i> and <i>Acinetobacter baumannii</i>	CFI Leaders Opportunity*	\$60,000
Development of a decomposition chemistry laboratory and geoforensic research facility	Canada Research Chairs Program*	\$250,000
Development of continuous-flow wet-laboratory and controlled temperature room facilities for the investigation of pulse-exposure effects of contaminants on aquatic organisms and biomarker validation.	Canada Research Chairs Program*	\$250,000
Essential Tools for Metabolic Profiling	NSERC Research Tool and Instruments	\$45,000
Thermochemical Analysis of Materials	NSERC Research Tool and Instruments	\$43,297
Total		\$803,175

*including CRC and matching funds from the Ontario Ministry of Research and Innovation

2. THE FACULTY

UOIT has hired excellent faculty who are experts in their field and dedicated to training the next generation of scientists and professionals.

The research interests of the faculty cover a range of topics within Applied Bioscience (see section 2.1.1), with strong elements of interaction between individuals; this should provide an excellent environment for PhD student training.

There are initially 15 professors involved in the proposed program. Several additional appointments are planned in the near future.

UOIT has hired well-qualified and experienced senior laboratory instructors. Dr. Sylvie Bardin, (Senior lab Instructor, Biology), Dr. Richard Bartholomew (Senior Lab Instructor, Chemistry), Dr. Kevin Coulter (Senior Lab Instructor, Chemistry), Dr. Christopher Garside (Senior Lab Instructor, Biology) and Kimberley Nugent (Senior Lab Instructor Forensic Science) will be available to support graduate students in the Applied Bioscience PhD program.

2.1 List of current faculty by field

Table 2-1 lists the faculty members involved in the proposed PhD program and identifies their research field, gender, home unit, and supervisory privileges. There are no expected retirements within the next seven years. Section 2.1.1 lists a brief description of the research interests of each faculty member.

Three of the core faculty in the program are involved exclusively in the PhD program in Applied Bioscience (**Category 1**). An additional subset of faculty are involved in the teaching and supervision of other graduate programs (**Category 3**), and there are two faculty classified as “other” (**Category 5**).

Graduate faculty appointments, categories of graduate teaching and supervision privileges are described in Section 2 of the General Policies and Procedures for Graduate Studies at the UOIT (see Appendix B). *Curricula Vitae* for all faculty members listed in Table 2-1 are provided in Volume II of this submission.

Table 2-1: Faculty Members by Field							
Faculty Name, Rank and Program Participation ¹	M/F	Ret. Date	Home Unit ²	Supervisory Privileges	Fields		
					Biomolecular Science	Ecosystem Health	Forensic Bioscience
Category 1							
Jean-Paul Desaulniers – Assistant	M		FS	Full	X		
Andrea Kirkwood-Assistant	F		FS	Full		X	
Krisztina Paal - Assistant	F		FS	Full	X		
Category 3							
Dario Bonetta - Assistant	M		FS	Full	X		
Shari Forbes – Assistant	F		FS	Full			X
Sean Forrester- Assistant	M		FS	Full	X		
Brad Easton-Assistant	M		FS	Full	X		
Julia Green-Johnson – Associate	F		FS	Full	X		
Ayush Kumar-Assistant	M		FHS	Full	X		
Douglas Holdway – Full	M		FS	Full		X	
Holly Jones-Taggart – Assistant	F		FS/FHS	Full	X	X	
Otto Sanchez- Associate	M		FHS	Full		X	
Janice Strap-Assistant	F		FS	Full	X	X	X
Category 5							
Cecilia Hageman – Assistant (currently at UOIT on leave from Ontario Centre of Forensic Sciences)	F		FS	Full			X
David Carter – Assistant (Adjunct)	M		FS	Full			X

¹ Category 1: Tenured or tenure-track core faculty members whose graduate involvement is exclusively in the graduate program under review.

Category 2: Non-tenure-track core faculty members whose graduate involvement is exclusively in the graduate program under review.

Category 3: Tenured or tenure-track core faculty members who are involved in teaching and/or supervision in other graduate program(s) in addition to being a core member of the graduate program under review.

Category 4: Non-tenured or tenure-track core faculty members who are involved in teaching and/or supervision in other graduate program(s) in addition to being a core member of the graduate program under review.

Category 5: Other core faculty including emeritus and adjunct professors.

Category 6: Non-core faculty who participate in the teaching of graduate courses.

² FS: Faculty of Science

FHS: Faculty of Health Science

There are 15 faculty members involved in the program, 13 of whom are core faculty at UOIT. 10 are from the Faculty of Science, 1 has a cross-appointment in the Faculty of Science and the Faculty of Health Sciences, 2 are from the Faculty of Health Sciences, and 1 is an Adjunct faculty member from the University of Nebraska and currently co-supervises an MSc student at UOIT. The remaining member is currently at UOIT on leave of absence from the Ontario Centre of Forensic Sciences, and is expected to be appointed an Adjunct faculty member when she returns to the Centre.

Faculty commitment to graduate student training and collaboration

All members of the faculty are deeply committed to the training of graduate students. Our members actively participate in graduate course team-teaching, serve on numerous advisory committees, provide constructive feedback to students during committee meetings and symposia, and help our graduate students become an integral part of the university community.

Our faculty interact very closely with one another, which has created a strong sense of community. This provides a healthy research culture for graduate students. Because of the close physical proximity of the research laboratories and faculty offices, our graduate students often seek the assistance of their peers and other faculty members. This is a unique type of research culture that our faculty members will work hard to maintain.

2.1.1 Faculty Research Interests

The research interests of the current Faculty in the Applied Bioscience program cover a wide range of topics that will be of interest to graduate students and provide excellent PhD projects within the three fields of the program; these are listed below. Other specific areas of research within the fields of the proposed program will be expanded in the future as we hire additional core faculty.

Dr. Jean-Paul Desaulniers

Chemical modification of biomolecular scaffolds that influence gene expression

Dr. Andrea Kirkwood

Microbial interactions and their effects on ecosystems

Dr. Krisztina Paal

Protein chemistry, covalent protein modification, ligand protein binding interactions

Dr. Dario Bonetta

Control of cell wall synthesis and integrity in plants and microorganisms.

Dr. E. Bradley Easton

Biosensors based on Ceramic Carbon Electrodes (CCE)

Dr. Shari Forbes

Forensic taphonomy and the chemistry associated with decomposition, including applications to food

Dr. Sean Forrester

The molecular biology of neurotransmission in parasitic nematodes

Dr. Julia Green-Johnson

Immunomodulatory potential of prebiotics and probiotic bacteria

Dr. Douglas Holdway

Aquatic toxicology and the development of bioindicators

Dr. Holly Jones-Taggart

Cancer metastasis and oncologic therapeutic targets

Dr. Ayush Kumar

Multi drug resistance in bacteria

Dr. Otto Sanchez

Cancer biology, carcinogenesis, metastasis and experimental therapeutics

Dr. Janice Strap

Environmental genomics and microbiology

Dr. Cecilia Hageman

Forensic Biology

Dr. David Carter

Microbiology of decomposition

2.1.2 Planned Faculty Hiring

The Faculty of Science will enhance the program’s capacity to offer graduate student positions by hiring additional faculty in the various fields in the program. Future faculty hires will be chosen carefully to maintain a balance between the different fields and for their suitability to conduct research and train graduate students within this interdisciplinary program.

For July 2009, the Faculty of Science plans to hire a new Professor dedicated to the field of forensic bioscience. This new faculty member will hold a PhD in either biology or a related field, will have expertise in the field of forensic science, and will be expected to contribute towards the Forensic Bioscience field through teaching and research development. His/her expertise will naturally fit within the focus of the Forensic Bioscience field and will expand the research opportunities available for potential graduate students.

Future hiring plans include faculty with research interests in Bioinformatics (2010) and in the field of Ecosystem Health (2011). The former addition will not only make a valuable contribution to the Biomolecular Science field but will be of great support to the other fields. The latter addition will contribute to the Ecosystem Health field.

Table 2-2 shows the plan for new faculty hires in the Faculty of Science. The faculty hired will be at various levels to ensure a healthy balance between full professors, associate professors, and assistant professors across all fields.

Table 2-2: Planned Faculty Hiring for the Years 2009 to 2012					
			Number in Each Field		
Home Unit ¹	Year	Total Number	Biomolecular Science	Ecosystem Health	Forensic Bioscience
FS	2009/2010	1	0	0	1
FS	2010/2011	1	1	0	0
FS	2011/2012	1	0	1	0

¹ FS: Faculty of Science

2.2 Research Funding

Table 2.3 presents the research funding that faculty members have received to date since 2001. Note that the funding listed represents only confirmed funding and will increase as the faculty members successfully secure additional funding from a variety of sources for which applications are currently pending. Since the first faculty member started at UOIT in 2003, the funding in Table 2.2 for the years 2001 to 2003 includes funding secured by UOIT faculty members while at other institutions.

Table 2-3: Research Funding Awarded by Source and Year					
Year	Granting Councils¹	Other Peer Adjudicated²	Contracts³	Other⁴	Total
02-03	\$60,000	\$16,000	\$27,000	\$625	\$103,625
03-04	\$153,714	\$29,250		\$150,000	\$332,964
04-05	\$608,714	\$45,000	\$15,000	\$550,000	\$1,218,714
05-06	\$436,894	\$104,280		\$300,000	\$841,174
06-07	\$442,438	\$106,000		\$300,000	\$848,438
07-08	\$887,227	\$174,620	\$75,000	\$96,466	\$1,233,313
08-09	\$742,573	\$220,000		\$300,000	\$1,262,573
Total	\$3,413,160	\$695,150	\$147,824	\$1,698,341	\$5,954,475

¹NSERC Discovery, NSERC CRD, NSERC CRD/Dairy Farmers of Canada, Tier 1 CRC, Tier 2 CRC, CFI, CFI Leader's Opportunity Fund, Canadian Institute for Health Research.

² Australian Institute of Nuclear Science & Engineering, Australian Institute of Nuclear Science & Engineering, Ontario Research Fund (ORF), Agriculture and Agri-food Canada - Agricultural Bioproducts Innovation Program (ABIP), Nova Scotia Health Research Foundation, CFDR, NSHRF, Atlantic Innovation Fund (AIF), Ontario Ministry of Agriculture and Food (OMAF), EJLB Foundation, J.P. Bickell Foundation, Cottrell College Science Award, the Canadian Foundation for Dietetic Research, University of Western Australia Research Grant, University of Nebraska-Lincoln Research Council, Forensic Sciences Foundation, Inc., Alberta Conservation Association, Ontario Centres of Excellence Interact Grant, Advanced Food and Materials Network (AFMNET),

³EKM, Rosell, Galagen, Alberta Sustainable Resource Development, and Bell University Laboratories.

⁴Other funding sources include UOIT Start-up Funds and Matching funds, and AUFA.

Table 2-4 presents the total external research funding by field for 2001 to 2008. As with Table 2-3, the amounts in Table 2-4 represent only the confirmed funding and will increase as the faculty successfully secure funding from the various sources listed above and from industry.

Table 2-4: Total Research Funding by Field – 2001 to 2008					
Program Fields	Granting Councils	Other peer adjudicated	Contracts	Other	Total
Biomolecular Science	\$1,187,094	\$593,150	\$85,324	\$1,106,189	\$2,971,757
Ecosystem Health	\$1,679,066	\$65,000	\$62,500	\$434,314	\$2,240,880
Forensic Bioscience	\$547,000	\$37,000		\$157,838	\$741,838
TOTAL	\$3,413,160	\$695,150	\$147,824	\$1,698,341	\$5,954,475

As the table shows, faculty members have been actively applying for funding from the Natural Sciences and Engineering Research Council (NSERC) of Canada, the Canadian Foundation for Innovation (CFI), and the Ministry of Research and Innovation. In addition, the faculty have been active in securing research funding through industry contracts. As the number of faculty increases over the next few years, it is fully expected that the research funding will increase substantially.

2.3 Graduate supervision experience

Table 2-5 lists the completed and current numbers of graduate student and postdoctoral fellow supervisions by the program faculty members. The faculty include senior professors who have successfully graduated students, and also junior professors who have not yet graduated students. However, by the time the PhD program is launched (planned for 2009), seven of the faculty who have not yet graduated students, will have graduated MSc students from the first Applied Bioscience MSc cohort of 11 students. A number of the faculty involved in the proposed program currently hold adjunct appointments at other universities. Table 2-6 outlines these adjunct appointments.

Table 2-5: Completed and Current Numbers of Thesis and Post-doctoral Supervisions by Faculty Member						
	Completed			Current		
Member	Master’s	PhD	PDF	Master’s	PhD	PDF
Category 1						
Desaulniers	0	0	0	0	0	0
Kirkwood	0	0	0	0	0	0
Paal	0	0	0	1	0	0
Category 3						
Bonetta	0	0	0	3	0	0
Easton	0	0	0	3	0	1
Forbes	0	1	0	5	2	1
Forrester	0	0	0	4	1	0
Green-Johnson	2	0	1	3	0	0
Holdway	3	11	4	4	0	1
Jones-Taggart	0	0	0	1	0	0
Kumar	0	0	0	1	0	0
Sanchez	0	0	0	1	0	0
Strap	0	0	0	1	0	0
Category 5						
Hageman	0	0	0	0	0	0
Carter	0	0	0	2	0	0

Table 2-6: Adjunct Appointments	
Member	University – Department
David Carter	Lagos State University College of Medicine, Forensic Science and Medicine. Lagos, Nigeria - Program in Forensic Science and Medicine. University of Nebraska-Lincoln, USA - Department of Entomology
Sean Forrester	McGill University - Institute of Parasitology
Douglas Holdway	University of Prince Edward Island – Faculty of Science RMIT University, School of Applied Sciences, Melbourne, Australia
Janice Strap	University of Idaho - Department of Microbiology, Molecular Biology and Biochemistry

2.4 Junior Faculty Mentoring

All faculty members have many supports available to assist in launching and facilitating their research career and to assist in the training graduate students. Especially important for junior faculty, this support has come in terms of mentorship from senior faculty, the Dean of Science, the Office of Research Services, and the Office of Teaching and Learning.

In the first year of appointment, all junior faculty members have a reduced teaching load, which provides them with the time needed to apply for research funding and get their career off to a good start.

There have been two off-campus Science faculty retreats (in 2005 and in 2008), at which all Science faculty discussed a variety of topics related to research and the training of graduate students. These will be continued into the future.

At the conclusion of each semester, the Dean meets with each faculty member one-on-one to discuss progress in teaching and research over the previous semester. An annual performance review process provides feedback on each faculty member's performance over the preceding year, and an annual Goals and Objectives document serves to assist the faculty members in planning their research and other goals for the coming year.

A rigorous review is conducted for all core faculty members in the third year of their initial appointment, with the goal of providing feedback towards achieving success in the eventual award of tenure.

2.5 Current and recent teaching assignments

Table 2-7 shows the planned teaching loads for the 2008/2009, academic year. Table 2-8 shows the teaching assignments for the 2007/2008 academic year. Table 2-9 shows the teaching assignments for the 2006/2007 academic year and Table 2-10 shows the teaching assignments for the 2005/2006 academic year.

Table 2-7: Teaching Assignments for 2008/2009			
Faculty Member	Rank	Undergraduate¹	Graduate¹
Dario Bonetta	Assistant	BIOL1020 (Biology II) BIOL3050 (Developmental Biology) BIOL4430 (Directed Studies) CHEM4430 (Directed Studies) PHY4430 (Directed Studies) FSCI4430 (Directed Studies)	APBS6100 Advanced Cell and Molecular Biology
David Carter	Assistant (Adjunct)	FORS 120 Introduction to Forensic Science, University of Nebraska-Lincoln FORS 120L Introduction to Forensic Science Laboratory, University of Nebraska-Lincoln, USA FORS 485 Current Issues in Forensic Science, University of Nebraska-Lincoln, USA FORS 498 Field Forensic Science. University of Nebraska-Lincoln, USA	FORS 898 Field Forensic Science. University of Nebraska-Lincoln, USA
Jean-Paul Desaulniers	Assistant	CHEM 4050U, Environmental Chemistry BIOL 2040U, Biochemistry CHEM 3120U, Advanced Organic Chemistry	APBS6100 Advanced Cell and Molecular Biology (5%)
Brad Easton	Assistant	CHEM 4040U: Physical Chemistry (Surfaces and Colloids) CHEM 3040U: Introduction to Physical Chemistry CHEM 3540: Instrumental Analytical Chemistry II	MTSC 6010G: Physics and Chemistry of Materials
Shari Forbes	Assistant	FSCI 4020 Forensic Medicine FSCI 3040 Forensic Chemistry	APBS6400 Advanced Topics in Forensic Bioscience
Sean Forrester	Assistant	BIOL3020 (Principles of Pharmacology and Toxicology) BIOL2840 (Cell and Molecular Biology) BIOL1840 (Biology for Engineers)	APBS6010G (Research in Applied Bioscience) APBS6100 Advanced Cell and Molecular Biology (5%)
Julia Green-Johnson	Associate	On research leave	
Cecilia Hageman	Assistant	FSCI 3010 – Criminalistics I FSCI 3030 – Criminalistics II FSCI 3020 – Forensic Biology FSCI 4050 – Law for Forensic Scientists	
Douglas Holdway	Full	Biol 2010U Introductory Physiology Biol 4030U Advanced Topics in Environmental Toxicology	APBS6010G (Research in Applied Bioscience) (5%)
Holly Jones-Taggart	Assistant	On Leave	

Andrea Kirkwood	Assistant	BIOL 4010U Introduction to Environmental Research Methods BIOL 1020 Introductory Biology II BIOL 3620U Conservation Biology	
Ayush Kumar	Assistant	MLSC 3131 Clinical Microbiology II MLSC4400 Clinical Project I MLSC2131 Clinical Microbiology I MLSC4401 Clinical Project II	APBS6100 Advanced Cell and Molecular Biology (5%)
Krisztina Paal	Assistant	CHEM 2120U (Organic Chemistry) CHEM 3220U (Structure Determination of Organic Molecules) BIOL 4050U (Advanced Topics in Pharmaceutical Biotechnology)	APBS6010G (Research in Applied Bioscience) (5%) APBS 6300G (Advanced Topics in Biological Chemistry, 50%)
Otto Sanchez	Associate	HLSC 2460U Pathophysiology I HLSC 2461U Pathophysiology II	
Janice Strap	Assistant	BIOL 4060 (Functional Genomics and Proteomics) BIOL 4020 (Environmental Risk Characterization) BIOL 4070 (Advanced Biochemistry)	APBS6300G (Advanced Topics in Biological Chemistry); 50% APBS6100 Advanced Cell and Molecular Biology (5%) APBS6010G (Research in Applied Bioscience) (5%)

Table 2-8: Teaching Assignments for 2007/2008

Faculty Member	Rank	Undergraduate¹	Graduate¹
Dario Bonetta	Assistant	BIOL1020 (Biology II) BIOL3050 (Developmental Biology) BIOL4430 (Directed Studies) CHEM4430 (Directed Studies) PHY4430 (Directed Studies)	APBS6010G (Research in Applied Bioscience) (5%) APBS6100 Advanced Cell and Molecular Biology (5%)
David Carter	Assistant (Adjunct)	FORS 120 Introduction to Forensic Science, University of Nebraska-Lincoln FORS 120L Introduction to Forensic Science Laboratory, University of Nebraska-Lincoln, USA	ENTO 896 Forensic Science and Criminal Investigation, University of Nebraska-Lincoln, USA
Jean-Paul Desaulniers	Assistant		
Brad Easton	Assistant	CHEM 4040U: Physical Chemistry (Surfaces and Colloids) CHEM 3040U: Introduction to Physical Chemistry CHEM 3540: Instrumental Analytical Chemistry II	MTSC 6010G: Physics and Chemistry of Materials (50%) MTSC 6140: Experimental Techniques in Materials Characterization (10%)
Shari Forbes	Assistant	CHEM 3530 Instrumental Analytical Chemistry FSCI 3040 Forensic Chemistry	APBS6010G (Research in Applied Bioscience) (5%)
Sean Forrester	Assistant	BIOL3020 (Principles of Pharmacology and Toxicology) BIOL2840 (Cell and Molecular Biology) BIOL1840 (Biology for Engineers)	APBS6010G (Research in Applied Bioscience) APBS6100G (Advanced Cell and Molecular Biology)

Julia Green-Johnson	Associate	BIOL 3030U (Microbiology and Immunology) BIOL 2830U (001 regular; 002 online): Microbiology for Health Science MLSC 2131 (Clinical Microbiology 1) MLSC 3130 (Clinical Microbiology) MLSC 3300 (Clinical Practicum 50%)	APBS6010G (Research in Applied Bioscience) (5%)
Cecilia Hageman	Assistant	FSCI 1010 – Intro Forensic Science (50 %) FSCI 2010 – Crime Scene Science (50 %) FSCI 3010 – Criminalistics I (50%) FSCI 3030 – Criminalistics II (50%) FSCI 3020 – Forensic Biology BIOL 4040 – Applied Molecular Biology	
Douglas Holdway	Full	BIOL 2010U Introductory Physiology BIOL 4030U Advanced Topics in Environmental Toxicology	APBS6010G (Research in Applied Bioscience) (5%)
Holly Jones-Taggart	Assistant	BIOL 2030 – Cell Biology, BIOL 2020 – Genetics and Molecular Biology, HLSC 0880 – Science Bridge	APBS6010G (Research in Applied Bioscience) (5%) APBS6100 Advanced Cell and Molecular Biology (5%)
Andrea Kirkwood	Assistant	BIOL 307 Ecology and Human Affairs, University of Calgary	
Ayush Kumar	Assistant	MLSC2111U Clinical Biochemistry I MLSC3110U Clinical Biochemistry II MLSC3111U Clinical Biochemistry II	APBS6100 Advanced Cell and Molecular Biology (5%)
Krisztina Paal	Assistant	CHEM 2020U (Introduction to Organic Chemistry) CHEM 2120U (Organic Chemistry) CHEM 3220U (Structure Determination of Organic Molecules) BIOL 4050U (Advanced Topics in Pharmaceutical Biotechnology)	APBS 6300G (Advanced Topics in Biological Chemistry, 50%)
Otto Sanchez	Associate	HLSC2460U Pathophysiology I HLSC2461U Pathophysiology II HLSC3462U Adv Pathophysiology	APBS6200G Environmental Determinants of Health
Janice Strap	Assistant	BIOL 4060 (Functional Genomics and Proteomics); BIOL 4020 (Environmental Risk Characterization) BIOL 4070 (Advanced Biochemistry)	APBS6300G (Advanced Topics in Biological Chemistry) (50%) APBS6010G (Research in Applied Bioscience) (5%) APBS6100 Advanced Cell and Molecular Biology (5%)

Table 2-9: Teaching Assignments for 2006/2007 at UOIT			
Faculty Member	Rank	Undergraduate¹	Graduate¹
Dario Bonetta	Assistant	BIOL1020 (Biology II) BIOL3050 (Developmental Biology) BIOL4430 (Directed Studies) CHEM4430 (Directed Studies) PHY4430 (Directed Studies)	
David Carter	Assistant (Adjunct)	ENTO 496 Forensic Science, University of Nebraska-Lincoln, USA ENTO 496L Practical Forensic Science, University of Nebraska-Lincoln, USA	ENTO 896 Forensic Science and Criminal Investigation, University of Nebraska-Lincoln, USA
Jean-Paul Desaulniers	Assistant		
Brad Easton	Assistant	CHEM 4040U: Physical Chemistry (Surfaces and Colloids) CHEM 3040U: Introduction to Physical Chemistry CHEM 4060U: Chemical and Molecular Spectroscopy CHEM 1800U: General Chemistry for Engineers	
Shari Forbes	Assistant	CHEM 3530/3540 Instrumental Analytical Chemistry I & II FSCI 1010 Introductory Forensic Science FSCI 2010 Crime Scene Science	
Sean Forrester	Assistant	BIOL3020 (Principles of Pharmacology and Toxicology) BIOL2840 (Cell and Molecular Biology) BIOL1840 (Biology for Engineers) ENVS1000 (Environmental Science) 50% BIOL4050 (Advanced Topics in Pharmaceutical Biotechnology)	
Julia Green-Johnson	Associate	BIOL 3030U (Microbiology and Immunology) BIOL 2830U Microbiology for Health Science MLSC 3130 (Clinical Microbiology) BIOL 2030U Cell Biology MLSC 3300 (Clinical Practicum: 50%)	
Cecilia Hageman	Assistant		
Douglas Holdway	Full	Biol 2010U Introductory Physiology Biol 4030U Advanced Topics in Environmental Toxicology	
Holly Jones-Taggart	Assistant	HLSC 0880 – Science Bridge HLSC 1200 – Anatomy & Physiology I HLSC 1201 – Anatomy & Physiology II BIOL 2020 – Genetics & Molecular Biology	
Andrea Kirkwood	Assistant		
Ayush Kumar	Assistant		
Krisztina Paal	Assistant	CHEM 1010U (Chemistry I) CHEM 2020U (Introduction to Organic Chemistry) CHEM 2120U (Organic Chemistry) CHEM 3220U (Structure Determination of Organic Molecules)	

Otto Sanchez	Associate	HLSC2460U Pathophysiology I HLSC2461U Pathophysiology II HLSC3462U Adv Pathophysiology HLSC2202U Comprehensive A&P	Lecturer, CHL 5416H Environmental Epidemiology (University of Toronto)
Janice Strap	Assistant	BIOL 4060 (Functional Genomics and Proteomics) BIOL 4020 (Environmental Risk Characterization) BIOL 4070 (Advanced Biochemistry) BIOL 1020 (Biology II)	

Table 2-10: Teaching Assignments for 2005/2006 at UOIT

Faculty Member	Rank	Undergraduate¹	Graduate¹
Dario Bonetta	Assistant	BIOL1020 (Biology II) BIOL3050 (Developmental Biology)	
David Carter	Assistant (Adjunct)		ENTO 896 Forensic Science and Criminal Investigation, University of Nebraska- Lincoln, USA
Jean-Paul Desaulniers	Assistant	Chemistry 215, Organic Chemistry II (Winter 2006) University of Michigan, Ann Arbor, MI 48109	
Brad Easton	Assistant		
Shari Forbes	Assistant	CHEM 3530/3540 Instrumental Analytical Chemistry I & II FSCI 1010 Introductory Forensic Science	
Sean Forrester	Assistant	BIOL3020 (Principles of Pharmacology and Toxicology) 50% BIOL2840 (Cell and Molecular Biology) BIOL1840 (Biology for Engineers) BIOL1010 (Biology I) 50% ENVS1000 (Environmental Science) 50%	
Julia Green-Johnson	Associate	Biochemistry for Health Science (BIOL 1810U) (2005) BIOL 2030U Cell Biology BIOL 3030U Microbiology and Immunology BIOL 2830 U Microbiology for Health Science	
Cecilia Hageman	Assistant		
Douglas Holdway	Full	ENVS 1000U Environmental Science (co-taught 50%) Biol 2010U Introductory Physiology Biol 3020U Principles of Pharmacology & Toxicology (co-taught 50%)	
Holly Jones-Taggart	Assistant	HLSC 0880 – Science Bridge HLSC 1200 – Anatomy & Physiology I HLSC 1201 – Anatomy & Physiology II BIOL 2020 – Genetics & Molecular Biology	
Andrea Kirkwood	Assistant		
Ayush Kumar	Assistant		

Krisztina Paal	Assistant	CHEM 1010U (Chemistry I, 2 sections) CHEM 2120U (Organic Chemistry) CHEM 1800U (Chemistry for Engineers) SCIE 1910U (Science in Context, 8%)	
Otto Sanchez	Associate	HLSC2460U & HLSC2461U	CHL5416H
Janice Strap	Assistant		

¹In addition to the above teaching assignments many faculty supervise undergraduate thesis students, provide mentoring for undergraduate thesis projects and participate in team teaching for the following undergraduate courses:

SCIE 1910U (Science in Context)

BIOL 4050U (Advanced Topics in Pharmaceutical Biotechnology)

BIOL 4430U (Directed Studies in Biology)

2.6 Commitment of faculty members from other graduate programs and/or other institutions

Three members of the faculty are involved exclusively in the Applied Bioscience PhD program. The remaining faculty are involved in two or more graduate programs. However, Drs. Bonetta, Green-Johnson, Forrester, Kumar, Jones-Taggart, Sanchez, Forbes, Holdway, and Strap, who have commitments with other programs, are primarily committed to the Applied Bioscience graduate program and all are currently supervising graduate students in the MSc program.

Dr. Hageman is at UOIT on a leave of absence from the Ontario Centre of Forensic Sciences during 2007-2009, and is involved in the undergraduate Forensic Science program. At the conclusion of her term, Dr. Hageman will become an Adjunct Professor with UOIT and will contribute to the proposed Forensic Bioscience field.

Dr. David Carter, from the University of Nebraska, is an Adjunct professor with the Faculty of Science and currently co-supervises a student in the Applied Bioscience MSc program.

Dr. Sean Forrester is an Adjunct professor with the Institute of Parasitology, McGill University and co-supervises a PhD student there.

3. PHYSICAL AND FINANCIAL RESOURCES

3.1 Laboratory facilities

Faculty in the Applied Bioscience program have been provided with excellent laboratory facilities, competitive start up funding to equip their labs with the technology that is essential for their research, and have been successful in obtaining external infrastructure funding. In short, PhD candidates will have the tools at hand to successfully complete their program.

3.1.1 Research Laboratories

Within the research wing of the Faculty of Science there are ten, 60 sq/m research laboratories. These laboratories generally contain two centre islands that will accommodate 4 graduate students comfortably. Researchers conducting cell biology research have been provided with a level 2 biosafety hood. Our researchers have been provided with excellent start-up and matching funds to equip their respective laboratories with the latest technology in their fields. In addition, several members have been successful in achieving Canada Foundation for Innovation funding and NSERC Research Tools and Instruments grants. The following are the details of the laboratory designations:

UA4520: Forrester (Main Lab)
UA4410: Forrester (Animal Room)
UA4540: Kumar (Main Lab)
UA4480: Green-Johnson (Main Lab)
UA4460: Bonetta (Main Lab)
UA4440: Jones-Taggart/Sanchez (Main Lab)
UA4680: Forbes/ Hageman (Main Lab)
UA4660: Paal/Desaulniers (Main Lab)
UA4640: Strap/Kirkwood (Main Lab)
UA4470: Strap (Microbiology Room)
UA4420: Easton (Main Lab)
UAB422: Holdway (Dry Lab)
UAB410: Holdway (Wet Lab/Aquatic Toxicology)

3.1.2 Equipment Room and Communal space

The research laboratory wing of the Faculty of Science contains a common equipment room, a shared autoclave room, a dark room equipped with a gel documentation system and film developing equipment, and a walk-in 4°C cold room. Research that requires the use of radioisotopes will have access to a specially designed and regulated radioisotope room. In addition, the individual research laboratories are large enough to house other large equipment items that can be shared by other researchers.

UA4406: Equipment Room
UA4405: Autoclave Room
UA4404: Dark Room
UA4402: Radioisotope Room
UA4403: Cold room

3.1.3 Aquatic Toxicology Facility

Those students interested in aquatic toxicology will have access to the 1390 sq/ft web lab, housing 12 large (1000 L) cold-water tanks, and 200 small (100 x 100 L and 100 x 10L) warm-water tanks for aquatic organisms.

3.1.4 Teaching Laboratories

The Faculty of Science teaching facilities have been equipped with the latest technology needed for research in biology (building UB) and chemistry (building UA2). These have been made available to our MSc students and will be available to our PhD students.

Some of the equipment includes:

- Microscopes (fluorescent, compound, inverted and stereo, comparison microscope and comparison microscope (capable of digital imaging)
- Molecular Biology equipment (gel electrophoresis, vacuum blotter, thermal cyclers, gel documentation system)
- Histology equipment (microtome, cryotome)
- Microplate Reader, with fluorescence, luminescence and spectrophotometric capabilities
- UV and white light transilluminators
- Centrifuges, including an ultracentrifuge and high speed
- Tissue culture facility, autoclaves
- Genetic analyzer/DNA Sequencer
- French press
- X-ray film processor
- Freeze-drier
- Electroporation system
- CO₂ and general incubators
- Biosafety cabinet level II
- 4 gas chromatographs (with flame ionization detection)
- FT-IR spectrometers
- 400 MHz NMR spectrometer
- HPLC with photodiode array detector
- Ion Chromatograph
- LC-MS and GC-MS, with electron capture and flame ionization detection capabilities
- Atomic Absorption Spectrometers, with a graphite furnace accessory
- Inductively Coupled Plasma Emission Spectrometer
- UV-Visible spectrophotometers, with thermostatted cells
- fluorimeter, with thermostatted cells

3.1.5 Science Stores

The Faculty of Science Stores maintains a minimum stock level of scientific consumable supplies required in the teaching and research laboratories. The Storesperson acts as a purchasing agent for the Faculty of Science, ensures that laboratory consumables are on-hand and available immediately when required, and also acts as the focal point for the receipt, storage and disposal of controlled substances.

3.2 Computer Facilities

Every graduate student at UOIT will have wireless access to library resources, email, and the internet, in addition to other online services within UOIT's Mobile Learning Environment. Individual supervisors will provide computer facilities for their PhD students. In addition, UOIT has 240 desktop computers available to students in the Learning Commons and library.

Graduate students will have access to the following facilities:

- SHARCNET (Shared Hierarchical Academic Research Computing Network) facilities (both within and outside UOIT) for high-performance computing
- AccessGrid videoconferencing technology (in conjunction with AccessGrid) for collaboration with colleagues at other institutions within the SHARCNET institutions and worldwide
- A CFI-funded Computational Science and Visualization Laboratory for computer simulation and computations
- A Linux Xeon-based Beowulf computer cluster
- A HP 7620 general-purpose computer

Since UOIT's founding in 2003, UOIT faculty members and their research groups have had access to very significant computing capabilities via its membership in the SHARCNET (Shared Hierarchical Academic Research Computing Network) high-performance computing consortium of 17 universities, colleges and research institutes geographically distributed across Ontario. Large computational nodes are located at McMaster University, the University of Western Ontario and the University of Guelph, and smaller local nodes are located at other institutions. SHARCNET was awarded a \$48M grant in 2004 to upgrade its facilities. Access to the SHARCNET facility by UOIT faculty and graduate students provides them with the opportunity to study problems that would otherwise be computationally prohibitive.

As part of its mission, UOIT seeks to advance the highest quality of learning, teaching, and professional practice in a technology-enabled environment. All faculty and graduate students are provided with an account that gives them access to electronic mail facilities, the internet, the University's course management system (WebCT), library resources, etc. In addition, students can easily access information about a variety of student services and non-academic resources available to them.

3.3 Space

The Faculty of Science is located in UOIT's Science Building (UA1). This building first opened in September 2003 and was extended in September 2004; it contains office space for faculty and graduate students, in addition to research lab space. The current total research space allocated to Science is 1,015 m². An additional 152 m² has been allocated for graduate student offices and 302 m² for core faculty offices.

Faculty members have private offices with telephone and computer lines to the University facilities. Graduate students have access to shared office facilities with wireless and wired internet connections and individual desks within research labs. All offices and research spaces are wired for access to UOIT's network. In addition, wireless access is available throughout the Science Building as well as the library and other spaces on campus.

Faculty office space averages 13 m² and faculty research space averages ~60 m².

3.4 Financial support of graduate students

Every PhD student offered admission to a UOIT graduate program in the Faculty of Science should be able to complete his/her program regardless of his/her financial status.

The minimal support for PhD students will be approximately \$18,000 per year, with funding coming from a variety of sources, including the following:

- UOIT Scholarships/Bursaries for domestic students and scholarships for excellent international students
- External Awards – These include NSERC postgraduate awards and provincial awards.
- Teaching Assistantships – Teaching assistantships of \$8400 will be available to PhD students in the APBS program. For the current undergraduate student intake, the Faculty of Science offers sufficient biology and chemistry laboratory/tutorial sessions to support 49 graduate student teaching assistantships. Of these, 38 will be available to graduate students in the APBS program.
- Research Assistantships/Awards – Additional support from individual supervisors will be available to students. Faculty members have been successful in obtaining research funding from various sources, including the NSERC Discovery Grant program, the Canada Research Chairs program, the NSERC Collaborative Research and Development Grant program, and industry. In addition, the competitive start up packages provided by the Faculties of Science and Health Science ensures that new faculty can offer graduate student positions immediately on their appointment.
- Provincial and Federal Loan Programs are also available.

3.5 Library resources

The University of Ontario Institute of Technology Library enriches the research, learning and teaching carried out by the university through exceptional information services and facilities to support all academic programs.

The construction of a new, state-of-the-art library for the University of Ontario Institute of Technology was completed in the fall of 2004. Designed by internationally renowned Diamond and Schmitt Architects Incorporated, the 75,000-square-foot library serves students, faculty, and staff. The four-storey, \$20.7-million library houses individual and collaborative learning spaces including both group study rooms and a quiet graduate study zone, research workstations, electronic classrooms, a reading room and periodicals collection.

Library collections and accessibility are discussed in detail in Appendix A. Paper copy and electronic resources supporting the PhD in Applied Bioscience are highlighted. Amongst the key databases are American Society of Microbiology (ASM), Annual Reviews – Biomedical Sciences, Bio One I & II, and Biosis Previews. While most databases offer indexing and/or full text for periodicals (magazines, journals, newspapers), many also offer full text for technical reports, conference proceedings and standards.

Students, staff and faculty have access to library resources using their wireless laptops, anytime from anywhere. Both digital resources and complementary print collections are available and librarians provide students with the skills needed to navigate effectively through the information environment. The Library also offers free interlibrary loan service to the UOIT population.

A more detailed presentation on the library resources is listed in Appendix A: Library Submission.

4. PROGRAM REGULATIONS AND COURSES

4.1 The intellectual development and the educational experience of the student

4.1.1 University Vision, Mission and Values

The mission and values of the university provide the foundation for all activities and are reflected in the plans for the intellectual development and educational experience of graduate students in the Faculty of Science.

Vision:

- The University of Ontario Institute of Technology is an innovative and market-oriented institution, pursuing inquiry, discovery and application through excellence in teaching and learning, value-added research and vibrant student life.

Mission:

- Provide career-oriented undergraduate and graduate university programs with a primary focus on those programs that are innovative and responsive to the needs of students and employers.
- Advance the highest quality of research.
- Advance the highest quality of learning, teaching, and professional practice in a technologically enabled environment.
- Contribute to the advancement of Ontario and Canada in the global context.
- Foster a fulfilling student experience and a rewarding educational (work) environment.
- Offer programs with a view to creating opportunities for college graduates to complete a university degree.

Values:

- Integrity and respect.
- We will treat each other with dignity, including those with challenges.
- Honesty and accountability.
- Our actions reflect our values, and we are accountable for both.
- Intellectual rigour.
- We strive for excellence and challenge convention

4.1.2 The Faculty of Science

Faculty Mission

The Faculty of Science at UOIT is committed to excellence and innovation in technology enhanced teaching and in interdisciplinary teaching and research relevant to the needs of society and the environment.

We are dedicated to creating and sharing scientific knowledge, and to infusing the thrill of discovery and inspiring vision, determination, independence, critical thinking, and integrity in our students, thereby preparing them for rewarding careers as the next generation of highly skilled scientists and professionals.

Innovative programs emphasize the skills and knowledge that students require for careers in Science. All our undergraduate programs adhere to our interdisciplinary ethos and are built on our common first year program of study. Over the course of a science career, baseline knowledge will continuously evolve, but the scientific foundations – the analytical and problem solving skills that form the bedrock of science and of our programs – provide the tools to adapt to future developments in any field of scientific endeavour.

4.1.3 Interdisciplinary Approach to Education

To facilitate interdisciplinary research, the UOIT academic units are not organized by departments but instead remain as cohesive faculties. In the Faculty of Science, biologists interact closely with chemists to tackle important research questions; additional interactions occur with physicists, mathematicians and computer scientists. The unique institutional organization allows researchers and graduate students to establish research collaborations across disciplines. This provides students with a greater breadth of knowledge and unique opportunities to gain experience with a variety of scientific techniques.

The unique educational experience of students in this program will be formed by the following:

Interdisciplinary Courses

These courses are team-taught by biologists and chemists and are intended to expose students to a range of research fields within the applied bioscience network. In addition, several courses will have a mix of students from biology and chemistry backgrounds who will take part in collaborative projects.

Interdisciplinary Advisory Committees

Advisory committees are comprised of biologists and chemists, who will guide students throughout their degree

Collaborative Research

Research projects involving biology and chemistry faculty are currently under way. This activity is expected to increase once a PhD program is implemented.

Seminar Series

This weekly seminar series in Applied Bioscience will be mandatory for all PhD students. Invited speakers will come from a variety of backgrounds and will be encouraged to provide seminars suitable for an interdisciplinary audience. Students in the program will also give a seminar each year, which not only develops communication skills but further exposes our graduate students to interdisciplinary research.

Intensive Research Project

The foundation of the PhD degree is an independent research project that provides the student with the appropriate depth of knowledge. In addition, the thesis which results from the program must make a significant contribution to new knowledge.

Presentation of Research

All students are expected to present their research at national and international conferences and symposia. Since students will be considered ambassadors of the University and Faculty of Science, the presented research must be of the highest quality that is expected for PhD-level research.

4.1.4 Curriculum and Program Requirements

Program learning outcomes

Graduates of the Applied Bioscience PhD program shall be able to:

- 1) Demonstrate specialized knowledge and understanding of essential facts, concepts, principles, and theories in a specific area of advanced study.
- 2) Develop a competency in independent thought, enquiry and problem solving
- 3) Apply the knowledge gained in their studies to specific research questions
- 4) Demonstrate a critical awareness of current problems and new knowledge about a particular area of applied bioscience research
- 5) Interpret current research trends and suggest future research avenues within the fields of applied bioscience
- 6) Understand the connections between biology, chemistry, and acknowledge the value of diverse interpretations, methods, and disciplines in solving research problems
- 7) Be able to work in research teams that span a range of expertise in chemistry and biology, and work collaboratively with scientists in other disciplines
- 8) Identify practical implications of applied bioscience research for both the scientific community and the general public

- 9) Use established techniques of research and enquiry to formulate specific research questions, propose and test hypotheses, determine methodologies, and interpret results
- 10) Recognize and be guided by social, professional, and ethical expectations and concerns involved in advanced education and research.
- 11) Demonstrate safe and competent use of laboratory tools, equipment and techniques, including cutting-edge technology in Biology and Chemistry, to support research activities
- 12) Communicate conclusions of their research clearly and effectively to both specialist and non-specialist audiences
- 13) Act independently to plan and implement activities to advance their knowledge and skills
- 14) Demonstrate a breadth of knowledge in areas related to biology, chemistry and health
- 15) Generate an original piece of research in the form of a dissertation that contributes new knowledge to a field of research
- 16) Build on a foundation that fosters life-long learning and scholarship

The objectives of the PhD program are achieved through a combination of advanced course work, independent research, mandatory research seminars, the publication of research in peer-reviewed journals, and a comprehensive research dissertation. The research dissertation must comprise a new contribution to the field of study.

4.1.5 The Fields

The PhD program comprises the following fields:

- Biomolecular Science
- Ecosystem Health
- Forensic Bioscience

Biomolecular Science

Biomolecular Science focuses on the use of molecular and cellular tools to investigate mechanisms of cell function; new approaches for combating infectious organisms and disease; biomaterials and bio-based products; drug discovery, drug formulation and site-specific drug delivery; the mechanisms of action of pharmaceuticals at the cellular and molecular level; and the molecular and cellular aspects of the immune system in response to pathogenic and non-pathogenic micro organisms.

This field has 3 overall objectives:

- 1) Understand the cellular components of organisms and the molecular mechanisms of cell function through the use of tools such as molecular biology, biotechnology and genomics
- 2) Understand how changes in cellular physiology cause disease
- 3) Understand the interaction between molecules that have either a pharmaceutical relevance or cause immune system modulation.

Ecosystem Health

The field of Ecosystem Health focuses on determining the implications of external toxicants on the health of ecosystems, discovering indicators for environmental problems and developing methods to lessen human exposure to toxicants. In addition, researchers in the program will investigate related areas such as environmental microbiology, the pathophysiology of environmental disorders and the micro and macro environmental factors causing cancer. Finally, research in the field will focus on specific environmental problems and develop solutions that will benefit Canadians.

This field has 3 overall objectives:

- 1) Develop methods to detect environmental toxicants and examine the impacts of these toxicants on the ecosystem
- 2) Determine the implications of environmental problems on ecosystem health and the development of disease
- 3) Develop solutions to environmental problems such as bioremediation and alternative energy sources

Forensic Bioscience

Forensic bioscience is a new and distinct field that combines special content areas of biological and chemical sciences with training in legal and forensic investigations. Homeland security, bioterrorism, and global pandemics are but three examples of areas in which skilled forensic bioscience workers will be in high demand for the foreseeable future. For many scientists, the field of forensic bioscience crystallizes an area of research at the interface between Biology, Chemistry, Forensic Science, and Legal Studies. Currently there are very few academically trained “experts” in the field, and as a result this field will fill the demand for trained professionals who are exposed to state-of-the-art technology, theory and practice in forensic bioscience.

This field has three overall objectives:

- 1) Investigate and contribute towards new developments in biotechnology and bioanalytical techniques associated with forensic analysis
- 2) Develop solutions to technological challenges in forensic bioscience, including large scale evidence throughput, robotics and quality assurance/quality control
- 3) Understand the issues that impact the worlds of the legal system user and scientific provider of forensic evidence

4.1.6 Learning community

UOIT is one of the few universities that from its inception had a mandate to become a research intensive university with high-quality career oriented undergraduate programs. In light of this, the Faculty of Science is committed to hiring faculty who are not only excellent researchers but excellent teachers. This has provided a rich environment for graduate student learning at any level. The way we have designed our courses allows students to learn, discuss and be challenged by all faculty in the program. This not only enhances learning but reinforces the program as a collaborative unit of faculty and students from different backgrounds and perspectives.

The PhD program will exemplify our commitment to interdisciplinary and collaborative learning. The students in this program will have the opportunity to engage each other at many different levels. For example, in courses, biology and chemistry students will collaborate on projects and exchange ideas. In addition, all of the students regardless of field conduct research in a common research wing of the Faculty of Science, which will facilitate interdisciplinary interaction. The graduate students and the majority of faculty members in the programs are located on the 4th floor of the Science building. Graduate students will share office space in a central graduate student office area.

The Colloquium Series in the Faculty of Science, initiated in fall, 2004, emphasizes interdisciplinary research and is an ongoing focal point for research interaction among faculty, postdoctoral fellows and research visitors.

The Applied Bioscience MSc program currently holds an annual symposium series where students provide a yearly update on their research and are evaluated by faculty in the program. This is an additional avenue for students to receive regular feedback.

The proposed PhD program will initiate a mandatory weekly seminar series where students will give seminars as well as listen to presentations by invited guests.

The students will become an important part of the academic community where they will interact closely with graduate faculty, senior laboratory instructors, teaching assistants and administrative staff. There will be a special graduate program and teaching assistant orientation which will function to both welcome the students to the community and provide clear guidance on the program regulations and expectations. Special social events will also help bring our students into the university community.

4.1.7 Scholarly activities

Many of our courses, outlined in Section 4.3, require students to lead discussions and present papers on various research topics. This provides an environment where students can engage each other, participate in discussions, and exchange ideas. In addition, in our courses students are required to evaluate peer reviewed articles and suggest future research that can emerge from these publications.

Faculty in the Applied Bioscience PhD Program will hold regular joint interdisciplinary laboratory meetings which will further encourage the exchange of ideas between faculty and students from different disciplines.

There will be many opportunities for students to present research and improve their communication skills. All students in the Applied Bioscience will be encouraged to attend scientific meetings and symposiums. In addition, they will present research in courses, yearly seminars, and a regular Applied Bioscience symposium.

It is expected that students who successfully complete the PhD program will publish their research findings in peer-reviewed journals related to their field.

Funded by generous support from Purdue-Pharma, the Faculty of Science hosts a Purdue-Pharma Visiting Lecture series, launched in April, 2008. At this annual public event, a distinguished visitor speaks on any of a broad range of research topics of critical importance to the health of Canadians. This event provides the opportunity for graduate students to be exposed to forefront research in areas related to their studies.

The Faculty of Science and its graduate students are committed to youth and public outreach, and our graduate students regularly engage the public on scientific research and the importance of science in society.

4.2 Program regulations

The PhD program is governed by UOIT's Graduate Studies Policies, details of which can be found in Appendix B.

Additional policies are defined by the Faculty of Science as outlined below.

4.2.1 Part-time studies

There will be no part-time studies in the program

4.2.2 Admission requirements

The minimum admission requirement for the Applied Bioscience PhD program is completion of an MSc level degree in Biology, Chemistry or related area at a Canadian university or its equivalent, with a minimum of a B+ average.

Under exceptional circumstances, Applied Bioscience MSc students may transfer directly to the PhD program after completing one academic year in the MSc program if the following conditions are met: 1) completion of a full master's program of course work (three courses worth a total of 9 credits) with at least an A- average, 2) strong evidence of research ability, and 3) approval of the direct transfer by the thesis supervisor(s) and the advisory committee. The transfer must also be approved by the Graduate Programs Director.

Prior to being accepted into the program, PhD students must find a professor who specializes in the applicant's desired area of research and is willing to act as a supervisor.

4.2.3 Language requirements

All applicants are required to give evidence of their oral and written proficiency in English. This requirement can be satisfied with one of the following criteria:

- i) The student's mother tongue or first language is English
- ii) The student has studied full-time for at least three years (or equivalent in part-time studies) in a secondary school or university where the language of instruction and examination was English; or
- iii) The student has achieved the required proficiency on one of the tests in English language acceptable to the University of Ontario Institute of Technology (see below)

Recommended Scores - English Language Proficiency Tests (higher scores may be required)

- TOEFL (computer based) 220
- TOEFL (paper based) 560
- IELTS 7
- MELAB 85
- CAEL 60

4.2.4 Degree requirements

For the PhD program, a student must complete three courses (one of which will be a special topics course specific to their field) and a dissertation (APBS 7070: Dissertation). In addition to the three courses and dissertation, the student must successfully complete the research seminar course (APBS 7050G) and a comprehensive thesis proposal defence and qualifying exam (APBS 7040). The latter is completed within 18 months of entry into the PhD program and consists of a written research proposal and an oral exam. Finally, students must make satisfactory progress in their research (evaluated yearly) and enrol each year in APBS 7060.

Students who transfer directly from the Applied Bioscience MSc program into the PhD program, must complete the seminar course, the special topics course, the thesis proposal/qualifying exam and the dissertation.

4.2.5. Supervisory Committee

The Supervisory Committee consists of the student's research supervisor(s) and at least two other faculty members, one of whom may be outside the university, but he or she must have sufficient expertise in the subject area. The Chair, who may be someone other than the student's research supervisor, is appointed by the Graduate Program Director of the student's home faculty. The Supervisory Committee must be established before the end of the first term of study.

4.2.6 PhD Qualifying Examinations

Each student in the doctoral program is required to prepare a written research proposal and pass an oral qualifying exam. Students are expected to successfully complete the oral qualifying exam within 18 months of their initial registration in the program. The purpose of the examination is to determine whether the candidate has the appropriate background knowledge and expertise to undertake a dissertation in the selected field of study.

An Examination Committee will conduct the examination. The goal of the examining committee is to determine that the candidate has sufficient understanding of the background information, rationale, and methodological issues to perform and analyze his/her research topic.

Examination Committee Structure

- The student's Supervisory Committee (the student's Supervisory Committee must be established prior to the oral examination).
- Graduate Program Director (or delegate) as Chair. The Chair cannot be a member of the student's Supervisory Committee.

All members of the Committee are voting members.

It is the candidate's responsibility to contact members of the Examination Committee to ascertain the breadth of material to be examined (e.g. defined by textbooks, reading list or course work).

Procedure for the Qualifying Exam

- The purpose of the exam is to focus on the proposed research of the candidate, and associated background knowledge needed to conduct the proposed research.
- A written dissertation proposal must be distributed to the Examination Committee 30 days prior to the examination date.
- An oral presentation of the PhD research plan (preferably 20 minutes and not more than 30 minutes).
- The thesis proposal and oral presentation will also include any progress made in the student research project.
- Open questioning of the candidate by the Examination Committee to ascertain the capabilities of the candidate to carry out the proposed research (no longer than 90 minutes).

At the end of the oral exam, the Chair will ask the candidate to leave the room, after which the Examining Committee will meet in a closed session. The Examining Committee will deliberate and make an evaluation of satisfactory or unsatisfactory. A written report will be prepared by the Chair, signed by all Committee members and submitted to the Office of Graduate Studies, with copies to the members of the Examination Committee. The results will be communicated to the student by the Chair of the Committee.

Explanation of Outcomes:

A judgment of satisfactory will allow the student to proceed with his/her PhD studies.

If the judgment is unsatisfactory, the student will be required to re-take the examination within 4 months. For a second exam, the examining committee must contain an additional second member of the Graduate Faculty in the program.

A judgment of satisfactory in a second examination will allow the student to proceed with his/her PhD studies. A second unsatisfactory judgment will result in a grade of FAIL and the student will be required to withdraw from the PhD program.

4.2.7 Progress reports

After completing the first year of their program and in each year thereafter, PhD students must complete a progress report that outlines what they have done in the previous year and outline their objectives for the following year. This progress report must be submitted to the student's Supervisory Committee. Permission to continue in the program will be based on a satisfactory report as determined by the student's Supervisory Committee.

4.2.8 Thesis examination procedures

Thesis procedures and evaluations will be conducted in accordance with the guidelines outlined in Section 6 of the General Policies and Procedures for Graduate Studies. (See Appendix B.)

Examining Committee

The Examining Committee evaluates the academic merit of the student's thesis/dissertation and decides whether the student has satisfactorily passed the oral examination.

The Examining Committee consists of the external examiner (see below), one university examiner (see Section 17.6.3.2) and all members of the candidate's supervisory committee (including the research supervisor). The university examiner is a core faculty member at UOIT who has not been involved with the student in any teaching or supervisory capacity. The committee is chaired by the Graduate Program Director or designate.

External Examiner

The external examiner should hold the rank of Full or Associate Professor (or equivalent) if they are at a university, or of comparable expertise and standing if not at a university. An external examiner for a PhD dissertation is a well-qualified, objective and experienced individual who has not had any direct or indirect contact with the student as either a course instructor or supervisor of the student's dissertation and who is not associated or affiliated with UOIT. This person will have considerable direct knowledge in the field of study of the subject matter.

The external examiner is appointed by the Dean of Graduate Studies, upon recommendation of the Graduate Program Director. A *curriculum vitae* of the recommended examiner and written rationale for the choice must be provided to the Dean of Graduate Studies.

Conflicts of interest must be avoided when recommending the names of external examiners to the Dean of Graduate Studies. External examiners must not be teaching or supervising family members or relatives of the student, must not be closely linked in a personal or research capacity, nor shall they have shared financial interests with either the student or the research supervisor. Should the student's dissertation contain chapters or sections of previously published works, the university and external examiners shall not have been involved in the review or editing of this material in any capacity.

External Examiner's Report

The external examiner shall prepare a report of his/her assessment of the candidate's dissertation and send it to the Dean of Graduate Studies no less than one week before the scheduled exam date. The Dean will distribute copies of the report to all other members of the Examining Committee. The content of the report is confidential and must not be discussed with the candidate prior to the scheduled examination. Depending on the content of the report, the Examining Committee and the Dean of Graduate Studies may meet to determine whether or not to proceed with the scheduled examination.

The Dean of Graduate Studies reserves the right to postpone the final examination if the External Examiner's report is not received by the deadline.

Oral Examination

Doctoral candidates are required to defend their completed thesis/dissertation orally in front of an Examining Committee. Students are expected to follow the advice of their research supervisor(s) and their Supervisory Committee in establishing when their work is ready for examination. In exceptional circumstances, students may request that the Dean of Graduate Studies arrange for an examination of the thesis/dissertation without the support of the research supervisor(s) and Supervisory Committee.

It is the student's responsibility to ensure that all materials are prepared and assembled appropriately. Students should consult their research supervisor(s) for specific regulations on the preparation and presentation of thesis/dissertation materials.

Written Thesis evaluation

Each member of the thesis examination committee will evaluate the written thesis using the criteria found in the table below. An overall judgement will be indicated as either pass or fail.

Doctorial Thesis Criteria					
Criteria	Excellent or top 10%	Very good	Good	Satisfactory	Unsatisfactory
Originality and Creativity					
Awareness of significance of findings					
Demonstration of technical skill					
Scientific contribution to the field					
Demonstration of a systematic flow of knowledge and a logical end point of the investigation					
Grasp of the subject; identification of gaps in knowledge (ie literature); evaluation of previous work					
Quality of the presentation of the document (grammar, coherence etc)					

4.2.9 Distance delivery

The program will not be delivered in a distance delivery manner.

4.2.10 Residency requirement

All program requirements must be completed on site at UOIT. It is expected that all requirements for the degree be completed within 4 years.

4.2.11 Administrative structure

The duties of the graduate program director are listed in the UOIT graduate studies policies. The Applied Bioscience PhD program will have a program review committee with representatives from each field who report to the graduate program director. An Applied Bioscience graduate program secretary is already in place. The duty of the secretary is to assist in the scheduling of committee meetings, maintain

student records, record minutes of the graduate program review committee meetings, and assist the graduate program director with other administrative items. The graduate program secretary will report to the graduate program director and the Dean of Science.

4.3 Graduate course listing

Table 4-1 lists the proposed graduate courses to be offered. There are 5 core courses common to the three fields which are indicated by specific numbering (**APBS x0x0**). In addition there is one course that is specific and mandatory in each field (Table 4-2). Students will be required to take 1 additional course with the **APBS 6x00** numbering. Students must consult their direct supervisor before selecting courses.

PhD students may take one undergraduate level course in addition to their graduate course requirements provided that it is recommended by their supervisor and approved by the graduate program director. If the student is required to take a course outside of their program map, it should be clearly indicated in their offer letter.

Outlines for all courses in the listing begin on page 47.

Table 4-1: Proposed Courses	
Course	Title
APBS 6010G	Research in Applied Bioscience
APBS 7040G	Thesis Proposal Defence and Qualifying Exam
APBS 7050G	Applied Bioscience Research Seminar
APBS 7060G	PhD Research
APBS 7070G	PhD Dissertation
APBS 6100G	Advanced Cell and Molecular Biology
APBS 6200G	Environmental Determinants of Health
APBS 6300G	Advanced Topics in Biological Chemistry
APBS 6400G	Advanced Topics in Forensic Bioscience
APBS 7100G	Special Topics in Biomolecular Science
APBS 7200G	Special Topics in Ecosystem Health
APBS 7300G	Special Topics in Forensic Bioscience

Core Courses= APBS x0x0

Table 4-2: Course Map per Field		
Biomolecular Science	Ecosystem Health	Forensic Bioscience
1) Core Courses 2) APBS 7100G 3) One additional	1) Core Courses 2) APBS 7200G 3) One additional	1) Core Courses 2) APBS 7300G 3) APBS 6400G

COURSE OUTLINES**Course Title:** APBS 6010G Research in Applied Bioscience**Prerequisite:** Enrolment in the Applied Bioscience graduate program**Course Description:**

This is a required team-taught course designed to provide a foundation for the graduate program in Applied Bioscience. The course will provide students with current background knowledge and skills needed for research in Applied Bioscience, and will also expose students to current issues and problems that this area of research may target. The course will introduce such topics as principles of experimental design, data interpretation and analysis of results and how to present and communicate scientific information in both oral and written formats. Students will also learn about the grant and scholarship process and how to write a research proposal, and they will be introduced to such issues as Research Ethics and Intellectual Property.

Topics that will be covered:

- 1) 21st Century Research in Applied Bioscience: differences and similarities between basic and applied biological research; hypothesis-driven research
- 2) The scientific method; principles of experimental design
- 3) Research ethics in Applied Bioscience
- 4) The granting system in Canada and the US
- 5) Basic grant writing skills
- 6) Scientific Writing: Communication of science in written formats, including preparation of scientific papers
- 7) Communication of science to the research community and the general public: verbal communication of science
- 8) Applied Bioscience research in Academia versus Industry
- 9) Intellectual property and patents in the context of Applied Bioscience

Learning Outcomes:

Students who complete this course have demonstrated the ability to:

- 1) describe the Applied Bioscience field and its importance to the lives of Canadians
- 2) have a good understanding of how research programs are started and maintained
- 3) understand the current issues and questions relevant in Research Ethics for Bioscience, including familiarity with the Tri-Council policy

- 4) apply advanced knowledge and skill in communicating science to both the scientific community and to more general audiences
- 5) critically examine current issues in Academic and Industry- based biomedical research

Delivery Mode: This is a one semester 3 credit course. The course will consist of one 2 hr session a week.

Rationale: The lectures, exercises and assignments will allow the students to achieve each of the above learning outcomes. The lectures are designed to provide a forum for students to learn about this rapidly changing field and to promote discussion. The lectures will be taught as a team by the UOIT Applied Bioscience faculty as well as guests from Industry and Academia.

Student Assessment: Two term papers 30% each, one oral presentation 20% and class participation 20%.

Faculty Qualification: PhD or equivalent

Representative Resources:

- 1) Science and technical writing: a manual of style. 2nd ed. New York : Routledge, 2001.
- 2) Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans
- 3) Human Pluripotent Stem Cell Research: Guidelines for CIHR-Funded Research
- 4) How to Prepare a Winning Proposal and other NSERC resources available for researchers preparing grant proposals at <http://www.nserc.ca>

Course Title: APBS 7040G PhD Thesis Proposal and Qualifying Exam**Prerequisite or Co-requisite:** Enrolment in the Applied Bioscience PhD program**Course Description:**

Students in the Applied Bioscience PhD program will be required to submit a comprehensive thesis proposal outlining their research objectives and proposed methodology. This thesis proposal also will consist of a literature review that addresses the current state of knowledge of their particular research topic. This course will consist of an oral qualifying exam that evaluates the students' grasp of the literature and their particular research plan.

Topics that will be covered:

Topics in this course may vary according to their specific research project

Learning Outcomes:

Students who successfully complete this course have demonstrated:

1. an in depth understanding of the current knowledge in their proposed field of research
2. a knowledge of the current gaps in knowledge of their proposed field
3. the ability to propose hypothesis
4. the ability to propose a logical plan to achieve their research objectives
5. an understanding about the significance of their proposed research
6. the ability to defend their research plan
7. an understanding of the possible challenges in achieving their research objectives

Rationale:

This course is designed to prepare the student to undertake an intensive research project in Applied Bioscience. It also provides the advisory committee an opportunity to determine whether the research objectives and methodology are achievable and appropriate for a doctorate thesis. The qualifying exam will test the student's background knowledge and ability to defend their proposed research plan.

Delivery Mode:

One formal advisory committee meeting. Supervisor is responsible for providing guidance where necessary

Student Assessment:

Written thesis proposal 60%; oral qualifying exam 40%

Faculty Qualifications:

PhD or equivalent; core faculty member in the Applied Bioscience PhD program

Representative Resources:

No textbook required

Course Title: APBS 7050G Research Seminar in Applied Bioscience

Prerequisite: good standing in the APBS PhD program

Course Description:

This course will require students at the end of their program to present a thorough overview of their thesis research, including relevant background material, research results and their interpretation. This seminar must address how the research will benefit society. The presentation will be expected to be appropriate for an interdisciplinary audience in Science. This course is a part of the regular seminar series in Applied Bioscience. Therefore, students are also expected to give yearly seminars that will provide an update on the progress of their research, provide peer-reviewed feedback on seminars of fellow students and be present at all other seminars. The final grade will be administered after their final seminar

Topics that will be covered:

These will be focused on specific research projects in Applied Bioscience.

Learning Outcomes:

Students who complete this course will have demonstrated the ability to:

1. use advanced communication skills in the dissemination of scientific information
2. interpret and present research results
3. answer questions about research using advanced knowledge
4. critically examine and discuss the implications of a given research project to society as a whole

Rationale:

This course is designed to provide students further experience in communicating scientific results and their interpretation. This will also provide students with a forum for gaining feedback from their colleagues and professors that can be incorporated into their final thesis.

Delivery Mode:

Student seminars will be regularly scheduled as needed.

Student Assessment:

Students will be evaluated based on the following:

- 1) How well the student has presented the background information on their research topic and appropriateness of this information within the context of the entire presentation
- 2) The scientific merit of the results
- 3) The clarity and thoughtfulness of the interpretation of the results
- 4) The overall delivery of the seminar
- 5) Participation in the regular seminar series

Feedback will be provided to the students by peers and faculty through a standardized evaluation form.

Faculty Qualification:

PhD or equivalent; faculty advisors will oversee the progress of their graduate students.

Course Title: APBS 7060G PhD Research**Prerequisite:** Good standing in the APBS PhD program**Course Description:**

This is a non-credit course that will be administered by the student's advisor. Students in the course are required to make satisfactory progress in their research, keep up to date with the literature on the current state of knowledge on their particular research and provide regular updates on their progress to their advisor. Students who make satisfactory progress with their thesis research will be able to continue in the program and enrol in this course the following year. Students are required to register for this course every year.

Topics that will be covered:

PhD Thesis Topic

Learning Outcomes:

Students enrolled in this course have reliably demonstrated the ability to:

- 1) Conduct their experiments in a careful, thoughtful and efficient manner
- 2) Make satisfactory progress on their research
- 3) Practice safe laboratory skills
- 4) Provide regular, clear and comprehensive updates on their research to their advisor
- 5) Keep up to date on the current literature related to their thesis topic

Rationale:

The day to day progress towards a comprehensive PhD dissertation is an important component of the research training of a graduate student. Most of this training is provided directly from the student's supervisor. This course is designed to both instil the importance of this training and allow the student to be formally and continuously registered in the program.

Delivery Mode:

N/A

Student Assessment:

Students will be evaluated based on the following:

- 1) Satisfactory progress towards their thesis

Faculty Qualification:

PhD or equivalent; faculty advisors will oversee the progress of their graduate students.

Course Title: APBS 7070G PhD Dissertation**Prerequisite:** Good standing in the APBS PhD program**Course Description:**

The dissertation is the primary component of the PhD degree requirement. The research must lead to an original contribution of knowledge in the field which must be reported fully in the candidate's dissertation. The research is carried out under the direction of the candidate's supervisor or co-supervisors, in co-operation with an advisory committee. This thesis will be accompanied by an oral thesis defence.

Topics that will be covered:

These will be focused on specific research projects in Applied Bioscience.

Learning Outcomes:

Students who successfully complete the PhD dissertation have reliably demonstrated the ability to:

- 1) understand and explain the essential facts, concepts, principles, and theories relating to their research topic.
- 2) design and conduct experiments, analyze and interpret experimental data, and/or computational results.
- 3) prepare and present, orally and in writing, to peers and experts, an original contribution to the field of study.
- 4) interpret data in a creative and thoughtful manner
- 5) generate a comprehensive unit that demonstrates a systematic flow of knowledge and a logical end to the investigation
- 6) make a valuable contribution to new knowledge
- 7) demonstrate a thorough understanding of the subject

Rationale:

The thesis is the key component of the PhD degree. It is designed to allow the student to make an original and comprehensive contribution to new knowledge. Upon completion of the thesis the student will have significant expertise in their area of study.

Delivery Mode:

N/A

Student Assessment:

Students will be evaluated based on the following:

- 1) Evidence of originality and creativity
- 2) The technical skill generated during the project
- 3) The interpretation of results
- 4) The significance of the findings to their field
- 5) The overall grasp of the subject
- 6) Quality of the presentation of the thesis document

Faculty Qualification:

PhD or equivalent; faculty advisors will oversee the progress of their graduate students.

Course Title: APBS 6100G Advanced Cell and Molecular Biology**Prerequisite or Co-requisite:** Enrolment in the APBS graduate program**Course Description:**

This will be a non-lecture based course where students and the faculty coordinator discuss current research in cell and molecular biology. The course will be a combination of group discussions and presentations. Each week a student will present either a research article or a synopsis of the current knowledge regarding a topic related to the course and possibly his/her own research interests. This will allow the students to apply basic concepts learned as an undergraduate student to the current state of knowledge in cell and molecular biology.

Topics that will be covered:

Topics in this course may vary according to research interests and current research events in cell and molecular biology, but would potentially include:

- Mechanisms of signal transduction and pharmacological effects
- Host immune response to bacteria and parasitic infection
- The cell biology of cancer and metastasis
- Virus-host cell interactions
- Cellular responses to toxic chemical and pollutant exposure
- Human genomics, including advanced topics in gene inactivation/activation, methylation, gene interaction and interference

Learning Outcomes:

Students who successfully complete this course have demonstrated the ability to:

1. apply in depth understanding of basic concepts to current knowledge in cell and molecular biology
2. critically interpret research results and suggest future research avenues
3. prepare and deliver a professional quality presentation of the current state of a particular research topic/problem
4. synthesize current knowledge and build hypotheses for further study within a specific area of cell and molecular biology

Rationale:

The discussion and presentation style format will expose students to an important part of research and discovery: the discussion of current knowledge. This will also provide a forum for active learning and encourage students to think beyond what is currently known in the area of cell and molecular biology.

Delivery Mode:

This is a one semester 3 credit course. The course will consist of one 2 hr forum per week.

Student Assessment:

Two term papers 40% each, oral presentation and class discussion 20%.

Faculty Qualifications:

PhD or equivalent with expertise in cellular or molecular biology

Advanced Cell and Molecular Biology continued...

Representative Resources:

There would be no textbook required for this course. Instead, extensive use will be made of relevant literature in cell and molecular biology. Journals of focus would include

Cell

Journal of Biological Chemistry

Journal of Immunology

Journal of Bacteriology

EMBO

Nature

Science

Journal of Experimental Medicine

Trends in Cell Biology

Trends in Immunology

Trends in Microbiology

Trends in Pharmacological Science

Nature Reviews Immunology

Nature Reviews Molecular Cell Biology

Aquatic Toxicology

Course Title: APBS 6200G Environmental Determinants of Health**Prerequisite or Co-requisite:** Enrolment in the APBS graduate program**Course Description:**

This course will explore interactions between environment and human health. It will comprehensively address principles of environmental health, followed by specific issues regarding harmful environmental agents, and Canadian and global environmental health challenges. It will be designed to be delivered by an interdisciplinary faculty team potentially including members from the Faculties of Health Sciences, Science, Social Sciences and Engineering. It will attract health and non-health graduate students interested in the multi-factorial nature of environmental diseases. At the end of this course, students should have a broad understanding of how human health is contextually determined by our environment and be familiar with published seminal environmental health research.

Topics that will be covered:**Principles of Environmental Health**

- Ecology, environmental sciences and health
- Mechanisms (pathophysiology) of environmental disease

Agents of Environmental Disease

- Physical, chemical and biological agents (environmental agents, pollutants)
- Routes of exposure: water, air, soil, food (issues of food and water safety)
- Susceptible human systems & populations

Environmental Health Practice in Canada

- Canadian environment
- Canadian environmental epidemiology
- Canadian environmental health law
- Occupational health in Canada

Global issues in Environmental Health

- Exposure and risk assessment & communication
- Political and socioeconomic determinants in environmental health (Moir)
- Prevention of environmental diseases

Research Methodology in Environmental Health

- Best evidence in studies of environmental effects in health
- Limitations of environmental health research
- Benefits of quantitative and qualitative methodology

Environmental Determinants of Health continued...**Learning Outcomes:**

Students who complete this course will have demonstrated the ability to:

- 1) apply an in depth understanding of how human health is contextually determined by our environment.
- 2) examine and explain the agents and mechanism of environmental disease.
- 3) conduct a critical assessment of local, national and global determinants of health
- 4) explore and utilize published seminal environmental health research and research methodology in the field.

Rationale:

Graduate students in this course will be exposed to original research that links basic sciences, health and the environment. This course will be unique in allowing students to address the importance of environmental agents as determinants of health, understand the strengths and limitations of environmental health studies and foresee the relevance of basic research into health and communities.

Delivery Mode: This is a one semester 3 credit course. The course will consist of one 3hr forum per week.

Student Assessment: Term paper 25%, oral presentation 25%, class discussion 25%, Final exam 25%.

Faculty Qualifications: PhD or equivalent

Representative Resources: There would be no textbook required for this course. Instead, extensive use will be made of relevant literature in Environmental Science and Environmental Health. Journals of focus will be included.

Specialized Books:

Blumenthal & Ruttenber, Introduction to Environmental Health, Springer
Brooks et al., Environmental Medicine, Mosby
Carson, Silent Spring, Houghton Mifflin
Freedman, Environmental Science: A Canadian Perspective, Prentice Hall
Schottenfeld & Fraumeni, Cancer Epidemiology and Prevention, Oxford

Specialized Journals:

American Journal of Industrial Medicine
Cancer Epidemiology, Biomarkers & Prevention
Environmental Health Perspectives
Environmental & Molecular Mutagenesis
Environmental Toxicology

Course Title: APBS 6300G Advanced Topics in Biological Chemistry**Prerequisite or Co-requisite:** Enrolment in the APBS graduate program**Course Description:**

This graduate course will explore a range of research topics at the intersection of chemistry and biology through examples selected from the current scientific literature.

Topics that will be covered:**Protein engineering** (genetic and chemical methods of protein modification)**Enzymes** (enzyme kinetics, enzyme inhibition, pharmaceutical application of enzyme inhibitors)**Receptors** (G-protein coupled receptors and ion channels as targets for pharmaceuticals)**Cofactors** (various cofactors of enzymes and their role in catalysis)**Enzymes for organic synthesis** (the use of various classes of natural and engineered enzymes for the synthesis of organic molecules)**Biotransformations** (the application of microorganisms in the production of chemical diversity)**Catalytic properties of nucleic acids****Bio-inorganic chemistry** (the role of metal ions in biological processes, metal-containing drugs)**Learning Outcomes:**

Students who complete this course will have demonstrated the ability to:

1. critically examine the current state of knowledge of research in biological chemistry.
2. explain various methods of generating modified proteins
3. distinguish between various types of enzyme inhibitions based on the analysis of enzyme kinetic data
4. describe the roles of cofactors in enzyme-catalyzed reactions
5. select an appropriate enzyme for desired transformation of organic molecules
6. explain how nucleic acids function as catalysts
7. define the roles of metals in biological systems
8. synthesize current research, present it in a comprehensible manner, and suggest future research avenues

Rationale:

This course will expose students to the current state of knowledge in biological chemistry through provision of the necessary background and discussion of appropriate scientific articles. The latter will provide a basis for active learning and will inspire students to think beyond what is currently known about science.

Advanced Topics in Biological Chemistry continued...**Delivery Mode:**

This is a one-semester 3 credit course with 3 hours of lecture weekly.

Student Assessment:

Students will be evaluated based on assignments, one midterm and a comprehensive final examination.

Faculty Qualifications:

PhD or equivalent with expertise in biochemistry or organic chemistry

Resources: No specific textbook for the course is required. Weekly readings will be selected from articles of peer-reviewed scientific journals, such as:

Science
Nature
Proceedings of the National Academy of Science, USA
Journal of the American Chemical Society
Angewandte Chemie International Edition
Chemistry & Biology
Journal of Biological Chemistry
Bioorganic & Medicinal Chemistry
Bioorganic and Medicinal Chemistry Letters
Bioconjugate Chemistry
Chembiochem: a European journal of chemical biology
Biochemistry
ACS Chemical Biology
Molecular Pharmaceutics

Representative texts that will be made available are:

Petsko, G. and Ringe, D. 2003. *Protein Structure and Function*. Blackwell.
Mann, J.E. 2003. *Chemical Aspects of Biosynthesis*. Oxford University Press, Wong, C-H and Whitesides, G.M. 1995. *Enzymes in Synthetic Organic Chemistry*. Pergamon,
Jencks, W.P. 1987 *Catalysis in Chemistry and Enzymology*. Dover.

Course Title: APBS 6400G Advanced Topics Forensic Bioscience

Prerequisite: Enrolment in the Forensic Bioscience field in the APBS graduate program

Course Description:

This graduate course will explore a range of research topics at the intersection of biology, chemistry, and forensic science through examples selected from the current scientific literature and available casework. The course will focus on current and new developments in biotechnology and bioanalytical techniques associated with forensic analysis, quality assurance concepts and the use of scientific evidence in court.

Topics Covered:

Molecular biotechnology: The application of molecular biology to both basic and applied (i.e. forensic) research in biotechnology

Forensic Bioinformatics: The application of data handling systems and software tools for identification purposes in a forensic context

Advanced topics in bioanalytical science: Investigation of new developments in advanced analytical tools and bioanalytical techniques and their application to forensic evidence

Pharmacology and forensic toxicology: The study of toxic substances and poisons, including their chemical composition and identification, based on their use in criminal investigations

Forensic Statistics: A focus on forensic applications of frequentist, bayesian, and multivariate statistics

Quality assurance concepts: Quality assurance standards for forensic testing laboratories, quality control of evidence assessment, identification, comparison, and reconstruction. Includes advanced chain of custody and laboratory information management systems

Legal and judicial systems: A study of current issues in criminal justice, expert testimony and its interpretation by the courts, legal and ethical issues associated with forensic evidence, and a mock court simulation

Policy, Ethics and Media Issues: Study of issues related to these themes

Advanced Topics in Forensic Bioscience continued.....**Learning Outcomes:**

Students who complete this course will have demonstrated the ability to:

- 1) Critically examine the current state of knowledge and research in forensic bioscience
- 2) Explain the application of biotechnology and bioanalytical techniques to forensic evidence and the statistical interpretation of that evidence
- 3) Understand the importance and limitations of bioinformatics in a forensic context
- 4) Identify the chemical composition of forensically-important drugs and understand their contrasting roles in living and deceased tissues
- 5) Explain the different levels of quality control and quality assurance required in a forensic laboratory
- 6) Discuss important legal, policy and ethical issues commonly faced by forensic scientists when giving expert testimony
- 7) Synthesize current research, present it in a comprehensible manner and suggest future research avenues

Rationale:

This course will expose students to the current state of knowledge in the forensic biosciences field through provision of the necessary background material and discussion of appropriate scientific articles and casework examples. The latter will provide a basis for active learning and will inspire students to advance the current knowledge base and challenge traditional concepts in forensic science.

Delivery Mode:

This is a one-semester 3 credit course with 3 hours of lecture weekly.

Student Assessment:

Students will be evaluated based on assignments, seminars, one midterm examination and a comprehensive final examination

Faculty Qualifications:

PhD or equivalent in a biological or chemical field with expertise in forensic science

Advanced Topics in Forensic Bioscience continued.....**Resources:**

No specific textbook for the course is required. Weekly readings will be selected from articles of peer-reviewed scientific journals, including:

Science
Nature
Proceedings of the National Academy of Science
Journal of Biological Chemistry
Bioorganic and Medicinal Chemistry
Forensic Science International
Journal of Forensic Science
International Journal of Legal Medicine
Science and Justice
Canadian Society of Forensic Science Journal
Journal of Forensic and Legal Medicine
Forensic Science, Medicine, and Pathology
Molecular Pharmaceuticals
Biochemistry

Representative texts that will be made available are:

- Smith, F. and Siegel, J.A. 2004. *Handbook of Forensic Drug Analysis*. Academic Press
- Bell, S. 2005. *Forensic Chemistry*. Prentice Hall
- Butler, J.M. 2001. *Forensic DNA Typing: Biology and Technology Behind STR Markers*. Academic Press
- Lucy, D. 2005. *Introduction to Statistics for Forensic Scientists*. Wiley

Course Title: APBS 7100G Special Topics in Biomolecular Science

Prerequisite: Enrolment in the Biomolecular Science field in the APBS PhD program

Course Description:

This course will require students to research and present orally a thorough overview of the current state of knowledge on a particular topic related to Biomolecular Science. The students should also be able to identify key gaps in knowledge. This seminar must address how advances in the related area of research will benefit society. The presentation will be expected to be appropriate for an interdisciplinary audience in Science.

Topics that will be covered:

These will be focused on specific topics in the Biomolecular Science field such as biotechnology, molecular pharmacology, genomics, molecular genetics, protein-ligand interactions, DNA-ligand interaction.

Learning Outcomes:

Students who complete this course will have demonstrated the ability to:

1. present the current state of knowledge on a particular topic into a clear and comprehensive seminar
2. identify the current gaps in knowledge
3. suggest further avenues for the advancement of knowledge
4. relate how scientific advances in this area will benefit society

Rationale:

This course is designed to provide students further experience in communicating a specific area of Applied Bioscience to an interdisciplinary audience. This will also provide students with a forum for gaining feedback from their colleagues and professors.

Delivery Mode:

Faculty coordinator from the Biomolecular Science field will schedule regular meetings to discuss various topics related to Biomolecular Science with the students, discuss proper presentation skills, and schedule presentation practice sessions to provide feedback. The final student seminar will be regularly scheduled during the seminar series.

Student Assessment:

Students will be evaluated based on the following:

- 1) How well the student organised the current state of knowledge into a single presentation
- 2) Discussion of current gaps in knowledge
- 3) Demonstrate a deep knowledge on the subject matter
- 4) Discuss how research in this area will impact society
- 5) Overall quality of the seminar presentation

Feedback will be provided to the students by peers and faculty through a standardized evaluation form.

Faculty Qualification:

PhD or equivalent; faculty coordinator will oversee the course.

Course Title: APBS 7200G Special Topics in Ecosystem Health

Prerequisite: Enrolment in the Ecosystem Health field in the APBS PhD program

Course Description:

This course will require students to research and present orally a thorough overview of the current state of knowledge on a particular topic related to Ecosystem Health. The students should also be able to identify key gaps in knowledge. This seminar must address how advances in the related area of research will benefit society. The presentation will be expected to be appropriate for an interdisciplinary audience in Science.

Topics that will be covered:

These will be focused on specific topics in the Ecosystem Health field such as toxicology, environmental health, biomonitoring and bioremediation.

Learning Outcomes:

Students who complete this course will have demonstrated the ability to:

1. present the current state of knowledge on a particular topic into a clear and comprehensive seminar
2. identify the current gaps in knowledge
3. suggest further avenues for the advancement of knowledge
4. relate how scientific advances in this area will benefit society

Rationale:

This course is designed to provide students further experience in communicating a specific area of Applied Bioscience to an interdisciplinary audience. This will also provide students with a forum for gaining feedback from their colleagues and professors.

Delivery Mode:

Faculty coordinator from the Ecosystem Health field will schedule regular meetings to discuss various topics related to Ecosystem Health with the students, discuss proper presentation skills, and schedule presentation practice sessions to provide feedback. The final student seminar will be regularly scheduled during the seminar series.

Student Assessment:

Students will be evaluated based on the following:

- 1) How well the student organised the current state of knowledge into a single presentation
- 2) Discussion of current gaps in knowledge
- 3) Demonstrate a deep knowledge on the subject matter
- 4) Discuss how research in this area will impact society
- 5) Overall quality of the seminar presentation

Feedback will be provided to the students by peers and faculty through a standardized evaluation form.

Faculty Qualification:

PhD or equivalent; faculty coordinator will oversee the course.

Course Title: APBS 7300G Special Topics in Forensic Bioscience

Prerequisite: Enrolment in the Forensic Bioscience field in the APBS PhD program

Course Description:

This course will require students to research and present orally a thorough overview of the current state of knowledge on a particular topic related to Forensic Bioscience. The students should also be able to identify key gaps in knowledge. This seminar must address how advances in the related area of research will benefit society. The presentation will be expected to be appropriate for an interdisciplinary audience in Science.

Topics that will be covered:

These will be focused on specific topics in the Forensic Bioscience field such as forensic biology, molecular genetics, analytical chemistry, and DNA analysis.

Learning Outcomes:

Students who complete this course will have demonstrated the ability to:

1. present the current state of knowledge on a particular topic into a clear and comprehensive seminar
2. identify the current gaps in knowledge
3. suggest further avenues for the advancement of knowledge
4. relate how scientific advances in this area will benefit society

Rationale:

This course is designed to provide students further experience in communicating a specific area of Applied Bioscience to an interdisciplinary audience. This will also provide students with a forum for gaining feedback from their colleagues and professors.

Delivery Mode:

Faculty coordinator from the Forensic Bioscience field will schedule regular meetings to discuss various topics related to Forensic Bioscience with the students, discuss proper presentation skills, and schedule presentation practice sessions to provide feedback. The final student seminar will be regularly scheduled during the seminar series.

Student Assessment:

Students will be evaluated based on the following:

- 1) How well the student organised the current state of knowledge into a single presentation
- 2) Discussion of current gaps in knowledge
- 3) Demonstrate a deep knowledge on the subject matter
- 4) Discuss how research in this area will impact society
- 5) Overall quality of the seminar presentation

Feedback will be provided to the students by peers and faculty through a standardized evaluation form.

Faculty Qualification:

PhD or equivalent; faculty coordinator will oversee the course.

4.4. Collateral and supporting departments

The Faculty of Health Science has played an important role in this proposal and will be integral part of its implementation.

5. OUTCOMES

5.1 Enrolment and graduations

As this is an application for a new program, this section is not applicable.

5.2 Employment

Employment records of the graduates from the program will be maintained on an ongoing basis.

5.3 Publications

Publication records of the graduates from the program will be maintained on an ongoing basis.

5.4 Projected graduate intake and enrolments

Table 5-1 shows the projected graduate student enrolment (both full-time and part-time students) over the next seven years. As additional faculty are hired over the next few years, the planned enrolment in the program is expected to increase.

TABLE 5-1: PROJECTED INTAKE AND ENROLMENTS						
YEAR	Cumulative Enrolment		Staff Requirements - Projected			
	Full-time	Part-time	Cumulative Full-time Faculty FTE	Cumulative Part-time Faculty FTE	Technical Support Teaching Assistants, etc.	Ratio of Full-time Students/ Full-time Faculty
2009 (Year 1)	8	0	16	0	0	0.5:1
2010 (Year 2)	16	0	17	0	0	0.9:1
2011 (Year 3)	27	0	18	0	0	1.5:1
2012 (Year 4)	31	0	18	0	0	1.7:1
2015 (Year 5)	33	0	19	0	0	1.7:1

At steady state it is expected that each faculty member is expected to supervise approximately 2 PhD students at any given time. This is under the assumption that in addition to PhD students, several faculty will be supervising MSc students.

Availability of funding

Based on the current funding situation and the availability of teaching assistantships each faculty member has sufficient funds to supervise 2 or more graduate students at any given time. Our faculty have been very successful at receiving external funding, such as NSERC discovery and collaborative research grants, in addition to other provincial and federal funding.

Availability of Faculty

The PhD program in Applied Bioscience will be offering 4 additional courses in the first year outside the current course offerings by the Faculty of Science. This will require 1 additional core faculty member to be hired before the program is launched. In order to reach a steady-state of 33 PhD students we will require 19 core faculty by 2015.

Appendix A: Library Resources

**LIBRARY SUBMISSION TO ONTARIO COUNCIL OF GRADUATE STUDIES (OCGS)
FOR:
THE DOCTOR OF PHILOSOPHY (PHD) IN
APPLIED BIOSCIENCE

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY (UOIT)**

Compiled by: Carol Mittlestead, B.A. (Hon), M.L.S., Associate Librarian

Introduction:

This document outlines the resources and services provided by the Library in support of the University of Ontario Institute of Technology's Doctor of Philosophy (PhD) in Applied Bioscience. In the first section, an overview of the Library from an "all users" perspective is provided. The second section details collections and services that specifically support the research endeavours of those teaching or enrolled in the PhD program. In this report, the term "collections" is used to describe both paper and electronic resources – books, indexes, periodicals (journals, magazines, newspapers), librarian recommended web sites, and data sets. The term "accessibility" addresses the physical presence of the Library, onsite reference assistance, the Library web page www.uoit.ca/library as a 24/7 portal, and interlibrary loan and document delivery.

The Library: An Overview

Facilities:

The Library is an American Library Association (ALA) award winning building designed by Toronto architects Diamond & Schmitt. Opened in late 2004, the Library boasts several noteworthy features:

- 75,000 square feet
- 500 seats
- 10 group study rooms
- 2 library orientation classrooms
- Round reading room with fireplace (2nd floor)
- Silent study and special collections room (3rd floor)
- *Graduate Student Quiet Study Zone (4th floor) – Swipe card access ONLY*
- *Graduate Student Lockers*
- Special needs adaptive technology area
- 160 public computers – wired and wireless
- Microsoft Office Suite
- Photocopiers and printers

Collections:

The Library's acquisition plan is based on evolving pedagogical needs as determined by the academic faculties. In close liaison with the deans and professors, subject specialist librarians define collection development strategies for the ongoing curriculum-based purchase of resources as well as for the evaluation and review of existing material.

"Traditional" (largely paper based) Resources

While the majority of the library's acquisition budget is devoted to electronic resources in accordance with new technology, customer service demands and UOIT's laptop university mandate, there is a small but comprehensive print collection. The plan is to increase paper book holdings by at least 3,750 volumes annually for several successive years with a current projected cost of \$400,000 to \$450,000 per annum. Similarly, the paper periodical collection is expected to remain constant with an investment of about \$50,000 per year excluding costs (e.g. binding) incurred through donations. It is realized that not all current and archival holdings have moved to electronic format. As noted below, other "traditional" resources are also being maintained.

- 88,000 volumes (160,000 volume capacity)
- 400 paper copy journals
- 4,200 audiovisuals (Media Services)
- 877 microfilm reels
- Special Collections e.g. Nuclear, Law
- Leisure reading paperback collection
- Archives including Dissertations & Theses (see also below)

Digital Resources

Just as the availability of digital resources increases substantially from year to year so does their use as UOIT enrolment increases. Currently over \$1.7 million or approximately 77% of the acquisitions budget is devoted to purchasing and maintaining electronic subscriptions.

There are primarily three categories of online publications – electronic books or e-books, electronic journals or e-journals (also includes electronic transactions, conference proceedings, standards, etc.) and data sets. The "explosion" of the technical document is reflected by the Library statistics recorded below:

- 47,000 e-books
\$63,000 in both 2004-5 and 2005-6; \$116,000 in 2006-7; \$150,000 in 2007-8;
\$175,000 anticipated in 2008-9
- Indexing and abstracting for over 75,000 electronic journals through various multidisciplinary and subject specific databases; 46,000 journals available immediately in full text
\$450,000 in 2005-6; \$550,000 in 2006-7; \$1.3 million in 2007-8; \$1.7 million anticipated in 2008-9

Access to statistics is provided through the Library's subscriptions to four data sets – E-Stat, DLI (Data Liberation Initiative), ICPSR (Inter-University Consortium for Political and Social Research) and ODESI (Ontario Data Documentation Extraction Service and Infrastructure

Initiative). E-Stat is Statistics Canada's educational database including census data and CANSIM (Canadian Socio-economic Management System). The DLI is a far more expansive and comprehensive collection of statistical sets assimilated and maintained by Statistics Canada and offered through the IDLS (Internet Data Library System) hosted by the University of Western Ontario's Social Science Computing Laboratory. ICPSR is the international equivalent of DLI and is hosted by the University of Michigan. ODESI is a new project funded by the Ontario Council of University Libraries and Ontario Buys that assimilates much of the government data described above as well as including information from polling companies and public domain files such as the Canadian National Election Surveys. Data sets from any of the four platforms that relate to environmental and health issues will be of particular value to those Applied Bioscience faculty and students focusing on the Ecosystem Health stream.

The Library obtains its electronic resources by both approaching the vendor directly and by participating in consortium negotiations. This is largely dependent on subject content and company or organization specifications. UOIT is a member of both OCUL (Ontario Council of University Libraries) and CRKN (Canadian Research Knowledge Network) – the provincial and national university library consortia, respectively, that provide for the effective group purchase and distribution of electronic resources.

Resource Accessibility & Assistance:

The Library constantly strives to make its resources and services more readily available to faculty, staff and students. Despite the increasing demand for electronic resources with off campus access, the Library is still valued for its sense of place and study facilities. Opening hours have been extended each academic year and this will again be the case for 2008-9 for an increase to 97 hours per week.

General inquiries or requests for specific assistance are handled in person, by phone or by e-mail. The Reference team including Subject Specialist Librarians offers class orientations, workshops and individual reference appointments.

The UOIT Library web site www.uoit.ca/library is available 24 hours per day, 7 days a week. It is both the portal for accessing resources and for discovering a multitude of procedural and instructional information. For guidance in navigating and assessing the collection in relation to one's research interest, it is recommended that all library users consult the tabs entitled "Research a Topic" and "Search Collections". Librarian Prepared Subject Guides are included here. For each topic a list of recommended books, e-books, media resources, electronic indexes and full text databases is provided along with links to statistics, data, government information and "free" but academically sound websites. A "special notes" or "need to know" section prefaces the Subject Guide if there are unique collections or lending conditions associated with a given topic. Help Sheets are available under the "Get Help" tab on the Library web page if the patron needs further research or technical assistance.

In addition to the Subject Guides mentioned above that emphasize pertinent indexes and databases, there are also other ways to effectively access electronic journals, magazines, and newspapers. Scholars Portal and E-Journals at Scholars Portal are OCUL platforms that allow an individual to access a number of databases simultaneously. The Library also provides a searchable alphabetical list of all indexes and databases, a searchable alphabetical list of all periodical (journal, magazine and newspaper) titles, and a citation locator that checks for either journal or article availability. Further, cross-referencing amongst databases is provided by a federated search engine or linking software called "Find It @ UOIT". If a patron is searching

one database, but the article is available in another, he/she will be redirected to this resource. If the article is not available at UOIT, the option to request an ILL (interlibrary loan) is displayed.

Refworks is a software tool that allows for citations to be “harvested” from various periodical databases or imported directly so bibliographies can be easily prepared. The user selects the appropriate bibliographic format (e.g. MLA, APA) and Refworks applies it to the references that have been assimilated. The complementary component is Refshare; it allows for bibliographies to be shared amongst colleagues and/or to be used as electronic reserve listings. Students may be directed to an article by their professor and simply authenticate into the Library system. The Library also provides information and assistance in creating durable links or persistent URLs as permitted by database licensing agreements and copyright law. This is yet another method of sharing resources amongst colleagues and/or creating reserve reading lists.

Interlibrary Loan (ILL) is currently free to all UOIT staff, students and faculty. Patrons are directed to an online request form available on the library’s web site. Borrowing and lending occur through RACER (rapid access to collections by electronic requesting) a VDX (Virtual Document Exchange) interlibrary loan system implemented in OCUL member libraries. Searches are primarily performed throughout Ontario universities, but items are obtained from other Canadian universities, CISTI (Canada Institute for Scientific and Technical Information) and international institutions too.

Faculty and students from UOIT may visit most other Canadian university libraries and borrow books (Reciprocal Borrowing Agreement) directly upon presentation of their UOIT photo identification card. Materials may be returned directly to the lending library or may be left at the UOIT Library where they will be returned to the appropriate lending library.

The Library: Program Specifics

Collections:

As noted in detail below, the Library acknowledges the three fields – Biomolecular Science, Ecosystem Health, and Forensic Science – that comprise the PhD in Applied Bioscience as well as the interdisciplinary nature of the program. Biology, chemistry and health science perspectives are all supported by collection development initiatives. Similarly, the Library has responded to the research intensity that is an essential component of any PhD program.

“Traditional” (largely paper based) Resources:

From its inception, UOIT has been building its reputation on science-based programming in mathematics, physics, chemistry and biology; Library collection development has echoed this. Many of the current 12,500 science volumes relate directly to the PhD in Applied Bioscience. For example, there are books on genetics, molecular pharmacology, toxicology, bioremediation, and forensic biology. Following the move to the new Library in late 2004 and the availability of more space, the investment in science books has averaged at \$128,000 per annum or 1,065 volumes per year. Despite the increased availability and popularity of e-books, it is expected this expenditure will remain constant for several years.

Approximately 8,000 supporting health science books are also available. Investment in this section of the print collection will be maintained at its current rate as well.

Through the purchase of books that focus on topics such as qualitative and quantitative research methods, the drafting of research proposals, intellectual property, grant writing, presentation techniques, technical communications, and university teaching, the Library is also addressing the practical information needs of all post graduate students.

Borrowing privileges for Faculty and Graduate Students are quite generous given the limited size of the collection:

- Limit of 50 regular loan items
- 30 day loan period with 2 renewals (i.e. 90 day total)
- Semester loan by REQUEST

Digital Resources:

E-books

As mentioned above, the Library is investing heavily in e-books. While some are yearly subscriptions, others are individual titles or publisher groupings by subject or date release (e.g. titles published in 2007) purchased on a one time basis. E-books most likely to interest Applied Bioscience PhD candidates include:

Access Science – e-version of the *McGraw Hill Encyclopedia of Science and Technology*

CRC netBase series:

Bioscience netBase – 315 titles on bioinformatics, biomedical engineering, biostatistics, biotechnology, epidemiology, immunology, neuroscience, pharmacology, toxicology

ChemLib netBase- 373 titles including books on biochemistry, environmental chemistry and forensic chemistry

ForensicnetBase/ LawEnforcementnetBase – 207 titles including books on forensic pathology

Examples of other *netBase* titles include: *Combined Chemical Dictionary, Dictionary of Commonly Cited Compounds, Dictionary of Drugs, Dictionary of Natural Products, Handbook of Chemistry & Physics, Properties of Organic Compounds*

Encyclopedia of Life Sciences

Merck Index

Springer E-Books - 27,000 titles including books on biomedical and life science, earth and environmental science, chemistry and materials science

** The UOIT Library is one of several OCUL libraries currently negotiating with Springer for access to its *Laboratory Protocols* series. These are 15 life science collections (e.g. Biochemistry, Cell Biology, Pharmacology/Toxicology) that provide instructions for the design and implementation of experiments according to procedural, safety and quality standards.

E-books from health science collections such as *Ovid* and *LWW* (Lippincott, Williams & Wilkins) may prove valuable as well.

Journals, Transactions, Conference Proceedings and Standards

Patrons can search for journals through an abstracting or indexing tool such as Biosis Previews, Scopus, or Science Citation Index Expanded for a comprehensive subject overview (linking to full text through Find It @ UOIT and interlibrary loan provided as described above) or they can choose to search more directly for full text. The UOIT Library presently provides access to over 4,300 full text science journals. They are available as traditional paper subscriptions, single electronic titles (e.g. Bioorganic & Medicinal Chemistry, Environmental & Molecular Mutagenesis, Forensic Science International, Aquatic Toxicology) or as one of several titles within an electronic database. These resources are not only a venue for periodicals; many also offer technical reports, conference proceedings and standards.

Below is an overview of journal holdings information pertinent to the Applied Bioscience program. First, a listing of electronic indexes and databases is provided. While these tools do allow for searching by specific journal title, their intrinsic value lies in their ability to perform subject searches across all content held within the database; the user starts with a concept and pulls articles from numerous journals simultaneously. Secondly, a select list of journal titles is provided based of their impact factors and thus relevancy to applied bioscience research.

*Indexes and Databases**Extremely Relevant:*

American Society of Microbiology (ASM)
Annual Reviews – Biomedical Sciences
Bio One I & II
Biosis Previews
CCOHS – Canadian Centre for Occupational Health and Safety*
E-Journals @ Scholars Portal (OCUL portal for simultaneous access to multiple publishers e.g. Elsevier/Science Direct, Springer, Kluwer, Wiley)
JStor (Journal Storage – archival titles)
Proquest Science
PubMed
Royal Society of Chemistry (RSC)
Science Citation Index Expanded (Part of ISI Web of Science)
Scopus
Wilson Applied Science & Technology Abstracts

Very Relevant:

CINAHL (Cumulative Index to Nursing and Allied Health Literature)
Environment Complete
Health Sciences: A Sage Full-Text Collection
Health Source: Nursing/Academic Edition
Medline
Proquest Nursing Journals

Relevant (multidisciplinary databases):

Academic One File
Academic Search Premier

*includes MSDS (Material Safety Data Sheets) and associated Ontario and federal legislation and standards

UOIT postgraduate students are directed to *JCR (Journal Citation Reports)*, an electronic resource that ranks journals by impact factor and indicates which journals are most frequently cited in each field. The UOIT Library scores exceedingly well under the JCR categories of Biochemical Research Methods; Biotechnology & Applied Microbiology; Cell Biology; Environmental Sciences; Immunology; Infectious Diseases; Microbiology; and Toxicology. Examples of journals with high impact factors that are held by the Library include:

Cell

Current Opinion in Genetics & Developmental Structural Biology (several other titles in the *Current Opinion* series as well)

Developmental Cell Cytokine & Growth Factor Reviews

EMBO (European Molecular Biology Organization) Journal

Environmental Health Perspectives

Global Change Biology

Immunology & Cell Biology

Molecular & Cellular Proteomics

Nature Reviews Molecular Cell Biology (complete Nature Reviews collection i.e. plus

Immunology, Microbiology, Cancer, Genetics, Drug Discovery, Neuroscience)

Trends in Cell Biology (several other titles in the *Trends in* series as well)

Acutely aware of UOIT's "youth", the Library obtains the electronic archives of key journals as well as current issues whenever possible. The following serve to illustrate:

<i>Journal of the American Chemical Society</i>	1879-present
<i>Journal of Biological Chemistry</i>	1905-present
<i>Journal of Immunology</i>	1916- present
<i>Nature</i>	1869 –present
<i>Science</i>	1880 –present

The library also operates a very active donation program searching for specific back run titles in paper format as necessary.

Data Sets (see comment in general section with respect to the Ecosystem Health field)

Thesis Databases and Digilog

The Library provides access to *PQDT (Proquest Dissertations and Theses)* and *Theses Canada Portal*. PQDT is a multidisciplinary international database of more than 2 million theses.

Indexing and abstracting is provided from 1861 to the present with fulltext provided from 1998 to the present. The mission of the Theses Canada Portal is to digitize and consolidate Canadian theses documents into one database. Each product offers interlibrary loan and purchase options for items not yet available in electronic format. As well as housing a paper copy of each UOIT postgraduate thesis in its Archives, the Library posts an electronic copy on Digilog, its own tailored version of D-Space or institutional repository software. Faculty and graduate students are also invited to post their research findings on Digilog.

The Library is preparing for UOIT's initial PhD programs and is committed to supporting the resource and research needs of both faculty and students.

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