Master of Science in Applied Bioscience

Proposal to Add New Field in Forensic Bioscience

Submission to the Ontario Council on Graduate Studies

May 2008

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1. INTRODUCTION

In April 2006, UOIT submitted a proposal to OCGS for a Master of Science Degree in Applied Bioscience. In the initial submission, there were two declared fields in the program; Biomolecular Science and Environmental Science and Health. Biomolecular science focuses on the use of molecular and cellular tools to investigate new approaches for combating infectious organisms and disease; biomaterials and bio-based products; drug discovery, drug formulation and site-specific drug delivery; and mechanisms of action of pharmaceuticals at the cellular and molecular level. The field of Environmental Science and Health includes an emphasis on environmental toxicology, whose goal is to determine the implications of external toxicants on the health of organisms and the discovery of indicators for environmental problems and methods to lessen human exposure to toxins. The program was granted approval in December of 2006 by the Ontario Council on Graduate Studies to commence. 11 students enrolled in the program in September, 2007.

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 of these subjects and the ability to tackle interdisciplinary problems and to work independently and successfully within collaborative networks. The program equips students with a wide array of both practical and conceptual scientific skills and prepares them for leadership roles in the life sciences.

UOIT's Faculty of Science is now seeking OCGS approval to add an additional field in ***Forensic Bioscience*** to the approved MSc in Applied Bioscience. This field will address an emerging and rapidly growing field within the discipline, support the University's mission to provide innovative programs in areas of global significance and capitalize on the experiences and research interests of new faculty as well as synergistic relationships within the University's interdisciplinary environment.

2. OVERVIEW OF NEW FIELD

Description of New Field

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. Forensic bioscience is a field that has gained prominence due to recent national and international events. National security, bioterrorism, and global pandemics are just three examples of areas in which skilled forensic bioscience workers will be in high demand in the future. For many scientists, the field of forensic bioscience crystallizes an area of research at the interface between Biology, Chemistry, Forensic Science, and Legal Science. Currently there are very few academically trained "experts" in the field, and as a result the proposed field will fill the demand for trained professionals who are exposed to state-of-the-art technology, theory and practice in forensic bioscience.

Definition and Rationale

Forensic science refers to the application of science to the processes of law. The field of forensic science is interdisciplinary in nature and encompasses a broad range of

scientific disciplines as they apply to the judicial system. Forensic science typically incorporates aspects of the natural and physical sciences (i.e. biology, chemistry, physics, mathematics, and computer science), as well as the social (i.e. anthropology, archaeology, and psychology) and legal sciences. Experts in forensic science are routinely involved in investigations of crime including civil and criminal proceedings as well as requests by the coroner. To ensure the admissibility of evidence in a court of law, the field is constantly under pressure to improve the practice, elevate the standards and increase the accuracy, precision and specificity of the sciences employed. This requirement necessitates the training of highly qualified personnel and increases the demand for higher levels of education.

Although there is a multitude of Masters in Science degrees available nationally, there are currently no Masters programs offered in the forensic sciences area within Canada. Graduates interested in the forensic science field and professionals wishing to improve their qualifications are forced to study internationally or to undertake a graduate degree in a discipline not directly relevant to forensic science. While the need for qualified experts in the field has increased, the availability of graduate programs in the field has not kept pace. Introduction of the proposed Forensic Bioscience field within the Applied Bioscience program will provide a tangible contribution towards advancing the education and knowledge base within the forensic community. Graduates of the program will fill the demand for qualified professionals and expert witnesses who are suitably trained to provided testimony in an expert capacity. They will also be equipped to proceed to PhD studies in biology or chemistry.

Forensic Bioscience as a Field

In the last twenty years, the field of forensic science has continued to expand and incorporate new sub-disciplines as deemed necessary in forensic investigations. Forensic bioscience is a new addition to the field and represents the integration of biology, chemistry, and their application to civil and criminal investigations. Forensic bioscience builds on a strong core science foundation by investigating the use of biological and chemical materials in a forensic science setting. Topics covered in the field include advances in molecular biotechnology, bioinformatics, advanced topics in bioanalytical science, pharmacology and forensic toxicology, forensic statistics, and quality assurance concepts. Students would also be expected to apply the theory and practical skills learnt to a mock court simulation.

While there is a broad range of sub-disciplines within the forensic sciences, the Faculty of Science at UOIT has chosen to focus on forensic bioscience due to faculty members' research and resource strengths in this area. The "department-free" environment at UOIT has provided the opportunity for faculty members to conduct interdisciplinary research without the boundaries often encountered at other universities. This unique situation has led to a strong collaborative foundation in the biological, chemical, forensic and health sciences, providing an ideal environment for graduate students to conduct research in the field of forensic bioscience. Students will benefit from the state-of-the-art technology available in most research laboratories as well as the expertise of a range of science professionals.

The undergraduate forensic science program currently offered at UOIT has a strong background in the core natural sciences and focuses specifically on biology and chemistry in the upper years of the program. Students graduating from the program have

a solid foundation in the biosciences and the proposed new field will build considerably on this foundation, providing undergraduates with the opportunity to increase their educational qualifications prior to seeking employment in the field of forensic science. Due to the limited number of employment opportunities in forensic science, it is becoming increasingly necessary to gain graduate qualifications in order to be competitive for forensic-related employment. The intellectual development and experience of the students in the proposed new field will focus on critical analysis, research, and presentation within a forensic bioscience context and will give them an educational and professional edge to enhance their ability to gain employment in this competitive field.

Graduates of the Applied Bioscience program in the field of Forensic Bioscience will be multi-skilled and highly qualified personnel who are employable in a variety of areas within the forensic science community, such as provincial and federal police services, government and private forensic laboratories, customs and immigration services, coroner's assistants, and the pharmaceutical and biotechnology industry.

3. THE FACULTY

Currently, there are 20.25 full-time core faculty member positions in the Faculty of Science, consisting of a mix of assistant, associate, and full professors. An additional 6 faculty members from Health Science participate in the Applied Bioscience MSc program. New Science faculty will continue to be recruited each year over the next 5 years, to eventually bring the staff to over thirty. Thus, the full time faculty complement will both grow and maintain continuity. All of the faculty are tenured or tenure track-core faculty members whose graduate involvement is in one of the existing MSc programs in Applied Bioscience; Material Science; or Modelling and Computational Science.

As noted in the original submission for the MSc in Applied Bioscience, one of the strengths is the quality of its members. The professors have an impressive publication record, and have been highly successful in acquiring grant funding from provincial and federal governments as well as private industry sources. Many of the faculty have won awards for their contributions to teaching, research, and community service. Research conducted by faculty members has contributed to the scientific community in a number of areas including, but not limited to, plant genetics, microbial ecology, probiotics, parasitology, cancer biology, applied chemistry, theoretical and physical chemistry, and drug chemistry.

Currently, the Faculty of Science holds two of the five Canada Research Chairs allocated to UOIT. Dr. Douglas Holdway holds a Tier I Canada Research Chair in Aquatic Toxicology and Dr. Shari Forbes holds a Tier II Canada Research Chair in Decomposition Chemistry. Both CRC holders currently have graduate students in the Applied Bioscience program and Dr. Forbes will play an instrumental role in the proposed Forensic Bioscience field.

The research interests of the faculty cover a range of topics within Applied Bioscience with a strong element of interaction between individual members. The following professors of the Faculty of Science were included in the original MSc proposal and will contribute to teaching and supervision in the proposed field of study. Brief outlines are

included to demonstrate their research in applied bioscience and their contribution to the proposed new field.

Dr. Dario Bonetta (Assistant Professor, Faculty of Science)
Dr. Bonetta's training and background spans developmental biology, genetics, molecular biology, and the biochemistry of plant and microbial systems. His research investigates the cell wall biology of plant and fungal systems. Research currently being conducted at UOIT is focusing on forensic botany and forensic mycology in an attempt to identify important plant and fungal species associated with decomposition. Dr. Bonetta's expertises are integral to this research. Dr. Bonetta will also contribute expertise related to molecular biology and will teach courses in the program.

Dr. Shari Forbes (Tier II CRC in Decomposition Chemistry, Assistant Professor, Faculty of Science)
Dr Forbes' background is in applied chemistry and forensic science. Her research incorporates analytical chemistry and biology to study the processes of lipid and protein degradation within soft tissue. Her current focus is to better understand the formation of organic biomarkers in soil as a result of soft tissue decomposition. The process of decomposition is highly dependent on the surrounding environment and consequently a through understanding of the environmental variables on the chemical breakdown of tissue is required. Dr. Forbes' research has applications to police and forensic investigations as well as to the food science industry.

Dr. Sean Forrester (Assistant Professor, Faculty of Science)
Dr. Forrester has been investigating parasitic helminthes for almost 11 years. His current research specializes on ligand-gated chloride channels in parasitic nematodes, a unique field of research in Canada. His specific expertise spans the fields of molecular biology, neurochemistry, molecular pharmacology, and electrophysiology. Dr. Forrester will help supervise projects relating to molecular biology, particularly the investigation of DNA evidence in a forensic context, and will also contribute his expertise towards projects relating to pharmacology and toxicology.

Dr. Julia Green-Johnson (Associate professor, Faculty of Science)
Dr. Green-Johnson's research deals with functional food components and their ability to influence the immune system, with a focus on their bioactivity in the mucosal environment. Her research program also involves characterization of bioactive products produced by lactic acid bacteria in milk and soy fermentations; microbe-host cell interactions, with an emphasis on the impact of probiotics and their bioactive products on cytokine and eicosanoid production; and neuroimmune interactions in the context of the mucosal microenvironment. Dr. Green-Johnson will predominantly contribute towards teaching within the proposed new field.

Dr. Douglas Holdway (Tier I CRC in Aquatic Toxicology, Full Professor, Faculty of Science)
Dr. Holdway's research examines ecotoxicological impacts of contaminants upon aquatic organisms, populations and communities; development and application of biomarkers of contaminant exposure and effects in aquatic organisms; effects of contaminant pulse-exposure on reproduction and long-term population health in aquatic ecosystems; and the detection of pathogens in drinking water. His research has a considerable impact on the relatively new area of environmental forensics which deals with civil and criminal investigations to determine sources of chemical contamination and

timing of releases to the environment. Environmental forensics is an area of investigation at the junction of the chemical and biological sciences and naturally fits within the proposed new field of forensic bioscience.

Dr. Holly Jones-Taggart (Assistant Professor, Faculty of Science (25%), Faculty of Health Sciences (75%))
Dr. Jones-Taggart research focuses on cancer metastasis to identify new pathophysiologic steps as potential oncologic therapeutic targets. Her research contributes to the growing evidence that the microenvironment of local host tissue actively participates in the prosperity of certain cancers to metastasize to specific organs. Her expertise includes cell based assays and the analysis of genetic pathways controlling migration, proliferation and survival of cancer cells as well as molecular biology tools for analyzing and manipulating gene expression. Dr. Jones-Taggart will help supervise research incorporating molecular biotechnology and bioanalytical techniques applied to forensic evidence.

Dr. Krisztina Paal (Assistant Professor, Faculty of Science)
Dr. Paal has a breadth of experience in biological and organic chemistry including site-specific covalent modification of proteins, ligand-protein binding interactions, enzymology, and organic synthesis. Her research focuses on developing hemoglobin-based red cell substitutes, kinetic characterization of enzymes involved in glycolipid metabolism, and binding interactions between paclitaxel and human serum albumin. As a result of her expertise in drug chemistry, she presently sits on the committee for a Masters student in the Applied Bioscience program comparing the antemortem and postmortem stability of incorporated drug analytes within hair. She will contribute towards additional research in the areas of drug chemistry and forensic toxicology in the proposed new field.

Dr. Otto Sanchez (Associate Professor, Faculty of Health Sciences)
Dr. Sanchez's research encompasses cancer biology, with emphasis on the problems of carcinogenesis, metastasis and experimental therapeutics. His diverse educational and professional experience as a medical doctor and pathologist, combined with graduate studies in cancer cytogenetics and metastasis, allows him to focus on research that aims at linking cellular and molecular cancer events to their potential clinical impact. He will contribute predominantly towards teaching in the proposed new field and can offer expertise to potential graduate students interested in the forensic pathological sciences.

Dr. Janice Strap (Assistant Professor, Faculty of Science)
Dr. Strap is a microbiologist who has experience in the fields of medical microbiology, phylogenetic analysis, microbial ecology and environmental microbiology. Her current research interests include: the investigation of diverse microbial communities in deep subsurface environments; use of environmental genomics to understand why some agricultural soils are suppressive for specific plant pathogens; and investigating the molecular basis of the ecophysiology of actinomycetes. Dr. Strap is presently on the committee for a Masters student in the Applied Bioscience program who is investigating the biochemical alteration of soil as a result of decomposition products. She will also sit on the committee for a new Masters student starting in September 2008 who plans to investigate the microbial community associated with decomposition using a metagenomics approach. This new area of research is referred to as Forensic Bacteriology.

New Faculty

Since the submission of the original proposal, one new Assistant Professor has been hired for the program. Dr. Cecilia Hageman has a BSc in Genetics, a PhD in Plant Sciences as well as an LL.B., and brings unique skills in forensic biology and legal expertise to the Faculty. Dr. Hageman has taken a leave of absence from the Ontario Centre of Forensic Sciences to be involved in the BSc in Forensic Science program at UOIT. At the conclusion of her term, Dr. Hageman will continue as an Adjunct Professor with UOIT and will contribute to the proposed Forensic Bioscience field. A CV for Dr. Hageman is provided in Appendix A.

The Faculty of Science has made a commitment to replace Dr. Hageman's position with another member of the Centre of Forensic Science's biology section. This commitment is based on the wealth of knowledge and experience that is provided by an industry expert who is actively involved in both casework and forensic research. The skills of an active forensic scientist have added additional credibility and considerable scope to the undergraduate forensic science program and it is expected that they will contribute the same value to the proposed graduate field in Forensic Bioscience.

In addition, the Faculty of Science has added two more members to the Applied Bioscience MSc program. Dr. Ayush Kumar, who has expertise in Molecular Microbiology, is a new core member of the graduate faculty and Dr. David Carter is a new Adjunct Assistant Professor (Special Faculty Category) who has specific expertise in decomposition soil ecology and will serve as co-supervisor for students in the proposed field. CVs for Dr. Kumar and Dr. Carter are provided in Appendix A.

In 2009, the Faculty of Science plans to hire a new Professor dedicated to the field of forensic science. The new faculty member will hold a PhD in either biology or chemistry (or a related field), will have expertise in the field of forensic science, and will be expected to contribute towards the proposed graduate 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.

Faculty Research Interests

The professors in the Faculty of Science are currently engaged in the following areas of research relevant to the proposed field:

- Biochemistry of soft tissue decomposition
- Nutrient cycling in soils and degradation of organic matter
- DNA analysis of forensically-important bacterial species in soil
- Biochemistry of plant and fungal systems
- Bioinformatics
- Molecular pharmacology and parasitology
- Drug chemistry and toxicology
- Environmental forensics
- Legal and judicial interpretation of statistical data in forensic science

The chart below identifies the core faculty members in the MSc in Applied Bioscience program and the fields (including the proposed new field in Forensic Bioscience) to which they will contribute.

Core Faculty in MSc in Applied Bioscience Program

Faculty Name & Rank	M/ F	Home Unit	Supervision Privileges	Current Fields	Proposed New Field – Forensic Bioscience
Category 1					
Emma Bartfay - Associate	F	Health Sciences	Full	ESH	
Wally Bartfay - Associate	M	Health Sciences	Full	ESH	
Dario Bonetta - Assistant	M	Science	Full	BMS	**X**
Shari Forbes – Assistant	F	Science	Full	BMS	**X**
Sean Forrester - Assistant	M	Science	Full	BMS	**X**
Julia Green-Johnson – Associate	F	Science	Full	BMS	**X**
Douglas Holdway – Full	M	Science	Full	ESH	**X**
Holly Jones-Taggart – Assistant	F	Health Sciences & Science	Full	ESH BMS	**X**
*Ayush Kumar, Assistant	M	Health Sciences	Full	BMS	**X**
Krisztina Paal - Assistant	F	Science	Full	BMS	**X**
Otto Sanchez - Associate	M	Health Sciences	Full	ESH BMS	**X**
Janice Strap – Assistant	F	Science	Full	BMS	**X**
Carolyn Byrne – Full & Dean of Health Science	F	Health Sciences	Full	ESH	
Category 3					
Fedor Naumkin - Assistant	M	Science	Full	BMS	
Category 5					
*Cecilia Hageman – Assistant	F	Science	Full	BMS	**X**
*David Carter – Assistant University of Nebraska Lincoln Adjunct Professor - UOIT	M	Science	Full	BMS	**X**

* New to the Faculty since the submission of the MSc in Applied Bioscience brief.

BMS - Biomolecular Science
EHS - Environmental Sciences and Health

Category 1: tenured or tenure-track core faculty members whose graduate involvement is in the Applied Bioscience program

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 Applied Bioscience program

Category 5: other core faculty: this category may include emeritus professors with supervisory privileges and persons appointed from government laboratories or industry as adjunct professors.

4. DEGREE REQUIREMENTS AND PROGRAM SEQUENCE

As outlined in the original program submission, the learning outcomes for the Applied Bioscience program are achieved through a combination of coursework, supervised research, a research seminar, and a research thesis. The combination of projects and/or research is designed collaboratively involving the student and an assigned faculty member, in conjunction with an advisory committee. Each learner has the opportunity to develop the prerequisites for specialized practice or advanced study in the fields of biomolecular science and/or environmental science and health.

Learning activities and materials in the graduate courses have been carefully designed to ensure that learners are exposed to study which is at the forefront of scientific theory and practice. The courses provide students with in depth learning in a specialized area of science, the opportunity for advanced development of common skills such as communication and teamwork, as well as participation in the scholarly activities of research, seminars, and presentations.

All Applied Bioscience graduate students must successfully complete three 3-credit courses (as outlined below) and must prepare and orally defend a thesis.

Core Courses (required)

- Research in Applied Bioscience (3 credits)
- Seminar in Applied Bioscience
- Thesis in Applied Bioscience (21 credits)

In addition, students must successfully complete two of the following electives.

Elective Courses

- Advanced Topics in Biological Chemistry (3 credits)
- Advanced Cell and Molecular Biology (3 credits)
- Environmental Determinants of Health (3 credits)
- Advanced Topics in Forensic Bioscience (3 credits) (NEW)

Students who wish to focus on the field of *Forensic Bioscience* will be required to take the new proposed course Advanced Topics in Forensic Bioscience as one of their electives. The other elective will be chosen from the electives already available within the Applied Bioscience program. The current courses focus on a diverse range of bioscience topics and will provide the student with a strong core foundation in this area on which they can build an understanding of the forensic applications.

Program and Sequence of Study

Program Map for students selecting the field of Forensic Bioscience in the Master of Science in Applied Bioscience program	
MSc – Year 1, Semester 1	Research in Applied Bioscience Initiation of research program
MSc – Year 1, Semester 2	Advanced Topics in Forensic Bioscience (proposed new course) **AND** One elective course from the following: ▪ Advanced Topics in Biological Chemistry ▪ Advanced Cell and Molecular Biology ▪ Environmental Determinants of Health
MSc – Year 2, Semester 1	Masters thesis research
MSc – Year 2, Semester 2	Completion of Thesis in Applied Bioscience Seminar in Applied Bioscience

5. NEW COURSES

The current selection of elective courses provides a solid foundation in the biosciences, and a new course is proposed to accommodate the inclusion of the proposed new field. ***Advanced Topics in Forensic Bioscience*** course will be taken by all students conducting research in the Forensic Bioscience field.

OUTLINE FOR PROPOSED NEW COURSE

Course Title: **Advanced Topics in Forensic Bioscience**

Prerequisite: APBS 6010G Research in Applied Bioscience; enrolment in the Forensic Bioscience field

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

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

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

6. PROGRAM REQUIREMENTS

Admission Requirements

The introduction of a new field will not necessitate any major changes to the minimum admission requirements for the approved MSc program. Each applicant to the Master's program in Applied Bioscience must meet the following requirements:

1. An honours undergraduate degree in Biology, Chemistry, or a related field, with a minimum grade point average of a second class B average (3.0 on 4.3) in the last two years of their respective BSc (Hons) program.
2. To assist with the assessment of the application, the student should provide relevant course numbers, titles, a brief description of course content, textbooks used and/or chapters covered, and the grade received
3. Admission depends on the availability of a Research Supervisor
4. The student must submit an official transcript from all post-secondary institutions attended
5. All non-English transcripts must be accompanied by an official translation. International students whose first language is other than English must meet the University's Language Requirements

In addition, applicants to any of UOIT's graduate programs must provide a minimum of two letters of reference from persons having direct knowledge of their academic competence, proof of English proficiency if the first language is not English, and a one-page statement of interest outlining their objectives in undertaking graduate study.

Degree Requirements

With the exception of the addition of one new elective, the degree requirements outlined in the original MSc in Applied Bioscience program submission will apply to the new field. As noted, students in the new proposed field of Forensic Bioscience will be expected to take the elective, Advanced Topics in Forensic Bioscience, in conjunction with one other elective.

Program Outcomes

The following are the objectives of the program as defined in Section 1.4 of the original MSc in Applied Bioscience program submission.

1. Demonstrate specialized knowledge and understanding of essential facts, concepts, principles, and theories in a specific area of advanced study
2. Apply the knowledge gained in their studies to specific research questions
3. Demonstrate a critical awareness of current problems and new knowledge about a particular area of applied bioscience research
4. Interpret current research trends and suggest future research avenues within the fields of applied bioscience
5. Understand the connections between biology, chemistry, and life sciences and acknowledge the value of diverse interpretations, methods, and disciplines in solving research problems

6. 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
7. Identify practical implications of applied bioscience research for both the scientific community and the general public
8. Use established techniques of research and enquiry to formulate specific research questions, propose and test hypotheses, determine methodologies, and interpret results
9. Recognize and be guided by social, professional, and ethical expectations and concerns involved in advanced education and research
10. Demonstrate safe and competent use of laboratory tools, equipment and techniques, including cutting-edge technology in biology and chemistry, to support research activities
11. Communicate conclusions of their research clearly and effectively to both specialist and non-specialist audiences
12. Demonstrate qualities and transferable skills necessary for employment
13. Act independently to plan and implement activities to advance their knowledge and skills

These program outcomes and targeted skills are equally applicable to all students in the MSc in Applied Bioscience program, whether they choose to focus their research on biomolecular science, environmental health and science, or the proposed field of forensic bioscience.

Intellectual Development and Educational Experience

The original MSc in Applied Bioscience was carefully designed to support the intellectual development and educational experience of the student. Section 4.1 in the original brief outlined aspects of the educational environment and proposed learning activities (both formal and informal) which would contribute to these goals. These include implementation of an interdisciplinary advisory committee for each graduate student, the opportunity to participate in teaching and instructional development, carefully designed curricula to highlight the interdisciplinary focus of the program, rigorous and clearly defined expectations, mentoring by high quality faculty members, exposure to a wide range of experts within and outside their immediate profession, and the opportunity to present their research at regional, national, or international conferences. The provision of a range of activities which encourage graduate students to develop and interact within a supportive community of peers will enhance their educational experience at UOIT.

The program reflects UOIT's commitment to providing innovative programs through excellence in teaching and learning, value-added research and vibrant student life. We believe that the opportunity to extend students' options to include the field of Forensic Bioscience benefits students by building on the existing base of advanced knowledge and research methodology as well as providing them with the opportunity to examine and contribute to a new and critical area of study within the discipline. The foundation of Forensic Science is built on fundamental biological and chemical principles. Therefore, developing a field within the Applied Bioscience program will not only provide students with specialized knowledge related to Forensic Bioscience but expose students to current knowledge related to molecular biology, environmental health, and biological chemistry, providing a comprehensive educational experience.

7. CONTRIBUTIONS TO THE UNIVERSITY'S MISSION

As noted in Section 1 of this report, the inclusion of a field of Forensic Bioscience in the MSc in Applied Bioscience program will fill the demand for trained professionals who are exposed to state of the art technology, theory and skills in forensic bioscience. This reflects one of the key elements of the University's mission: to provide innovative programs which are responsive to the needs of students and employers and which advance the highest quality of both research and learning, teaching, and professional practice in a technologically enabled environment. In addition, focused study and research in this critical area will also support the University in its efforts to make significant contributions to the understanding and resolution of important issues which affect Canadians on a national and global scale.

8. IMPACT OF NEW FIELD ON THE ALREADY APPROVED MSc IN APPLIED BIOSCIENCE PROGRAM

The introduction of a third field in the program will not result in the diversion of faculty from previous graduate courses and/or supervision. The faculty members in this program are tenured or tenure track-core faculty members.

Since the implementation of the original program, a new position has been created in the Faculty of Science, directly related to the proposed new field of forensic bioscience. In addition, the Faculty of Science has added two further members to the Applied Bioscience MSc program, who have expertise in molecular microbiology and decomposition soil ecology. An additional new faculty member with a background in forensic science is planned to be hired in the next round of hiring. The qualifications and research experience of these new faculty members will add value to the approved program, and make it possible to provide teaching/supervision for students in the proposed specialized field of forensic bioscience. Finally, the award of a Tier II Canada Research Chair to Dr. Forbes will enhance the capacity to supervise students in the proposed field.

The introduction of the new field will not result in a major increase in the enrolment targets of the MSc program listed in the original submission. It is anticipated that the new faculty resources will accommodate increases due to the new field without any negative effect on the original program.

Existing space and technological resources will be sufficient to support this field. An additional research facility that will be utilized in the proposed field will be the UOIT Crime Scene House. The house is currently used as a training facility to teach students and police officers the practical aspects of crime scene investigation. Research that is designed to improve or enhance crime scene skills may be conducted within the house to test the methodologies in a realistic environment. The Geoforensic Research Facility has also been implemented since the submission of the original MSc in Applied Bioscience program. As part of the Canada Research Chair program, Dr. Forbes received funding through the Canada Foundation for Innovation (CFI) to establish an outdoor research facility for decomposition research. This facility will allow graduates enrolled in the proposed new field to also conduct research in a realistic forensic setting.

Library collections and resources will be enhanced to reflect the new areas of content.

APPENDIX A: CURRICULA VITAE FOR FACULTY NEW TO PROGRAM

Dr. Ayush Kumar

Dr. Cecilia Hageman

Dr. David Carter