Carleton UNIVERSITY
Canada's Capital University

Office of the Vice-Provost and Associate Vice-President (Academic)

memorandum

DATE: November 18, 2016

TO: Senate

FROM: Dr. John Shepherd, Vice-Provost and Associate Vice-President (Academic), and Vice-Chair, Senate Academic Program Committee

RE: Joint PHD program in Biomedical Engineering, Joint with the University of Ottawa – **New Program Approval**

SAPC Motion

THAT SAPC recommends to Senate the approval of the commencement of the Joint PhD program in Biomedical Engineering with the University of Ottawa with effect from September 2017, with a report to be submitted to the Ottawa Carleton Committee on Graduate Quality Assurance by June 30, 2019 on a reconsideration of the requirement that students entering the program who have already successfully completed BIOM 5010/BMG 5112 or the equivalent be required to take an additional 3 credit (University of Ottawa) or 0.5 credit (Carleton University) elective.

Senate Motion

THAT Senate approve the commencement of the Joint PhD program in Biomedical Engineering with the University of Ottawa with effect from September 2017, with a report to be submitted to the Ottawa Carleton Committee on Graduate Quality Assurance by June 30, 2019 on a reconsideration of the requirement that students entering the program who have already successfully completed BIOM 5010/BMG 5112 or the equivalent be required to take an additional 3 credit (University of Ottawa) or 0.5 credit (Carleton University) elective.

Background

The PHD program in Biomedical Engineering is a joint program with the University of Ottawa and is governed by the Joint Institutional Quality Assurance Process.

The program has followed the necessary approvals processes at each of the universities. These approval processes involve first a decision from the Ottawa Carleton Committee on Quality Assurance. From that point the proposal is considered by the Graduate Program Committee, Senate Executive and Senate at the University of Ottawa, and the Carleton University Committee on Quality Assurance, Senate Academic Program Committee and Senate at Carleton University. The proposed program is to be considered by the University of Ottawa's Senate on November 28th.

The requirement for a report originated with the Ottawa Carleton Committee on Quality Assurance and has subsequently been endorsed by all committees at the University of Ottawa and Carleton University.

Senators will note that the self-study (Appendix A) contains additions and changes using track changes. The reason for this is that the Quality Council Appraisal Committee appreciates seeing easily identifiable evidence in the self-study for a proposed program when the champions of the program have responded to recommendations made by the external academic reviewers or observations made by university committees as these committees have reviewed the documentation after the external academic reviewers have submitted their report and the program champions have responded to it.

Attachments

Appendix A: Self-Study with Appendices (updated)
Appendix B: Discussant's Report
Appendix C: Site Visit Agenda and Brief Biographies of External Reviewers
Appendix D: External Reviewers' Report
Appendix E: Response to the External Reviewer's Report
Appendix F: Discussant's Final Recommendation Report
Appendix G: Recommendation from the Carleton University Committee on Quality Assurance

Quality Assurance Framework and Carleton's Institutional Quality Assurance Process (IQAP)

Upon the proposed program being approved by the Senates of the University of Ottawa and Carleton University, the required documentation will be submitted to the Quality Council for its review and a decision on whether PHD program in Biomedical Engineering will be authorized to commence.

Office of the Vice-Provost and
Associate Vice-President
(Academic)

Institutional Quality Assurance Process

Biomedical Engineering

PhD

(Volume I)

June 17, 2016

Approvals Table

Program Lead **Adrian D. C. Chan, Department of Systems & Computer Engineering, Carleton University**	**Date**
Chair/Director(s): **Andy Adler, Director, Ottawa-Carleton Institute for Biomedical Engineering, Carleton University**	**Date**
Hilmi Dajani, Associate Director, Ottawa-Carleton Institute for Biomedical Engineering, University of Ottawa	**Date**
Dean(s): **Matthias Neufang, Dean, Faculty of Graduate & Postdoctoral Affairs, Carleton University**	**Date**
Rafik Goubran, Dean, Faculty of Engineering & Design, Carleton University	
Malcolm Butler, Dean, Faculty of Science, Carleton University	
Claire Turenne-Sjolander, Dean (interim), Faculty of Graduate & Postdoctoral Studies, University of Ottawa	
Claude Laguë, Dean, Faculty of Engineering, University of Ottawa	

Committees Reviews and Approvals

Carleton University

Vice-Presidents' Academic Research Committee	October 28, 2015
Financial Planning Group	December 14, 2015
Curriculum Committee	March 2, 2016
Faculty Board	March 16, 2016
Ottawa-Carleton Committee on Graduate Quality Assurance	May 24, 2016
Carleton University Committee on Quality Assurance	October 26th, 2016
Senate Committee on Curriculum, Admissions on Studies Policy	November 1rst, 2016
Senate Academic Program Committee	November 3rd, 2016
Senate	November 25th, 2016
Quality Council	

University of Ottawa

University of Ottawa FGPS Council (letter of intent)	December 9th, 2015
Ottawa-Carleton Joint Committee	October 19, 2016
University of Ottawa Sous-Comité	October 3, 2016
University of Ottawa FGPS Council	October 19th, 2016
University of Ottawa Executive Senate	November 15th, 2015
University of Ottawa Senate	November 28th, 2016

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List of Abbreviations

CHEO	Children's Hospital of Eastern Ontario
CHG	Department of Chemical and Biological Engineering (University of Ottawa)
CRC	Canada Research Chair
CU	Carleton University
EECS	School of Electrical Engineering and Computer Science (University of Ottawa)
EMBS	Engineering in Medicine and Biology Society
FGPA	Faculty of Graduate and Post-doctoral Affairs (Carleton University)
FGPS	Faculty of Graduate and Post-doctoral Studies (University of Ottawa)
IEEE	Institute of Electrical and Electronics Engineering
MAE	Department of Mechanical and Aerospace Engineering (Carleton University)
MCG	Department of Mechanical Engineering (University of Ottawa)
OCIBME	Ottawa-Carleton Institute for Biomedical Engineering
OHRI	Ottawa Hospital Research Institute
PHYS	Department of Physics (Carleton University)
SCE	Department of Systems and Computer Engineering (Carleton University)
SCS	School of Computer Science (Carleton University)
TOH	The Ottawa Hospital
TRC	The Ottawa Hospital Rehabilitation Centre
UO	University of Ottawa
UOHI	University of Ottawa Heart Institute

PART A THE PROGRAM

A.1 Program overview

A.1.1 Background

The Ottawa-Carleton Institute for Biomedical Engineering (OCIBME) was established in 2006. This multi-disciplinary institute combines resources from seven participating academic units:

- Carleton University (CU)
  - Department of Systems & Computer Engineering (SCE)
  - Department of Mechanical & Aerospace Engineering (MAE)
  - School of Computer Science (SCS)
  - Department of Physics (PHYS)
- University of Ottawa (UO)
  - Department of Mechanical Engineering (MCG)
  - School of Electrical Engineering & Computer Science (EECS)
  - Department of Chemical & Biological Engineering (CHG)

The Institute draws on the expertise of two participating medical research units: the University of Ottawa Heart Institute (UOHI) and the University of Ottawa Eye Institute. It also draws on the expertise of a number of prominent researchers from other associated academic units in the two universities and medical professionals from hospitals and well-established medical research institutions. Students enrolled in a graduate program of OCIBME are hosted by one of the participating academic units. OCIBME members may also be drawn from an associated academic unit and receive co-supervisory privileges.

OCIBME has been offering a multi-disciplinary Master of Applied Science degree (MASc) in Biomedical Engineering since its inception in 2006; this was one of the first graduate degrees in biomedical engineering in Canada. The program underwent a Cyclical Program Review that was completed in 2015, with a final evaluation of Good Quality with Report.

OCIBME has four main research fields identified:

1. Medical Instrumentation
2. Biomedical Image Processing
3. Biomechanics & Biomaterials
4. Medical Informatics & Telemedicine

The MASc in Biomedical Engineering is part of the collaborative program in Data Science at Carleton University and was added to the Ottawa-Carleton Joint Collaborative Program in Bioinformatics (introduced for 2016/17). The masters-level program was also expanded to include a coursework-only based completion option and a coursework plus project completion option (introduced for 2016/17); these completion options use the MEng degree designation, which is common practice for non-thesis based masters programs in engineering, and is generally considered a terminal degree. The MEng in Biomedical Engineering also includes a concentration in Clinical Engineering, which is comprised of a coursework, project, and internship. The MEng in Biomedical Engineering was identified as an opportunity for a program enhancement during the last Cyclical Program Review of the joint Ottawa-Carleton MASc Program in Biomedical Engineering.

In addition, Carleton University and the University of Ottawa each offer successful biomedical engineering undergraduate programs, which are accredited by the Canadian Engineering Accreditation Board. At Carleton University, there is the BEng in Biomedical & Electrical Engineering (introduced in 2006) and BEng

in Biomedical & Mechanical Engineering (introduced in 2008). New first year registrations per year, averaged over the past three years, have been 42 and 47 students for the two programs, respectively. At the University of Ottawa, there is the BASc in Biomedical Mechanical Engineering (introduced in 2006). New first year registrations per year averaged 82 over the past three years.

OCIBME has close ties with local Ottawa hospitals, which provides unique opportunities for students. The Ottawa Hospital is a leading academic health sciences centre in Canada. It is one of the largest teaching hospitals in Canada, with specialty centres in cancer, heart, kidney and vision care, as well as rehabilitation service. Some of the unique divisions of The Ottawa Hospital and other hospitals, where OCIBME members have collaborative relationships, include:

- University of Ottawa Heart Institute (UOHI): Canada's largest and foremost cardiovascular health centre.
- The Ottawa Hospital Rehabilitation Centre (TRC): specializes in the physical rehabilitation of people who have experienced a disabling physical illness or injury.
- Children's Hospital of Eastern Ontario (CHEO): a pediatric health and research center providing services to Eastern Ontario, Western Quebec, Nunavut, and parts of Northern Ontario. CHEO has established itself as a world-class centre providing leading-edge treatment, diagnostic and laboratory services for children and youth.
- Élisabeth Bruyère Hospital: Ottawa's largest single site provider of in-patient rehabilitation. The rehabilitation program is designed to maximize the functional ability of patients who have suffered an injury and offers geriatric, stroke and neuromusculoskeletal rehabilitation. Élisabeth Bruyère Hospital is also home to Canada's largest academic palliative care and end-of-life hospital unit and is Ottawa's only palliative care hospital unit.

A few specific examples of collaborations with local hospitals include:

- Dr. Natalie Baddour (MCG) and Dr. Edward Lemaire (TRC): wearable mobility monitoring using a smartphone-based approach
- Dr. Isabelle Catelas (MCG) and Dr. Paul Beaulé (OHRI/TOH): hip implant arthroplasties: prospective database and study
- Dr. Xudong Cao (CHG) and Dr. Eve Tsai (Civic Hospital): recruiting endogenous stem cells for the repair of spinal cord injuries
- Dr. Adrian Chan (SCE) and Dr. David Grynspan (CHEO): objective and subjective measures of the distal villous hypoplasia pattern in placentas
- Dr. Adrian Chan (SCE) and Dr. Homer Yang (TOH): perioperative ischemia reduction study
- Dr. Hanspeter Frei (MAE) and Dr. Paul Beaulé (TOH): effect of surgical correction on acetabular labrum seal
- Dr. Hanspeter Frei (MAE) and Dr. Eugene Way (TOH): patient specific spinal fusion cages
- Dr. Rafik Goubran (SCE) and Dr. Frank Knoefel (Elisabeth Bruyère Hospital): technology to support and monitor ageing, including the AGE-WELL National Centres of Excellence
- Dr. Michel Labrosse (MCG), Dr. Munir Boodhwani (UOHI), Dr. Vincent Chan (UOHI), and Dr. Benjamin Sohmer (UOHI): development of computational tools for patient-specific aortic valve repair simulation
- Dr. Sangeeta Murugkar (PHYS), Dr. Libni Eapen (TOH), Dr. M. Niedbala (TOH), Dr. Balazs Nyiri (TOH), and Dr. Barbara Vanderhyden (CMM, U Ottawa): characterization of radioresistance in human ovarian cancer cells using Raman techniques
- Dr. Andrew Speirs (MAE) and Dr. Paul Beaulé (TOH), Dr. Greg Cron (TOH), and Dr. Wade Gofton (TOH): osteochondral permeability and the role of cartilage-bone cross talk in osteoartritis.

- Dr Andrew Speirs (MAE), Dr. Paul Beaulé (TOH), and Kawan Rakhra (TOH): subchondral bone changes in femoroacetabular impingement.

A.1.2 Proposed Program

A PhD in Biomedical Engineering is being proposed which builds upon the existing successful undergraduate and graduate programs. The PhD program extends the graduate multidisciplinary program offerings to effectively provide knowledge and skills required at the interface between engineering and medicine.

The PhD program in Biomedical Engineering was identified as an opportunity for growth during the last Cyclical Program Review of the joint Ottawa-Carleton MASc Program in Biomedical Engineering.

A.1.3 Program Goals

The proposed PhD program in Biomedical Engineering will complement the existing MASc/MEng program in Biomedical Engineering. The goal of this PhD program is to provide advanced education and research opportunities in applying engineering knowledge and principles in the area of medicine and biology. The PhD program provides opportunities, at the cutting-edge of biomedical engineering, for generating new innovative knowledge and applications. As with the existing MASc/MEng program in Biomedical Engineering, the PhD program in Biomedical Engineering is intended to be a multidisciplinary degree, welcoming applicants from a wide variety of academic backgrounds, including: engineering, science, computer science, biomedical sciences, health sciences, or a related discipline.

A.1.4 Program Structure

The program calendar details are provided in PART I of this program brief. It is noted that course codes are different between Carleton University and the University of Ottawa. Carleton University course codes are specified, with the corresponding University of Ottawa course code in brackets. The credits counts are also different between the two institutions. A regular full term course is 0.5 credit at Carleton University and 3 credits at University of Ottawa. Carleton University credit counts are specified, with the corresponding University of Ottawa credit counts in brackets. University of Ottawa also does not specify a credit count for their PhD thesis.

All biomedical engineering graduate programs (i.e., masters-level and PhD) have been designed to provide foundation knowledge in biomedical engineering through the compulsory course BIOM 5010 (BMG 5112) Introduction to Biomedical Engineering. This course provides students a background on human anatomy and physiology, research methods, research ethics, and engineering systems approaches for analysis and modeling. PhD students with a biomedical engineering background (e.g., completed the MASc in Biomedical Engineering) that have already completed BIOM 5010 (BMG 5112), or equivalent, would have this compulsory requirement considered fulfilled; in such cases, students will be required to replace that requirement with another course (free elective), selected in consultation with their supervisor. In addition, all biomedical engineering graduate programs include the seminar course BIOM 6800 (BMG XXXX) Biomedical Engineering PhD Seminar. This seminar course provides student some breadth, an opportunity to develop their communication skills, interact with researchers in the area of biomedical engineering, and a forum to network and build a student community in biomedical engineering. The BIOM 6800 (BMG XXXX) seminar parallels the BIOM 5800 (BMG 6996) Biomedical Engineering Seminar that is required in the masters-level program in Biomedical Engineering and shown to be a useful program element.

Similar to other engineering graduate PhD programs, which are jointly offered between Carleton University and the University of Ottawa, the PhD program consists of 3 courses and a thesis; the seminar is in addition to these 3 courses.

OCIBME Biomedical Engineering programs have at least half the coursework as biomedical engineering courses (BIOM (BMG) coded courses); for the PhD this amounts to two of the three course requirements. There is an unrestricted elective that allow students to choose courses from any discipline depending on the needs of their education and thesis research. Biomedical engineering, being a multidisciplinary area of research, benefits from such flexibility in the program. As with other joint programs, students in this PhD program may choose elective graduate courses from either university. Enrollment in a course may be subject to the approval of the unit offering the course, which will address issues regarding resource availability (e.g., class size limitations) and prerequisite knowledge. Electives also require the approval of the Program Director, which provides oversight in the selection of appropriate electives.

A.1.5 Program Distinctiveness

A number of Biomedical Engineering programs exist across Canada (PART J). Biomedical engineering is a large growth area (see PART K). This level of growth is due to the large demand for technology in healthcare (research, design, and implementation) to improve efficiency and efficacy. These demands are also increasing for a variety of reasons, including the aging population. As such, there is a growing need for highly qualified personnel in the area of biomedical engineering, which this proposed PhD program will help address.

Carleton University and University of Ottawa have a good history of delivering academic programs in Biomedical Engineering at the undergraduate and graduate level. The proposed PhD program provides several new and unique research dimensions in the field of biomedical engineering relative to other biomedical programs in Canada. This PhD program enjoys the unique advantage of being offered jointly by a number of academic units (departments/schools) from two university institutions. Each of these units have distinguished research strengths and recognized contributions in a number of biomedical research fields. The PhD program presents a unique opportunity to benefit from the synergy of combining the diverse background and expertise of a number of prominent researchers at both universities. The OCIBME membership includes 5 Canada Research Chairs (CRC): Andy Adler (CU, Tier II Biomedical Engineering), Winnie Ye (CU, Tier II Nano-scale Integrated Circuit Design for Reliable Opto-electronics and Sensors), Sreeraman Rajan (CU, Tier II Sensor Systems), Isabelle Catelas (UO, Tier II Bioengineering in Orthopedics), and Azzedine Boukerche (UO, Tier II Large-Scale Distributed Interactive Simulations and Mobile Computing and Networking). The OCIBME membership also includes 4 University of Ottawa Research Chairs: Pierre Berini, Abdulmotaleb El-Saddik, Emil Petriu, and Jianping Yao. OCIBME leverage features of being a joint institute between the two universities, including shared teaching and guest lectures, joint research projects, graduate student co-supervision, and participation in thesis examination committees. The sharing of research/laboratory facilities and major research collections between the two institutions also provides students with a broad spectrum of research resources.

OCIBME has good collaborative relationships with local hospitals. The Ottawa Hospital is a leading academic health sciences centre in Canada and one of the largest teaching hospitals in Canada. It ranks third out of more than 600 Canadian hospitals for competitive, Canadian Institutes of Health Research (CIHR) peer-reviewed grants.

OCIBME has begun working with programs that support entrepreneurship, such as Invest Ottawa and Lead to Win. Graduate students in Biomedical Engineering have also participated in the Prizes in Entrepreneurship and Innovation (PEI) student competitions that are supported by the University of Ottawa Faculty of Engineering's Entrepreneurship and Innovation Endowment Fund (EIEF). These

supports will help technology transfer in research and innovation within the field of biomedical engineering. Indeed, several members of OCIBME have already contributed to founding spin-off companies based on technologies developed in their academic laboratories, including:

- GaitTronics Inc. (www.gaittronics.com)
- neurOQOre Inc. (www.neuroqore.com)
- Health Parametrics Inc. (www.healthparametrics.com)

A.2 Mission and strategic direction

A.2.1 Carleton University

The proposed PhD program in Biomedical Engineering is consistent with Carleton's Strategic Integrated Plan (2013-2018). It aligns with the values of Excellence, Interdisciplinarity, Experiential Learning and Student Engagement, and Collaboration and Partnerships. The program aligns with aspects of Programs and Enrolment (Theme 1), Research (Theme 2) and Students (Theme 3); more specifically:

Goal 1-1: To develop new programs and initiatives that build on academic strengths and respond to societal needs.

- The PhD program builds upon the strengths of Carleton University's Biomedical Engineering programs that currently exist at the undergraduate level (BEng in Biomedical & Electrical, and BEng in Biomedical & Mechanical) and graduate level (MASc/MEng in Biomedical Engineering). It also expands existing relationships with local Ottawa hospitals, including The University of Ottawa Heart Institute (UOHI), Children's Hospital of Eastern Ontario (CHEO), Élisabeth Bruyère Hospital, and The Ottawa Hospital. There is a growing societal need for biomedical engineering programs. In traditional clinical settings (e.g., hospitals), medical technology is becoming increasing prevalent and essential. There is also a rapid increase in so-called Patient Empowering – Information Leveraging Technologies, which include technology for health, wellness, and performance, that are being used outside clinical settings, such as smart health homes and wearables. Biomedical research has also involved industrial collaborations that are continuing to expand, providing knowledge translation pathways, including commercialization.

Goal 1-2: To ensure the sustainability of Carleton University through a long-term enrolment model and effective and efficient management of resources.

- Over the years, Carleton University has built up an institutional strength in biomedical engineering. There exists a good foundation of resources (e.g., courses, laboratories, and faculty) in related programs, including the BEng in Biomedical & Electrical, BEng in Biomedical & Mechanical, and MASc/MEng in Biomedical Engineering, and collaborations with industry, hospitals, and other research institutes. The proposed PhD program continues to build upon these strengths, leveraging existing resources to deliver quality programs in an effective and efficient manner.

Goal 2-1: To enhance Carleton University as a highly reputable research-intensive comprehensive university

- Faculty members in OCIBME have a good record of research excellence, demonstrated by various indicators such as research publications, research grants, awards and honours, and knowledge mobilization. The PhD program will enhance the breadth and depth beyond the existing MASc/MEng program in Biomedical Engineering. Relationships with the local Ottawa

hospitals, researchers at the Ottawa Hospital Research Institute (OHRI), and industry will also be strengthened by the PhD program, enabling greater knowledge mobilization to knowledge-users and knowledge translation, including commercialization.

Goal 3-1: To ensure the employability and future success of our students through experiential learning, engagement, innovative teaching, and holistic support services.

- OCIBME has demonstrated a strong commitment to the student experience, including providing a foundation course for critical and creative thinking, integrity and ethical conduct (including research ethics), and research methods. The program structure includes a forum for students to gain knowledge from various speakers (e.g., researchers, government, and industry) and has included seminars on presentation skills and research management. OCIBME students have also had opportunities for research collaborations with industry, commercialization opportunities (including spin-offs), and internships (e.g., MITACS Accelerate). Program development has involved and continues to involve relevant stakeholders (e.g., close relationships with Directors of Biomedical Engineering and medical researchers from the local Ottawa hospitals). Faculty have a good record of supporting student activities outside of the formal programmatic activities, including the Institute of Electrical and Electronics Engineers (IEEE) Engineering in Medicine and Biology Society (EMBS) student club at Carleton University (CU@EMBS).

The PhD in Biomedical Engineering was included in Carleton's Strategic Mandate Agreement submission (March 31, 2014), indicating an intended start date of fall 2016, respectively. Enrolment at steady-state is projected at 17 for the PhD program. In the Carleton University Strategic Mandate Agreement, as agreed upon by the Ministry of Training, Colleges and Universities (MTCU; 2014-17), MTCU confirmed Carleton's institutional strengths in Advanced Technology and Design, Life and Health Sciences, and further identified Advanced Technology and Innovation, and Health Sciences as program areas of growth. This Strategic Mandate Agreement also explicitly notes "17 PhD spaces allocated as part of the Priorities Envelope are provided to Carleton University in 2016-17 to support a doctoral program in Biomedical Engineering". In 2015, the MASc program in Biomedical Engineering received 42 applications, and in the current academic year (2015 – 2016), 22 students are enrolled in the program.

A.2.2 University of Ottawa

The proposed PhD program in Biomedical Engineering aligns very well with two of the University of Ottawa's Strategic Areas of Development in Research (SADRs): Health and e-Society. By its very nature, biomedical engineering is an interdisciplinary field that seeks to develop advanced enabling technologies that help diagnose and treat a wide variety of diseases and conditions. Technologies such as new imaging modalities, intelligent prosthetics, advances in telemedicine, and many others are bringing major changes to the practice of medicine and health delivery. As a result, the proposed PhD program also fits very well with two of University of Ottawa's areas of institutional strength as expressed in its Strategic Mandate Agreement with the Province of Ontario (2014 – 2017), namely the areas of Medicine and Health, and Science and Technology.

In addition, the PhD program builds upon the existing undergraduate program in Biomedical Mechanical Engineering, as well as the MASc/MEng program in Biomedical Engineering. It also expands existing relationships the University of Ottawa has with local Ottawa hospitals, including The University of Ottawa Heart Institute (UOHI), Children's Hospital of Eastern Ontario (CHEO), Élisabeth Bruyère Hospital, and The Ottawa Hospital (TOH). In September 2015, 81 students enrolled in the undergraduate program in Biomedical Mechanical Engineering, while the MASc program in Biomedical Engineering received 41 applications. In the current academic year (2015 – 2016), 26 students are enrolled in the MASc program. The creation of the PhD program will augment enrolment in Biomedical Engineering, and fits very well

with the university's Destination2020 Strategic Enrolment Plan to increase the percentage of graduate students, and especially PhD students, among the additional students who will be accepted annually.

The proposed PhD program also aligns very well with major goals of the University of Ottawa's Destination 2020 Roadmap, more specifically:

- Research Excellence: The University of Ottawa has a world class medical school, associated institutions, and allied health disciplines. This represents a large reservoir of technological needs, ideas, and research potential for biomedical engineering that is reflected by ongoing collaborations between faculty in OCIBME and health researchers. The introduction of the PhD in Biomedical Engineering would strengthen these collaborations and provide opportunities for the in-depth pursuit of research questions in biomedical engineering in ways that are not possible with the current MASc/MEng program.
- Student experience: OCIBME has demonstrated a strong commitment to the student experience, including providing a foundation course for critical and creative thinking, integrity and ethical conduct (including research ethics), and research methods. The PhD program structure includes a forum for students to gain knowledge from various speakers (e.g., researchers, government, industry) and has included seminars on presentation skills and research management. OCIBME students have also had opportunities for research collaborations with industry, commercialization opportunities (including spin-offs), and internships (e.g., MITACS Accelerate). Faculty have a good record of support student activities outside of the formal programmatic activities, including the Ottawa Student Chapter of the Canadian Biomaterials Society. In addition, the interdisciplinary nature of the proposed programs offer opportunities for students to gain knowledge in research outlooks and methodologies that go beyond the narrow boundaries of individual disciplines. For example, engineering students would learn about conducting research with human subjects, the social impact of their work, and the ethical issues associated with their research.
- Bilingualism: Although the proposed Biomedical Engineering program is not a bilingual program, approximately half of the faculty are able to carry out all academic tasks (teaching, supervising, thesis examination) in both English and French. Students registered at the University of Ottawa have a right to produce their work and to answer examination questions in the official language of their choice.

A.3 Relationship to other academic programs

All biomedical engineering graduate students will be associated with one of the seven participating academic units as their home department.

As biomedical engineering is a multidisciplinary field, students in the PhD program in Biomedical Engineering will have unrestricted electives where they may take any graduate-level course at Carleton University or University of Ottawa, which is the same as the unrestrictive electives in the MASc/MEng program in Biomedical Engineering. Students taking electives outside of their program will require approval of the OCIBME Director or Associate Director, as well as permission from the unit offering the course and course instructor.

Letters of support included are:

- Dr. Yvan Labiche, Chair, Department of Systems & Computer Engineering (Carleton University)
- Dr. Metin Yaris, Chair, Department of Mechanical & Aerospace Engineering (Carleton University)
- Dr. Doug Howe, Director, School of Computer Science (Carleton University)
- Dr. Gerald Oakham, Chair, Department of Physics (Carleton University)

- Dr. Claude D'Amours, Chair, School of Electrical Engineering & Computer Science (University of Ottawa)
- Dr. Natalie Baddour, Chair, Department of Mechanical Engineering (University of Ottawa)
- Dr. David Taylor, Chair, Department of Chemical & Biological Engineering (University of Ottawa)

PART B PROGRAM LEARNING OUTCOMES AND ASSESSMENT

B.1 Program learning outcomes and degree level expectations

The Council of Ontario Universities has established a framework of Degree Level Expectations (DLEs) that specify what students should know, and be able to do, after successfully completing degree programs. The DLEs for PhD degrees at the graduate level are represented by the following six categories:

1. Depth and breadth of knowledge
2. Research and scholarship
3. Level of application of knowledge
4. Professional capacity / autonomy
5. Level of communications skills
6. Awareness of limits of knowledge

Table B.1 provides the learning outcomes for the PhD program in Biomedical Engineering. Graduates of the PhD program in Biomedical Engineering, will have gained specialized skills and knowledge to be able to propose and carryout research and development in the area of biomedical engineering, generating new innovative knowledge and applications. Graduates of the PhD program in Biomedical Engineering will also have the skills and ability to work effectively a multidisciplinary area and an awareness of the issues at the interface between engineering, biology, and healthcare. Each learning outcome is mapped to the degree level expectations. The elements of the program that contribute to each learning outcome are also indicated in this table.

TABLE B.1 LEARNING OUTCOMES, DEGREE LEVEL EXPECTATIONS, AND PROGRAM MAPPING

Learning Outcomes Graduates of the PhD in Biomedical Engineering will be able to:	**Degree Level Expectation**	**Program Mapping**
1) Discuss aspects of human anatomy and physiology using appropriate medical terminology.	1	BIOM 5010 (BMG 5112)
2) Develop, and/or apply in novel ways, appropriate theories and methods to generate new knowledge, applications, or understanding that advances the field of biomedical engineering.	2,3,4,6	BIOM 5010 (BMG 5112), BIOM (BMG) elective, comprehensive exam, thesis proposal, thesis
3) Design and carry out computational (e.g., modeling, signal processing) and/or experimental (e.g., data collection) procedures to solve problems or answer questions in the field of biomedical engineering.	2,3	BIOM 5010 (BMG 5112), BIOM (BMG) elective, thesis proposal, thesis
4) Critically analyze computational or experimental outcomes.	2,3	BIOM 5010, BIOM elective, comprehensive exam, thesis proposal, thesis
5) Communicate (written and oral) complex and/or ambiguous scientific ideas, issues, methods, and conclusions to multidisciplinary and lay audiences that may be broad (e.g., people with a non-scientific background).	2,5	BIOM 6800 (BMG XXXX), BIOM 5010 (BMG 5112), BIOM (BMG) elective, elective, comprehensive exam, thesis proposal, thesis
6) Identify the engineering design issues associated with the interface between engineering, biology, and healthcare (e.g., biocompatibility, electrical safety, privacy).	1,3,4,6	BIOM 5010 (BMG 5112), BIOM (BMG) elective, comprehensive exam, thesis proposal, thesis

7) Consider, primarily, the ethical and health/safety and secondarily the legal, economic, environmental, social, political, manufacturability, and sustainability constraints and obligations associated with biomedical engineering research and practice.	1,4,6	BIOM 5010 (BMG 5112), BIOM (BMG) elective, comprehensive exam, thesis proposal, thesis

B.2 Program structure and curriculum map

The PhD program in Biomedical Engineering, similarly to all Ottawa-Carleton joint PhD programs in engineering, requires 3 graduate courses and a thesis. PhD students will complete a comprehensive exam, normally before the end of the fourth term of registration within the PhD program. The student will be tested within one of the four fields in OCIBME: 1) Medical instrumentation, 2) Biomedical image processing, 3) Biomechanics and biomaterials, and 4) Medical informatics and telemedicine). These topics may be divided into subtopics, as needed. PhD students will also complete a thesis proposal, normally before the end of the sixth term of registration within the PhD program. Students will be required to submit a written research proposal in advance of an oral examination. This oral examination will focus on the proposed research but the student could also be examined on other topics related to their field of research; in particular those related to weaknesses demonstrated in the comprehensive exam.

BIOM 5010 (BMG 5112) Introduction to Biomedical Engineering is a compulsory course common to all OCIBME graduate programs (masters and PhD); the course provides students fundamentals regarding human anatomy and physiology, engineering systems to analysis and modeling, research methods, and research ethics. In addition to BIOM 5010 (BMG 5112), students will also be required to take at least one additional BIOM (BMG) course. Students entering the PhD program in Biomedical Engineering, with a background in biomedical engineering (e.g., MASc in Biomedical Engineering (or equivalent)), may have taken BIOM 5010 (BMG 5112) or equivalent. In such cases, students will be required to replace that requirement with another course (i.e., a free elective chosen in consultation with the thesis supervisor, and with the approval of the OCIBME Director or Associate Director).

The Biomedical Engineering programs have at least half the coursework as biomedical engineering courses (BIOM (BMG) coded courses). The remaining courses are free elective. As biomedical engineering is a highly multidisciplinary field, permitting students the freedom to choose an elective that best suits their education and research is desired.

All OCIBME graduate programs require students to complete a biomedical engineering seminar course. PhD students are required to complete BIOM 6800 (BMG XXXX) Biomedical Engineering PhD Seminar (a 0.0 credit course), attending at least 20 seminars, with presenters from a wide range of expertise within biomedical engineering, including researchers at Carleton University and the University of Ottawa, researchers from other research institutions, and industry. Students must also provide a written abstract and deliver at least two presentations within this seminar course.

The compulsory course and seminar course also provides students the opportunity to meet, interact, and network with other biomedical engineering graduate students. With seven participating academic units, across two university campuses, it is important to provide students a structure that allows building a sense of community and belonging; a strength that was noted in the last cyclical review of the OCIBME MASc program in Biomedical Engineering.

As with other joint institutes between Carleton University and the University of Ottawa, OCIBME students benefit from having access to the resources at both universities, including courses. BIOM (BMG) courses, including BIOM 5010 (BMG 5112) and BIOM 6800 (BMG XXXX), will be delivered at one of the institutions for students at both institution to access. This arrangement has been met with good success in existing

joint institute programs (e.g., efficient use of resources, increased student mobility and interaction across institutions), including the OCIBME master's program.

B.2.1 Articulation of the learning outcomes

Table B.1 provides a mapping of the learning outcomes to the various elements in the program. The following provides a more detailed explanation of this mapping.

Learning outcome 1: The compulsory course BIOM 5010 (BMG 5112) provides students fundamental knowledge regarding human anatomy and physiology. Unlike courses in the sciences, this course is taught from an engineering perspective, so includes an engineering systems approach to human anatomy and physiology, including analysis and modelling.

Learning outcome 2: The compulsory course BIOM 5010 (BMG 5112) helps develop students in terms of research methodology. Their BIOM (BMG) elective courses build a student's knowledge and skills for research; each course has a research element (e.g., paper review, project). The student's thesis research will be the main contributor to this learning outcome.

Learning outcome 3: The compulsory course BIOM 5010 (BMG 5112) provides students a basis for analysis and modeling of human anatomy and physiology. This is supported further by their BIOM (BMG) elective courses, which have a research element within the course where students will be performing computations and/or experimental procedures, or critically analyzing them. The student's thesis research will be the main contributor to this learning outcome.

Learning outcome 4: The compulsory course BIOM 5010 (BMG 5112) provides students a basis in terms of research methodology, including data presentation, data analysis, and interpretation. This is supported further by their BIOM (BMG) elective courses, which have a research element within the course where students will be performing critical analysis. The student's thesis research will be the main contributor to this learning outcome.

Learning outcome 5: BIOM 6800 (BMG XXXX) is seminar course taken by biomedical engineering PhD students and will be delivered in conjunction with BIOM 5800 (BMG 6996), a seminar course taken by biomedical engineering masters-level students. PhD students will attend at least 20 seminars, with presenters from a wide range of expertise within biomedical engineering, including researchers at Carleton University and the University of Ottawa, researchers from other research institutions, and industry. PhD Students must also provide a written abstract and deliver at least two presentations within this seminar course. In addition, the compulsory course BIOM 5010 (BMG 5112) also requires students to communicate scientific ideas in written and in oral formats (e.g., research ethics board application, which outlines the research idea, motivation, methods, impact, and research issues). This is supported further by their BIOM (BMG) elective courses, which have a research element within the course, where students will provide written work and in many cases a presentation. This learning outcome will be further supported by the student's thesis, including their research proposal (written and oral) and thesis dissertation and defense.

Learning outcome 6: The compulsory course BIOM 5010 (BMG 5112) provides students an understanding of research ethics, including safety and privacy. BIOM (BMG) elective courses include this learning outcome within the topic of the course (e.g., electrical safety within BIOM 5100 Medical Instrumentation). The student's thesis research is also conducted in a manner that complies with the institutional policies and regulations (e.g., ethical conduct for research involving humans, biohazard).

Learning outcome 7: The compulsory course BIOM 5010 (BMG 5112) provides students an understanding of research ethics; students must subject an application to the research ethics board,

which must consider the issues such as ethics, health, and safety. The course also includes the impact of technology on society. BIOM (BMG) elective courses include this learning outcome within the topic of the course (e.g., electrical safety within BIOM 5100 Medical Instrumentation). The student's thesis research is also conducted in a manner that complies with the institutional policies and regulations (e.g., ethical conduct for research involving humans, biohazard).

TABLE B.2 PROGRAM MAPPING AND ARTIFACTS

	Artifact[1]	LO1[2]	LO2	LO3	LO4	LO5	LO6	LO7
BIOM 5010 (BMG 5112)	W,O,X	I	I	I	I	R	I	I
BIOM (BMG) elective	W,O,X	R	R	R	R	R	R	R
BIOM 6800 (BMG XXXX)	W,O	R				R		
BIOM 6909 (BMG XXXX)	W,O	M	M	M	M	M	M	M

[1] Activities and artifacts: W – written paper, O – oral presentation, X – Examination
[2]Level: I – introductory, R – reinforcement, M – mastery

B.3 Program learning outcomes assessment plan

B.3.1 Program Assessment Committee

OCIBME will have a Program Assessment Committee that will be responsible for assessing the learning outcomes for the all OCIBME programs. Membership to the Program Assessment Committee is normally for a three-year period, with the possibility to renew, and are approved by the OCIBME Board of Management (see Section C.1 for membership). The Program Assessment Committee will consist of at least four members from four different participating units, with at least two members from Carleton University and at least two members from the University of Ottawa. The Program Assessment Committee will select a chair from its own membership.

B.3.2 Program assessment methodology

Learning outcomes will be assessed using a number of sources of data. Each source of data will provide an indicator of the level of achievement for each learning outcome, using a four point rubric (i.e., does not meet, minimally meets, meets, exceeds). Assessments may include:

- Assessment of student deliverables, such as course assignments, course exams, course project reports, thesis proposal, and thesis dissertation.
- Student self-evaluation via surveys
- Faculty evaluation based on oral thesis defenses for PhD students.
- BIOM (BMG) course instructor evaluations based on course work
- Focus groups with students and/or faculty members

In order to document and demonstrate the level of performance of students, the Program Assessment Committee will provide a written report every three years to the OCIBME Board of Management regarding the program learning outcomes analysis. The OCIBME Board of Management provides direction and oversight to program changes, and can use the outcomes of the program learning assessments for

continual program improvement. Program changes are operationalized by the Director and Associate Director of OCIBME.

As the program length of the PhD is expected to be four years, the first assessment, which is scheduled to be conducted in the third year, will only have partial data for the PhD; however, the assessment will still be conducted to provide early indicators for program improvements.

B.4 Program essential requirements

Requirements essential for a student's success in completing the program include:

- A good foundation in at least one area relevant to biomedical engineering. OCIBME welcomes applicants from a wide variety of academic backgrounds, such as engineering, science, computer science, biomedical sciences, and health sciences.
- Capacity to conduct systematic research, including the ability to integrate and critique the literature related to their field of research.
- Capacity and commitment to learning, including independent learning and lifelong learning; this includes a willingness for learning outside their original field of expertise.
- Capacity to effectively communicate scientific ideas (e.g., methodology, results, conclusions) to a multidisciplinary audience.
- Intrinsic motivation and responsibility, including internal accountability, in organizing their work and fulfilling the obligations related to the program.
- Behavior consistent with academic integrity and the use of procedures for responsible, safe, and ethical conduct of research.

Both universities are committed to assisting students with disabilities as long as they meet their admission requirements and those of the program of studies they have selected. In accordance with admission policies, the admission committee selects academically qualified candidates for admission to all programs by examining each applicant's academic record and the impact of any extenuating circumstance.

The program essential requirements of the PhD program in Biomedical Engineering have been reviewed in consultation with the Paul Menton Centre to ensure capacity for reasonable academic accommodation of students with disabilities, in accordance with the Carleton University Academic Accommodation Policy. The learning outcomes can be attained as outlined in the program description with the use of appropriate academic accommodations.

Candidates with disabilities may volunteer special information and identify circumstances that may have affected past academic performance. This information is confidential to the admission committee. Both universities are committed to removing barriers that result in discrimination on the basis of disability, to the greatest extent possible, while ensuring that academic integrity is maintained. The Student Academic Success Centre (SASC) at Carleton University and Student Academic Success Service (SASS) at the University of Ottawa both offer access services that act as intermediary between students, their faculty and other university offices to ensure that the special needs of these students are addressed and that the best possible learning conditions are being offered.

More information can be found at:
http://www.sass.uottawa.ca/access/
http://www.carleton.ca/pmc/
http://www.carleton.ca/sasc/

PART C GOVERNANCE

As with the existing MASc/MEng program, the proposed PhD program will be governed by OCIBME; a joint institute between Carleton University and the University of Ottawa.

The day-to-day operation of OCIBME is the responsibility of the Director. The Director supervises the maintenance of the Institute office with the administrative and secretarial assistance provided on a regular basis.

There is an OCIBME Board of Management consisting:

- Director
- Associate Director
- Chairs/Directors of all participating academic units:
- Associate Chairs/Directors (graduate officers) of all participating academic units (or their representatives)
- Representative from associated medical research units

Additional members may be added by the Deans of Graduate Studies to ensure equal representation from both universities.

This Board meets as necessary, normally twice per year, to establish policy and to monitor the operation of the OCIBME.

C.1 Board of Management

The terms of reference of the Board of Management are:

- To review and propose regulations and guidelines governing OCIBME graduate programs for approval by the seven participating academic units and their respective universities, in such areas as:
    - Admission standards
    - Course requirements and content
    - Examinations
    - Thesis requirements
    - Residence regulations
- To review and coordinate admissions policy.
- To coordinate the content of courses and the approval of new courses (after approval by the offering departments).
- To review the list of elective courses on a timely basis
- To approve all calendar changes

C.2 Director

The Director is responsible for the operation and promotion of OCIBME. The Director's duties are:

- to coordinate the business of OCIBME

- to serve as Chairperson of the Board of Management
- to make, in conjunction with the Associate Director, executive decisions for OCIBME and the Board of Management
- to communicate with the chairs/directors of the seven participating academic units and the Graduate Deans
- to prepare and distribute suitable publicity material about OCIBME.
- to review applicants for admission and to convene a meeting of the Admissions Committee when the admissibility of a candidate requires discussion.

The Director of OCIBME is appointed for a three-year term and the position alternates between the two Universities. The Director is responsible to each Department/School through the Departmental Chair/School Director. Early in the third year of the term of the Director, the Chair/Director of the future Institute Director's Department/School consults the other Chairs and nominates a new Director.

After approving the nominee, the Board of Management recommends him/her to both University administrations for the post. If for some reason the Director is not able to complete his/her term, anew Director is appointed through the process outlined above, and serves for the remaining term of the Director.

C.3 Associate Director

The Associate Director shares the administrative duties and executive decisions of the Director, as outlined above, and reports to and makes recommendations to the Director. The Associate Director will be chosen from the institution that does not hold the directorship, according to the same procedure and for the same time as the Director. If for some reason the Associate Director is not able to complete his/her term, a new Associate Director from the same university is appointed according to the same procedure for the rest of that term. The Associate Director acts for the Director in his/her absence.

PART D THE FACULTY

D.1 Faculty appointed to the unit or program

Information was solicited from OCIBME members from November 2015 to January 2016. Table D.2 lists a total of 75 members of OCIBME. It is noted that there are some members that are missing (www.ocibme.ca lists the full membership); members may not have responded for various reasons (e.g., on leave or sabbatical).

OCIBME has a rich membership with a good breadth of expertise coming from all seven participating units, complemented by members from other units, including the health sciences and medicine.

There are OCIBME members whose core focus is biomedical engineering, while there are other members for whom biomedical engineering would be less central. All OCIBME thesis research must have a supervisor in one of the seven participating units. OCIBME members not within a particular unit, as well as adjuncts, may serve as a co-supervisor.

TABLE D.1 UNIT ABBREVIATIONS

CBE	Department of Chemical and Biological Engineering (UO)
DOE	Department of Electronics (CU)
EECS	School of Electrical Engineering and Computer Science (UO)
MAE	Department of Mechanical and Aerospace Engineering (CU)
MAT	Department of Mathematics and Statistics (UO)
MECH	Department of Mechanical Engineering (UO)
MED	Faculty of Medicine (UO)
MUSI	School of Music (UO)
PHY	Department of Physics (CU)
SCE	Department of Systems and Compute Engineering (CU)
SCS	School of Computer Science (CU)
SHK	School of Human Kinetics (UO)
SIT	School of Information Technology (CU)
SRS	School of Rehabilitation Sciences (UO)
UOHI	University of Ottawa Heart Institute (UO)

TABLE D.2 CORE PROGRAM FACULTY

Faculty Name	Rank	M/F	Appointment Status	Unit	Supervision Privileges*	Area of Specialization/Field Affiliations
Adler, Andy	Full	M	Tenure	SCE	D	Medical Instrumentation, Biomedical Image Processing
Ahmadi, Mojtaba	Associate	M	Tenure	MAE	D	Biomechanics & Biomaterials
Aitken, Victor	Associate	M	Tenure	SCE	D	Biomedical Image Processing
Amyot, Daniel	Full	M	Tenure	EECS	D	Medical Informatics & Telemedicine
Anis, Hanan	Full	F	Tenure	EECS	D	Medical Instrumentation
Baddour, Nathalie	Associate	F	Tenure	MECH	CDM	Biomechanics & Biomaterials

Berini, Pierre	Professor	M	Tenure	EECS	D	Medical Instrumentation
Bolic, Miodrag	Associate	M	Tenure	EECS	D	Medical Instrumentation
Bouchard, Martin	Professor	M	Tenure	EECS	D	Medical Instrumentation
Bourgault, Yves	Professor	M	Tenure	MAT	CDM	Biomechanics & Biomaterials
Cao, Xudong	Professor	M	Tenure	CBE	D	Biomechanics & Biomaterials
Catelas, Isabelle	Associate	F	Tenure	MECH	D	Biomechanics & Biomaterials
Chan, Adrian	Full	M	Tenure	SCE	D	Medical Instrumentation, Biomedical Image Processing
Clackdoyle, Rolf	Adjunct	M		PHY	CDM	Biomedical Image Processing
Comeau, Gilles	Full	M	Tenure	MUSI	CDM	Biomechanics & Biomaterials
Dajani, Hilmi	Associate	M	Tenure	EECS	D	Medical Instrumentation
Dansereau, Richard	Full	M	Tenure	SCE	D	Medical Instrumentation
de Kemp, Robert	Adjunct	M		UOHI	CDM	Biomedical Image Processing
Doumit, Marc	Assistant	M	Tenure	MECH	D	Biomechanics & Biomaterials
El-Saddik, Abdulmotaleb	Full	M	Tenure	EECS	D	Medical Instrumentation
Fenech, Marianne	Associate	F	Tenure	MECH	D	Biomechanics & Biomaterials
Frei, Hans Peter	Associate	M	Tenure	MAE	D	Biomechanics & Biomaterials
Frize, Monique	Dist.	F	Tenure	SCE	D	Medical Instrumentation, Biomedical Image Processing, Medical Informatics & Telemedicine
Giguere, Christian	Full	M	Tenure	SRS	CDM	Medical Instrumentation
Godin, Michel	Associate	M	Tenure	PHY	D	Medical Instrumentation
Goubran, Rafik	Full	M	Tenure	SCE	D	Medical Instrumentation
Graham, Ryan	Assistant	M	Tenure Track	SHK	CDM	Biomechanics & Biomaterials
Green, James	Associate	M	Tenure	SCE	D	Medical Informatics & Telemedicine
Groza, Voicu	Full	M	Tenure	EECS	D	Medical Instrumentation
Heath, Emily	Assistant	F	Tenure Track	PHY	D	Biomedical Image Processing
Johns, Paul	Full	M	Tenure	PHY	D	Biomedical Image Processing
Joslin. Chris	Associate	M	Tenure	SIT	D	Biomedical Image Processing
Klein, Ran	Adjunct	M		UOHI	CDM	Medical Instrumentation, Biomedical Image Processing

Knoefel, Frank-Dietrich	Adjuct	M		SCE	CDM	Medical Instrumentation
Labrosse, Michel	Associate	M	Tenure	MECH	D	Biomechanics & Biomaterials
Laganier, Robert	Full	M	Tenure	EECS	D	Biomedical Image Processing
Lamontagne, Mario	Full	M	Tenure	SHK	CDM	Biomechanics & Biomaterials
Lang, Jochen	Associate	M	Tenure	EECS	D	Biomedical Image Processing
Lee, WonSook	Full	F	Tenure	EECS	D	Biomedical Image Processing
Lemaire, Edward	Full	M	Non-Tenure Track	MED	CDM	Medical Instrumentation, Biomechanics & Biomaterials
Liang, Ming	Full	M	Tenure	MECH	D	Medical Instrumentation
Liu, Peter	Professor	M	Tenure	SCE	D	Medical Informatics & Telemedicine
Matida, Edgar	Associate	M	Tenure	MECH	D	Biomechanics & Biomaterials
Mavripilis, Catherine	Associate	F	Tenure	MECH	D	Biomechanics & Biomaterials
Murugkar, Sangeeta	Assistant	F	Tenure Track	PHY	D	Biomedical Image Processing
Mussivand, Tofy	Professor	M	Tenure	UOHI	CDM	Medical Instrumentation
Necsulescu, Dan	Full	M	Tenure	MECH	D	Biomechanics & Biomaterials
Nganbe, Michel	Associate	M	Tenure	MECH	D	Biomechanics & Biomaterials
Nussbaum, Doron	Full	M	Tenure	SCS	D	Biomedical Image Processing
Omelon, Sidney	Assistant	F	Tenure	CBE	D	Biomechanics & Biomaterials
Ono, Yuu	Associate	M	Tenure	SCE	D	Medical Instrumentation, Biomedical Image Processing
Paquet, Eric	Adjunct	M		EECS	CDM	Biomedical Image Processing
Payeur, Pierre	Full	M	Tenure	EECS	D	Biomedical Image Processing
Perkins, Theodore	Assistant	M	Non-Tenure Track	MED	CDM	Medical Informatics & Telemedicine
Petriu, Dorina	Full	M	Tenure	SCE	D	Medical Instrumentation, Medical Informatics & Telemedicine
Petriu, Emil	Full	M	Tenure	EECS	D	Medical Informatics & Telemedicine
Peyton, Liam	Full	M	Tenure	EECS	D	Medical Informatics & Telemedicine
Rajan, Sreeraman	Associate	M	Tenure Track	SCE	D	Medical Instrumentation

Russell, Donald	Full	M	Tenure	MECH	D	Biomechanics & Biomaterials
Sach, Adam	Assistant	M	Non-Tenure Track	MED	CDM	Medical Instrumentation
Shirmohammadi, Shervin	Full	M	Tenure	EECS	D	Medical Instrumentation
Speirs, Andrew	Assistant	M	Tenure	MECH	D	Biomechanics & Biomaterials
Suuronen, Erik	Adjunct	M		UOHI	CDM	Biomechanics & Biomaterials
Tait, Niall	Full	M	Tenure	DOE	CDM	Medical Instrumentation
Tavoularis, Stravos	Professor	M	Tenure	MECH	D	Biomechanics & Biomaterials
Tsai, Eve	Assistant	F	Non Tenured	MED	CDM	Biomedical Image Processing
Turcotte, Marcel	Associate	M	Tenure	EECS	D	Medical Informatics & Telemedicine
Ukwatta, Eran	Assistant	M	Tenure Track	SCE	D	Biomedical Image Processing
Variola, Fabio	Assistant	M	Tenure Track	MECH	D	Biomechanics & Biomaterials
Wainer, Gabriel	Full	M	Tenure	SCE	D	Medical Informatics & Telemedicine
White, Anthony	Full	M	Tenure	SCS	D	Medical Informatics & Telemedicine
Xu, Tong	Associate	M	Tenure	PHY	D	Biomedical Image Processing
Yagoub, Mustapha	Full	M	Tenure	EECS	D	Medical Instrumentation
Ye, Winnie	Associate	F	Tenure	ELEC	D	Medical Instrumentation
Zakutney, Timothy	Adjunct	M		UOHI	D	Medical Instrumentation, Medical Informatics & Telemedicine

*D=full privileges; M=full privileges at master's level only; CD=co-supervision privileges at doctoral level, full privileges at master's level; CDM=co-supervision privileges only at both doctoral and master's level; CM=co-supervision privileges at master's level, no privileges at doctoral level

D.2 Faculty research funding

Institution data on research funding are provided in Table D.3 and Table D.4. OCIBME members have a good level of funding. OCIBME members are generally involved in other graduate programs (e.g., members from SCE and EECS would also be part of the Ottawa-Carleton Institute of Electrical and Computer Engineering (OCIECE) and involved in research involving electrical and computer engineering). It is difficult to discern the portion of research funding that is attributed to biomedical engineering research.

TABLE D.3 RESEARCH FUNDING FROM CARLETON UNIVERSITY (THOUSANDS OF DOLLARS)

Year	Tri-Council	Internal	Canadian	US	Intl	Other	Total
2008-09	$1,823	$74	$1,580		$78		**$3,555**
2009-10	$1,845	$75	$1,800	$47	$62		**$3,829**
2010-11	$1,587	$42	$1,097		$3		**$2,729**

2011-12	$1,549	$49	$1,329	$2	$50		**$2,979**
2012-13	$1,629	$40	$984	$4	$57		**$2,714**
2013-14	$1,531	$211	$1,425	$24			**$3,191**
2014-15	$1,423	$74	$1,225				**$2,722**

TABLE D.4 RESEARCH FUNDING FROM UNIVERSITY OF OTTAWA (THOUSANDS OF DOLLARS)

Year	Federal Tri-Council Operating Grants[1]	Contracts[2]	Infrastructure[3]	Others[4]	Total
2008-2009	$14,791	$8,050	$861	$9,255	**$32,957**
2009-2010	$14,344	$7,631	$2,930	$10,052	**$34,958**
2010-2011	$19,058	$10,154	-	$8,004	**$37,215**
2011-2012	$17,109	$10,759	$1,095	$10,256	**$39,220**
2012-2013	$16,783	$9,995	$457	$10,398	**$37,633**
2013-2014	$16,727	$5,401	-	$8,043	**$30,171**
2014-2015	$19,145	$5,530	-	$6,754	**$31,429**

[1]Only includes operating grants from the three federal funding agencies (CIHR, NSERC and SSHRC).
[2]Include both Research & Development and Service contracts received from Tri-Council, private sectors and Governments.
[3]Includes funds for the purchase and maintenance of research infrastructure from the Canada Foundation for Innovation and the Ontario Ministry of Economic Development and Innovation.
[4]Includes everything other than the first three categories, such as Canada Research Chairs, University & Faculty contributions, fellowships and bursaries and other operating grants (non Tri-Council).

D.3 Distribution of thesis supervision

Table D.5 provides a summary the supervision of the OCIBME members that responded (from November 2015 to January 2016). These data suggests that are active in supervision. OCIBME members are generally involved in other graduate programs, so some of these supervisions are not biomedical engineering students.

TABLE D.5 DISTRIBUTION OF SUPERVISION (CO-SUPERVISION IN BRACKETS)

Faculty Name	Rank	Completed			Current		
		Master's	PhD	PDF	Master's	PhD	PDF
Adler, Andy	Full	14	4	0	6	3	0
Ahmadi, Mojtaba	Associate	22	3	0	7	4	1
Aitken, Victor	Associate	8	1(2)	0	3	0	0
Amyot, Daniel	Full	28	8	2	3	6	0
Anis, Hanan	Full	5	3	2	2	3	1
Baddour, Nathalie	Associate	15	1	0	4	4	0
Berini, Pierre	Professor	29	4	3	5	11	2
Bolic, Miodrag	Associate	8(10)	2(1)	6(2)	3(3)	2(3)	1(1)
Bouchard, Martin	Professor	22	8	7	3	7	0
Bourgault, Yves	Professor	15	7	5	2	5	0
Cao, Xudong	Professor	10(3)	3(2)	6 (1)	1	3	1
Catelas, Isabelle	Associate	5	0	2	2	1	0
Chan, Adrian	Full	7 (18)	0 (3)	0	3 (2)	0 (3)	0
Clackdoyle, Rolf	Adjunct	3	4	4	0	2	0
Comeau, Gilles	Full	18	0(1)	0	10(1)	3	0
Dajani, Hilmi	Associate	7(6)	1(1)	0	0	4(4)	0(1)

Dansereau, Richard	Full	14	6	1	9	6	0
Doumit, Marc	Assistant	2	0	0	7	0	0
El-Saddik, Abdulmotaleb	Full	65(5)	18(4)	6	18	18 (2)	4
Fenech, Marianne	Associate	4	1	0	3	3	0
Frei, Hans Peter	Associate	3 (3)	1 (2)	0	0	2	0
Frize, Monique	Dist.	42	5	0	1	0	0
Giguere, Christian	Full	62	1	0	4	4	0
Godin, Michel	Associate	2	1	1	3	3	4
Goubran, Rafik	Full	65	18	0	2	5	0
Graham, Ryan	Assistant	0	0	0	2	2(1)	
Green, James	Associate	13	0	1	4	0	5
Heath, Emily	Assistant	7	0	0	1	3	0
Johns, Paul	Full	8	2	0	1	0	0
Joslin. Chris	Associate	19	0	1	11	3	0
Klein, Ran	Adjunct	1	0	0	1	1	0
Knoefel, Frank-Dietrich	Adjuct	0(3)	0(3)	0(1)	0(3)	0(4)	0(1)
Labrosse, Michel	Associate	11	1	0	4	3	1
Laganier, Robert	Full	23	8	10	6	7	0
Lamontagne, Mario	Full	15 (1)	2 (3)	1	0	2	0
Lang, Jochen	Associate	13	2	1	4	2	0
Lee, WonSook	Full	5	3	0	0	0	0
Lemaire, Edward	Full	16	1	0	2	3	0
Liang, Ming	Full	45	8	9	7	8	0
Liu, Peter	Professor	1	0	0	0	2	0
Mavripilis, Catherine	Associate	12	10	7	0	3	1
Murugkar, Sangeeta	Assistant	0 (1)	0(1)	0(1)	0	0(1)	0
Mussivand, Tofy	Professor	0	0	0	0	0	0
Necsulescu, Dan	Full	28	5	0	0	0	0
Nganbe, Michel	Associate	11	1(1)	0	2	3	0
Nussbaum, Doron	Full	8(14)	0(3)	0(1)	2(0)	0(0)	0(0)
Omelon, Sidney	Assistant	0	0	0 (1)	1	1	0
Ono, Yuu	Associate	7(7)	0	0	1(1)	3	1
Paquet, Eric	Adjunct	8	0	1	0	0	0
Payeur, Pierre	Full	22	1	8	7	5	0
Perkins, Theodore	Assistant	9	0	4	1	3	2
Petriu, Dorina	Full	53	21	10	5	5	1
Petriu, Emil	Full	53	21	10	5	5	1
Rajan, Sreeraman	Associate	0 (1)	0 (1)	0 (3)	0	0	0
Russell, Donald	Full	11(10)	2	0	(3)	0	0
Sach, Adam	Assistant	0	0	0	1 (1)	1	1
Shirmohammadi, Shervin	Full	27	9	9	5	7	1
Speirs, Andrew	Assistant	0	0	0	1	1	0
Suuronen, Erik	Adjunct	8 (3)	4 (1)	6 (1)	0	0	0
Tavoularis, Stravos	Professor	35	19	16	4	4	1
Tsai, Eve	Assistant	5	0	4	1	1	1

Turcotte, Marcel	Associate	7 (2)	0 (4)	0 (2)	1	1 (2)	0
Ukwatta, Eran	Assistant	0	0	0	0	0	0
Variola, Fabio	Assistant	5	1	1	5	2	1
Wainer, Gabriel	Full	53	9	4	4	6	1
White, Anthony	Full	13 (6)	3	0	1	3	0
Xu, Tong	Associate	4(0)	1(0)	0	0(0)	0(2)	0
Yagoub, Mustapha	Full	32 (7)	8 (1)	3	8	11	0
Ye, Winnie	Associate	12(1)	0	0	4(3)	1(2)	0
Zakutney, Timothy	Adjunct	1 (1)	0	0	2 (2)	0	0

D.4 Current teaching assignments

Table D.6 provides a list of teaching assignments of the OCIBME members that responded. Some curriculum vitae did not include teaching assignments and are therefore missing; however, in general, faculty members have the normal teaching load associated with their unit, which are three 0.5 credit (3 credits) courses per year plus supervision of fourth year projects.

TABLE D.6 DISTRIBUTION OF TEACHING ASSIGNMENTS

Faculty Name	2015-16	2014-15	2013-14	Notes
Adler, Andy	BIOM 5010	BIOM 5010	BIOM 5010	1 course teaching relief, CRC Chair 1 course teaching relief, Chair REB (2012/13-2014/15) 1 course teaching relief, OCIBME Director (2015/16)
Ahmadi, Mojtaba	MAAE2101 MAAE4500 MECH 4806	MAAE2101 MAAE4500 MECH 4806	MAAE2101 MAAE4500 MECH 4806	
Amyot, Daniel	CSI5112		CSI 5112	
Baddour, Nathalie		MCG5396		Chair, MECH
Bolic, Miodrag	BIOM5100	BIOM5100	BIOM5100	
Bouchard, Martin	ELG5376	ELG5376		
Cao, Xudong	CHG8188	CHG8188		
Catelas, Isabelle	MCG3141	Academic leave	MCG3141	Canada Research Chair
Chan, Adrian	SYSC 4201 BIOM 5101	SYSC 4201 BIOM 5101	SYSC 4201 BIOM 5101	1 course teaching relief, OCIBME Director (2012/13 to 2014/15), 1 course teaching relief, Associate Dean FGPA (2015/16)
Clackdoyle, Rolf	PHYS 5291			
Comeau, Gilles	MUS5904 MUS6931	MUS5904 MUS6770	MUS5902; MUS6770 MUS6931 MUSC6932	
Dajani, Hilmi	BMG 5109	BMG 5109	BMG 5109	1 course teaching relief, OCIBME Associate Director (2012/13 – 2015/16)

Dansereau, Richard	SYSC5602	SYSC4405	SYSC3610	
El-Saddik, Abdulmotaleb	ELG 5121A	ELG 5121A ELG 5121B	ELG 5121A ELG 5121B	1 course teaching relief, URC (2013-14, 2014-15, 2015-2016) 1 course teaching relief, research credit (2013-14, 2014-15, 2015-2016) Half-year sabbatical (2015-16)
Fenech, Marianne	MCG5138H	BMG7199		
Frei, Hans Peter	MAAE 2300 MAAE 3202 MECH 4705		MAAE 3202 MAAE 3202 MECH 4013	Sabbatical (2014-15)
Godin, Michel	PHY8191 PHY2323 PHY2104;	PHY8191 PHY2323 PHY2104;	PHY8191 PHY2323 PHY2104	
Goubran, Rafik				Dean of Engineering & Design
Graham, Ryan	APA 6303	ELG5100	ELG5100	
Green, James	BIOM 5405	SYSC2001 BIOM 5405 BIOM 5800	SYSC 2001 BIOM 5405 BIOM 5800 SYS C5906	
Habash, Riadh	BMG 5330	BMG 5330	BMG 5330	
Heath, Emily	PHYS 1004 PHYS 2305	PHYS 1008	BP8103	
Johns, Paul		sabbatical	PHYS5203	
Joslin. Chris	BIT 4000 IMD4901	BIT 4000 IMD4901	BIT 4000 IMD4901	
Klein, Ran	BIOM 5200			
Labrosse, Michel		MCG5108	BMG5300	
Lang, Jochen	ELG5124		ELG5124	
Liang, Ming		MCG179/EMP5179	MCG179/EMP5179	
Matida, Edgar	MAAE2400 MECH3310 MECH5009	MAAE2400 MECH3310 MECH5009	MAAE2400 MECH3310 MECH5001	
Mavripilis, Catherine	MCG5138			
Murugkar, Sangeeta	PHYS1002	PHYS2202 PHYS4007	PHYS4008	
Mussivand, Tofy	BMG 5311	BMG 5311	BMG 5311	
Nganbe, Michel	MCG5138			
Ono, Yuu		SYSC4205 BIOM5200	SYSC44205 SYSC3006	
Payeur, Pierre	ELC 5163	ELC 5163	ELC 5163	
Perkins, Theodore	BCH5101 BNF5106	BCH5101 BCH4300B		
Petriu, Dorina	ELG 4912 ELG 4913	ELG 4912	ELG 4912 ELG 4913	

Rajan, Sreeraman	SYSC 4405			1 course teaching relief as a new hire (2015-16) 1 course relief Tier 2 CRC Chair
Russell, Donald	BIOM 5301	BIOM 5301	BIOM 5301	Associate Dean FED Clerk of Senate
Speirs, Andrew	MECH4604 MECH3700 MECH4013	MECH4604 MECH3700 MECH4013	MECH2300 MECH3700	1 course teaching relief as a new hire (2013-14)
Suuronen, Erik	CMM 5315 BCH 9999 BCH 7999 CMM 9999		CMM 5304 CMM 9998 CMM 9999 CMM 7999	
Turcotte, Marcel		CSI 5126		
Ukwatta, Eran	SYSC 4203 SYSC 2100			1 course teaching relief as a new hire (2015-16)
Variola, Fabio			MCG 5138	
Wainer, Gabriel	SYSC 2003	SYSC 4001		
White, Anthony		COMP 4601 COMP 4107 COMP 2601	COMP 4601 COMP 2601	Sabbatical (2015-16) 1 course teaching relief for teaching overload in 2012-13 (2013-14)
Xu, Tong	PHYS 2004 PHYS 4203/5313 PHYS 3207	PHYS 2004 PHYS 4203 PHYS 5204	PHYS 2004 PHYS 4203 PHYS 3207	
Yagoub, Mustapha	ELG 3639		ELG 3639	
Zakutney, Timothy	SYSC 4202	SYSC 4202	SYSC 4202	Contract Instructor

D.5 Contract instructors

BIOM (BMG) graduate courses are taught normally taught by full time faculty members in one of the participating units. On occasion a contract instructor has been used when a faculty member is on sabbatical or leave. One exception is BIOM 5311 (BMG 5311) Design of Medical Devices and Implants, which has been consistently taught by Dr. Tofy Mussivand (UOHI) for a number of years.

PART E PROGRAM ADMISSION AND ENROLMENT

E.1 Admissions requirements

The normal requirement for admissions into the PhD program is a master's degree with thesis in engineering, science, computer science, or a related discipline, with an average of at least B+.

Students who are in the master's program in Biomedical Engineering may be admitted to the Ph.D. program if they show outstanding academic performance and demonstrate significant promise for advanced research, upon recommendation of the student's home academic unit.

E.2 Projected enrolment

The enrollment of domestic students will be dependent upon the number of funded positions granted by the Ontario Ministry of Training, College, and Universities. The projections assume that these are funded positions.

TABLE E.1 PROJECTED ENROLMENT

	2016	2017	2018	2019	2020	2021
Carleton University						
Domestic	4	8	12	17	17	17
International	1	2	3	4	4	4
University of Ottawa						
Domestic	3	5	8	10	12	12
International	1	2	3	4	4	4
Total						
Domestic	7	13	20	27	29	29
International	2	4	6	8	8	8

Student enrolment for the MASc in Biomedical Engineering is not evenly distributed across the seven participating units, with the bulk of the students residing in SCE and MAE at Carleton University, and EECS and MCG at the University of Ottawa. There is a recent trend of an increased student enrollment in the remaining three units (SCS and PHYS at Carleton University and CHG at the University of Ottawa). The distribution in student enrolment, and associated trends, is expected to be similar for the PhD in Biomedical Engineering.

PART F STUDENT EXPERIENCE AND SATISFACTION

F.1 Student orientation, advising, and mentoring

Students will be associated with a home unit, which will be one of the seven participating units and the same unit as their supervisor. Each institution provides orientation for its graduate students through the faculty of graduate studies and often through the home unit as well.

PhD students will have a supervisor that will provide advising and mentoring through their thesis. The student will also have a thesis committee for their comprehensive exam and research proposal.

There are biomedical engineering student clubs/chapters associated with the IEEE Engineering in Medicine and Biology Society (EMBS), Canadian Medical and Biological Engineering Society (CMBES), and the Canadian Biomaterial Society (CBS). These student clubs/chapters provide a number of events, including welcome orientation events, seminars, networking events, and social events. It is expected that the PhD students, similar to the existing master students will be highly active, engaged, and supportive of one another.

The compulsory course BIOM 5010 (BMG 5112) Introduction to Biomedical Engineering and BIOM 6800 (BMG XXXX) Biomedical Engineering PhD Seminar has also been used as an opportunity to orient and advise students, as well as providing students to interact with their biomedical engineering peers.

F.2 Student funding

Student funding for the proposed program will come primarily from the faculty of graduate studies. Additional funding may result from external awards and faculty research grants.

F.2.1 Carleton University

Carleton University has made a commitment to fund up to four PhD students in Biomedical Engineering each year to a steady-state of 17 funded students. Students are funded through combinations of Scholarships, Teaching and/or Research Assistantships. Teaching Assistantships in PhD programs are normally supported for eight terms. Scholarships are normally dispersed over three terms per year.

Additional financial assistance for all programs may come from external funding. We will encourage students to compete for scholarships from OGS, and NSERC or CIHR as appropriate to their discipline background, as well as internal and smaller external grants. Core faculty may provide support to students under their supervision from external funding, and are expected to continually apply for such funding to support their longer term research programs. We also expect core faculty to apply jointly for funding, and thereby fund students working collaboratively on such projects.

F.2.2 University of Ottawa

The University of Ottawa will apply to Ontario Ministry of Training, Colleges, and Universities for funding of PhD students in Biomedical Engineering. The number of positions that are funded by the ministry will determine the funding that will be provided by the University. Students are funded through combinations of Scholarships, Teaching and/or Research Assistantships. Teaching Assistantships in PhD programs are normally supported for eight terms.

Additional financial assistance for all programs may come from external funding. We will encourage students to compete for scholarships from OGS, and NSERC or CIHR as appropriate to their discipline background, as well as internal and smaller external grants. Core faculty may provide support to students under their supervision from external funding, and are expected to continually apply for such funding to

support their longer term research programs. We also expect core faculty to apply jointly for funding, and thereby fund students working collaboratively on such projects.

F.3 Career paths of graduates

The PhD program in Biomedical Engineering addresses the student demand for highly specialized and innovative education in the area of biomedical engineering. Indeed, a number of graduating MASc students have expressed that they would have enrolled in a PhD program in Biomedical Engineering if the opportunity existed. The number of PhD students with research in biomedical engineering is growing and this program appropriately meets this need.

Career paths of graduates of PhD program in Biomedical Engineering are anticipated to be diverse, given the multidisciplinary nature of the program[1]. Table 5.1 identifies potential career paths for students in the PhD program in Biomedical Engineering. Graduates from the PhD program in Biomedical Engineering would tend towards careers that are more research focused, such as biomedical data analysis, medical device research and design, and simulation and modeling of diseases and biological systems.

TABLE 5.1 CAREER PATHS

Educational	Public Sector	Private Sector	Non-Profit
• medicine • law • business • education	• regulatory agencies • health care policy • hospitals	• medical device manufacturers • sports/fitness equipment manufacturers • pharmaceutical companies • patent analyst • rehabilitation/orthopedic engineering	• medical research institutions

Often biomedical engineers come with foundational knowledge in another discipline (e.g., electrical engineering, mechanical engineering, computer science, physics). The PhD program in Biomedical Engineering provides students skills in operating in a multidisciplinary environment (e.g., communication across disciplines), while dealing with complex issues related to technology and biology. Such an educational experience also enables the development of transferable skills (e.g., systems thinking) that are useful in many areas beyond biomedical engineering.

[1] Information compiled members of OCIBME and a variety of sources including:
- http://learn.org/articles/Masters_in_Biomedical_Engineering_Your_Salary_and_Career_Questions_Answered.html
- http://www.rochester.edu/college/sophomores/assets/pdf/careerpaths/BiomedEnghandout.pdf
- https://collegegrad.com/careers/biomedical-engineers

PART G RESOURCES

G.1 Support and technical staff

OCIBME support staff resources, currently includes a part-time graduate administrator that helps with applicants and supports OCIBME level activities (e.g., meeting minutes); this administrator is also involved with the other engineering related joint institutes (five in total) and is not dedicated to OCIBME. OCIBME is an interdisciplinary institute that spans seven academic units. Unlike other joint institutes, there is not a direct relationship between the institute and a single unit at each university. OCIBME is therefore unable to rely on unit staff resources for items such as OCIBME membership maintenance, calendar changes, website updates, and cyclical program review documentation. OCIBME applicants are processed and managed at the unit level, and do rely on the resources of that unit (e.g., graduate chair and graduate administrator).

Additional administrative support is being sought to support the growing OCIBME graduate programs, including an expected growth in applications. Specifically, a 0.5 FTE administrative position is suggested at Carleton University and a 0.5 FTE position is suggested at the University of Ottawa. The administrative support would be responsible for items that had previously fallen to the Director and Associate Director (e.g., OCIBME membership maintenance, calendar changes, website updates, and cyclical program review documentation).

G.2 Teaching resources

The OCIBME faculty exceeds 100 members. The up-to-date membership can be viewed at www.ocibme.ca. Although OCIBME has a large membership, the number of faculty delivering BIOM (BMG) courses is a small percentage. In the 2015/16 academic year, 11 BIOM (BMG) courses were offered, as well as the BIOM 5800 (BMG 6996) seminar. There are other courses that are in development that could likely be made available as BIOM (BMG) courses in the future (e.g., Fundamentals on Nano-Bio-Communications & Nano-Bio-Networks, PHYS 5291 Advanced Topics in Medical Physics).

Many of the OCIBME members are members of multiple joint institutes and their programs. For example, faculty in units such as the Department of Systems & Computer Engineering (SCE) and the School of Electrical Engineering & Computer Science (EECS) would also be members of the Ottawa-Carleton Institute for Electrical and Computer Engineering (OCIECE), and faculty in Department of Mechanical & Aerospace Engineering (MAE) and Department of Mechanical Engineering (MECH) would also be members of the Ottawa-Carleton Institute for Mechanical and Aerospace Engineering (OCIMAE).

Participating units have been committing the faculty resources, specifically teaching, to deliver a quality MASc/MEng program in Biomedical Engineering. The PhD program will be primarily leveraging existing courses, so no new additional faculty are currently required; however, there will be a commitment among participating units to ensure that a minimum of 12 BIOM (BMG) courses are being offered every year. Normally, a minimum of 5 of these BIOM (BMG) courses will come from the electrical & computer engineering side of biomedical engineering, and a minimum of 5 will come from the mechanical engineering side of biomedical engineering. The only new courses that are proposed for the PhD program in Biomedical Engineering is BIOM 6800 (BMG XXXX) Biomedical Engineering PhD Seminar and BIOM 6909 (BMG XXXX) Ph.D. Thesis (see section I.3.1). The BIOM 6800 (BMG XXXX) Biomedical Engineering PhD Seminar will be run in conjunction with the existing BIOM 5800 (BMG 6996) seminar and will not require an additional teaching resource.

It is estimated that, on average, two contract instructors annually would be required. These would be used to address intermittent teaching shortages (e.g., faculty on sabbatical, faculty with course reliefs associated with administrative positions).

G.3 Space

No net new space is required for the PhD program in Biomedical Engineering. The existing space and facilities associated with the MASc/MEng program in Biomedical Engineering provide adequate room to accommodate the proposed PhD program.

G.4 Library resources

The library report from Carleton University and the University of Ottawa are attached. No addition library resources are required for the PhD program in Biomedical Engineering.

PART H DEVELOPMENT OF THE SELF-STUDY

The self-study was developed as a collaborative effort by a Program Development Committee that consisted of a member from each of the seven participating academic units and a student member who graduated from the OCIBME MASc in Biomedical Engineering and is currently in the PhD program in Mechanical Engineering at the University of Ottawa. The members were:

- Prof. Adrian D. C. Chan (Lead, SCE)
- Prof. Jason Etele (MAE)
- Prof. Doron Nussbaum (SCS)
- Prof. Paul Johns (PHYS)
- Prof. Isabelle Catelas (MCG)
- Prof. Hilmi Dajani (EECS)
- Prof. Xudong Cao (CHG)
- Rym Mehri (student)

PART I CALENDAR LANGUAGE

I.1 Admissions Requirements

The normal requirement for admissions into the PhD program is a master's degree with thesis in engineering, science, computer science, or a related discipline, with an average of at least B+.

Students registered full-time in the M.A.Sc. in Biomedical Engineering program at Carleton University, who shows outstanding academic performance and demonstrates significant promise for advanced research, may be permitted to transfer into the doctoral program, without completing the master's program, upon recommendation of the student's home academic unit.

I.2 Program Requirements

I.2.1 Carleton University

PhD in Biomedical Engineering [10.0 credits]

1. 0.5 credit in: BIOM 5010 [0.5] Introduction to Biomedical Engineering	0.5
2. 0.5 credit in BIOM (BMG) courses	0.5
3. 0.5 credit in elective courses at either Carleton University or University of Ottawa with the approval of the OCIBME Director or Associate Director.	0.5
4. Completion of: BIOM 6800 [0.0] Biomedical Engineering PhD Seminar	0.0
5. Successful completion of the comprehensive examination before the end of the fourth term of registration	
6. A written thesis proposal and oral examination to take place before the end of the sixth term of registration	
7. Thesis BIOM 6909 [8.5 credits]	8.5
Total Credits	10.0

Students are expected, at a minimum, to meet with their thesis advisory committee on an annual basis.

I.2.2 University of Ottawa

PhD in Biomedical Engineering [9 credits + thesis]

1. 3 credits in: BMG 5112 [3 cr] Introduction to Biomedical Engineering	3
2. 3 credits in BMG (BIOM) courses	3
3. 3 credits in elective courses at either University of Ottawa or Carleton University with the approval of the OCIBME Director or Associate Director.	3
4. Completion of: BMG XXXX [0 cr] Biomedical Engineering PhD Seminar	0
5. Successful completion of the comprehensive examination before the end of the fourth term of registration	
6. A written thesis proposal and oral examination to take place before the end of the sixth term of registration	
7. Thesis BMG 9999	
Total Credits	9

Students are expected, at a minimum, to meet with their thesis advisory committee on an annual basis.

I.3 Courses

I.3.1 New Courses

BIOM 6800 [0.0 credit] (BMG XXXX)
Biomedical Engineering PhD Seminar
This course is in the form of seminars presented by graduate students and other researchers in the area of Biomedical Engineering. To complete this course, a student must attend at least 20 seminars and make two presentations in the context of this seminar series.

BIOM 6909 [8.5 credit] (BMG 9999)
Ph.D. Thesis

I.3.2 Existing Courses

BIOM 5010 [0.5 credit] (BMG 5112 [3 credits])
Introduction to Biomedical Engineering
Research ethics and methods. Engineering systems approach to analysis and modelling of human anatomy and physiology. Introduction to topics including biomechanics, electrophysiology, and computational biology. Biomedical technologies. Impact of technology on society.

BIOM 5100 [0.5 credit] (BMG 5103 [3 credits])
Biomedical Instrumentation
Instrumentation designed to measure physiological variables related to the function of the heart, lungs, kidney, nervous and musculo-skeletal system; emergency, critical care, surgery and anaesthesia equipment.
Also listed as SYSC 5302 (ELG 6320).
Prerequisite(s): permission of the instructor.

BIOM 5101 [0.5 credit] (BMG 5104 [3 credits])
Biological Signals
Modeling of neuromuscular biological signals, including subthreshold phenomena, active behaviour of cell membranes, and innervation processes. Measurement of biological signals, including electrode effects. Time domain, frequency domain, and adaptive filtering techniques for noise reduction.
Also listed as SYSC 5307 (ELG 6307).

BIOM 5106 [0.5 credit] (BMG 5109 [3 credits])
Advanced Topics in Medical Instrumentation
Recent and advanced topics in the field of medical instrumentation and its related areas.

BIOM 5200 [0.5 credit] (BMG 5105 [3 credits])
Medical Image Processing
Mathematical models of image formation based on the image modality and tissue properties. Linear models of image degradation and reconstruction. Inverse problems, regularization for image reconstruction. Image formation in radiology, computed tomography, MRI, nuclear medicine, ultrasound, positron emission tomography, electrical impedance tomography.
Precludes additional credit for SYSC 5304 (ELG 5127).
Prerequisite(s): permission of the instructor.

BIOM 5201 [0.5 credit] (BMG 5106 [3 credits])

Introduction to Medical Imaging Principles and Technology
Basic principles and technological implementation of x-ray, nuclear medicine, magnetic resonance imaging (MRI), and other imaging modalities used in medicine. Contrast, resolution, storage requirements for digital images. Applications outside medicine, future trends.
Also listed as PHYS 5201.
Prerequisite(s): permission of the Physics department.

BIOM 5202 [0.5 credit] (BMG 5107 [3 credits])
Wavelet Applications in Biomedical Image Processing
Introduction to wavelet analysis and processing techniques for the quantification of biomedical images and signals. Topics include: multiresolution algorithms for denoising and image restoration, multiscale segmentation and classification for computer aided diagnosis and compression.
Prerequisite(s): SYSC 5602/ELG 5376 and BIOM 5200/BMG 5105, or permission of the instructor.

BIOM 5203 [0.5 credit] (BMG 5108 [3 credits])
Advanced Topics in Biomedical Image Processing
Recent and advanced topics in the field of biomedical image processing and its related areas.
Prerequisite(s): permission of the instructor.

BIOM 5300 [0.5 credit] (BMG 5300 [3 credits])
Biological and Engineering Materials
Properties of structural biological materials (bone, tendon, ligament, skin, cartilage, muscle, and blood vessels) from an engineering materials viewpoint. Selection of engineering materials as biomaterials. Introduction to biocompatibility. Histology of soft tissues. Viscoelasticity, mechanical properties and models of muscles, ligaments and tendons.
Prerequisite(s): permission of the instructor.

BIOM 5301 [0.5 credit] (BMG 5301 [3 credits])
Biomechanics of Skeletal System, Motion and Tissue
Analysis of human motion. Kinematics and kinetics of various activities. Engineering analysis and modeling techniques applied to human motion. Injury mechanics, treatment, prosthetic replacements. Fracture behaviour and healing processes.
Prerequisite(s): permission of the instructor.

BIOM 5302 [0.5 credit] (BMG 5302 [3 credits])
Biofluid Mechanics
Properties of blood. Blood flow models for vessels, circulation systems and the heart. Artificial blood vessels. Kidney flow and exchange. Modeling of perfused tissues and cells. Transport phenomena across membranes. Molecular and ionic transport. Other body fluids.
Prerequisite(s): permission of the instructor.

BIOM 5303 [0.5 credit] (BMG 5303 [3 credits])
Ergonomics and Design
Review of ergonomic issues encountered in engineering design, including biomechanical, physical and physiological issues. Strategies for human interaction with complex systems, such as aircraft cockpits, equipment control consoles, human-robotic interactions, and tele-operated equipment.
Prerequisite(s): permission of the instructor.

BIOM 5304 [0.5 credit] (BMG 5110 [3 credits])
Advanced Topics in Biomechanics and Biomaterials
Recent and advanced topics in the field of biomechanics and biomaterials and its related areas.

BIOM 5306 [0.5 credit] (BMG 5306 [3 credits])
Special Topics in Mechanical and Aerospace Engineering: Biomechanics
Overview of human anatomy and physiology with emphasis on artificial organ and prosthetic device design requirement. Application of engineering principles to cells and tissues, biofluid mechanics, human body energetics, measurement techniques, mechanics of human body systems, with emphasis on the artificial heart.
Also listed as MECH 5801 (MCG 5489).
Precludes additional credit for MCG 5489/MECH 5801.
Also offered at the undergraduate level, with different requirements, as MAAE 4906, for which additional credit is precluded.

BIOM 5311 [0.5 credit] (BMG 5311 [3 credits])
Design of Medical Devices and Implants
Solutions to clinical problems through the use of implants and medical devices. Pathology of organ failure and bioengineering and clinical aspects of artificial organs. Examples: blood substitutes, oxygenators, cardiac support, vascular substitutes, pacemakers, ventricular assist devices, artificial hearts and heart valves.
Prerequisite(s): permission of the instructor.

BIOM 5312 [0.5 credit] (BMG 5312 [3 credits])
Design of Orthopaedic Implants and Prostheses
Anatomy of the musculo-skeletal system. Electromyography. Static and dynamic analysis of the human skeleton. Materials and manufacturing considerations for orthopaedic devices. Strength and failure theories. Implant fatigue, fracture and corrosion.
Prerequisite(s): permission of the instructor.

BIOM 5314 [0.5 credit] (BMG 5314 [3 credits])
Biocontrols
Application of traditional control system principles to the human body. Functionality of sample actuators and sensors. Characterization of human body control loops with emphasis on system stability, robustness, and effect of adverse external disturbance.
Prerequisite(s): permission of the instructor.

BIOM 5315 [0.5 credit] (BMG 5315 [3 credits])
Biorobotics
Interpretation of physical laws as applied to human motion, kinematics and dynamics of humanoid robots, modeling of biological sensors and actuators, artificial muscles, tele-manipulation, robot assisted surgery, and multi-fingered end-effectors. Design of mechatronic devices including rehabilitators, extenders, haptic devices, and minimally invasive surgery systems.
Prerequisite(s): permission of the instructor.

BIOM 5316 [0.5 credit] (BMG 5316 [3 credits])
Biotransport Processes

Application of chemical engineering principles to medicine and biology. Principles of mass transfer and fluid dynamics in topics such as hemodialysis, artificial kidney, diffusion in blood, mass transfer in the eye, drug distribution in the body, and advanced life support systems.
Prerequisite(s): permission of the instructor.

BIOM 5323 [0.5 credit] (BMG 5323 [3 credits])
Rehabilitation Engineering
Multidisciplinary approach to assistive-device design. Biomechanics applied to rehabilitation. Gait, neurological disorders, pathological gait, prosthetics, orthotics, seating, and mobility. Transducers, bio-instrumentation, EMG, FES. Augmentive communication and sensory aids. Human-assistive device interfaces, human-robot interfaces, computer-vision-guided rehabilitation aids, telerehabilitation.
Prerequisite(s): permission of the instructor.

BIOM 5330 [0.5 credit] (BMG 5330 [3 credits])
Electromagnetic Fields and Biological Systems
Review of electromagnetic waves at radio and microwave frequencies. Electrical and magnetic properties of tissue. Impact of electromagnetic waves on tissue. Cellular effects.
Prerequisite(s): permission of the instructor.

BIOM 5400 [0.5 credit] (BMG 5317 [3 credits])
Medical Computing
Introduction to information technology research used in the medically related fields such as biotechnology, cancer treatment, and biometric. Topics may include: medical imaging, telemedicine, telesurgery, DNA analysis, and medical information systems.
Prerequisite(s): permission of the instructor.

BIOM 5401 [0.5 credit] (BMG 5318 [3 credits])
Advanced Health Care Engineering
Healthcare and technology; overview of medical devices and sensors; safe and effective use and management of technology; telemedicine; medical databases, data collection, storage, retrieval and computers in medicine; electronic patient records, PACS; clinical decision-support systems.
Also listed as SYSC 5300 (ELG 6130), EACJ 5303 (ELG 5123).
Prerequisite(s): permission of the instructor.

BIOM 5402 [0.5 credit] (BMG 5402 [3 credits])
Interactive Networked Systems and Telemedicine
Telemanipulator; human motoring and sensory capabilities; typical interface devices; mathematical model of haptic interfaces; haptic rendering; stability and transparency; remote control schemes; time delay compensation; networking and real-time protocols, history and challenges of telemedicine; telemedicine applications: telesurgery, tele-monitoring, tele-diagnosis and tele-homecare.
Also listed as SYSC 5303 (ELG 6133).
Prerequisite(s): permission of the instructor.

BIOM 5403 [0.5 credit] (BMG 5111 [3 credits])
Advanced Topics in Medical Informatics and Telemedicine
Recent and advanced topics in the field of medical informatics and telemedicine and its related areas.

BIOM 5405 [0.5 credit] (BMG 5111 [3 credits])

Pattern Classification and Experiment Design
Introduction to a variety of supervised and unsupervised pattern classification techniques with emphasis on correct application. Statistically rigorous experimental design and reporting of performance results. Case studies will be drawn from various fields including biomedical informatics.
Also listed as SYSC 5405 (ELG 6102).
Prerequisite(s): undergraduate introductory probability and statistics.

BIOM 5800 [0.0 credit] (BMG 6996 [0 credit])
Biomedical Engineering Seminar
This course is in the form of seminars presented by graduate students and other researchers in the area of Biomedical Engineering. To complete this course, a student must attend at least ten seminars and make one presentation in the context of this seminar series.

BIOM 5906 [0.5 credit] (BMG 7199 [3 credit])
Directed Studies in Biomedical Engineering
Various possibilities exist for pursuing directed studies on topics approved by a course supervisor, including the above-listed course topics where they are not offered on a formal basis.

PART J BIOMEDICAL ENGINEERING PROGRAMS IN CANADA

TABLE J.1 BIOMEDICAL ENGINEERING PROGRAMS IN CANADA

University	Unit	MEng	MASc/MSc	PhD	Clinical Engineering	Research Field
Proposed Program						
Carleton University and University of Ottawa	Ottawa-Carleton Institute for BME			3 courses + thesis+ seminar		Medical Instrumentation; Biomedical Image Processing; Biomechanics & Biomaterials; Medical Informatics & Telemedicine
Standalone Programs within Biomedical Engineering Units (School/Department/Institute)						
Carleton University and University of Ottawa	Ottawa-Carleton Institute for BME	10 courses + seminar OR 7 courses + project + seminar	5 courses + thesis+ seminar		5 courses + internship + project+ seminar	Medical Instrumentation; Biomedical Image Processing; Biomechanics & Biomaterials; Medical Informatics & Telemedicine
University of Alberta	Department of Biomedical Engineering	n/a	3 courses + thesis	2 courses + thesis	n/a	Biomechanics; Tissue Engineering; Rehabilitation; Biomaterials; Imaging
Dalhousie University	School of Biomedical Engineering	n/a	6 course + thesis	4 courses + thesis	n/a	Medical Devices; Biomechanics, Robotics; Imaging
McMaster University	School of Biomedical Engineering	n/a	3 courses + thesis	3 courses + thesis	n/a	Biomaterials; Tissue Engineering; Imaging; Robotics; Biophotonics; Bioprocessing
University of Toronto	Institute of Biomaterials and Biomedical Engineering	n/a	4 courses + thesis	2 courses + thesis	6 courses + internship + thesis + seminar	Biomaterials; Lab-on-Chip; Tissue Engineering; Imaging; Systems Biology; Rehabilitation;
Standalone programs within Other Units						
École Polytechnique	Graduate Program in Biomedical Engineering	8 courses + project	5 courses + thesis	5 course + thesis		Biomechanics; Biophotonics; Tissue Engineering; Biomaterials; Biomedical Signal Analysis; Imaging
McGill University	Graduate Program in Biomedical Engineering	n/a	4 courses + thesis	thesis	n/a	Biomaterials; Tissue Engineering; Biomedical Signal Analysis; Lab-on-Chip; Biomaterials; Imaging
University of British Columbia	Graduate Program in Biomedical Engineering	9 course + project	6 courses + thesis	2 courses + thesis	7-8 courses + internship	Biomechanics; Biomaterials; Imaging; Medical Devices
University of Calgary	Graduate Program in	8 courses + project	4 courses + thesis	2 courses + thesis	n/a	Biomechanics; Tissue

	Biomedical Engineering					Engineering; Rehabilitation; Biomaterials; Imaging
University of Manitoba	Graduate Program in Biomedical Engineering	n/a	6 courses + thesis	4 courses + thesis	n/a	Biomedical Signal Analysis; Imaging; Biomechanics; Rehabilitation; Biophotonics
University of Saskatchewan	Division of Biomedical Engineering	8 courses + project	4 courses + thesis	3 courses + thesis	8 courses + internship	Imaging; Biomechanics; Biomedical Signal Analysis
University of Western Ontario	Graduate Program in Biomedical Engineering	n/a	4 courses + thesis	4 courses + thesis	n/a	Imaging; Robotics; Biomaterials: Biomechanics
Options within Other Programs						
Queen's University	Collaborative Graduate Program in Biomedical Engineering	n/a	4-5 courses + thesis	4 courses + thesis	n/a	Biomaterials; Biomechanics; Tissue Engineering; Biomedical Signal Analysis
Simon Fraser University	Engineering Science	10 courses OR 8 courses + project	4 courses + thesis	6 courses + thesis	n/a	Imaging; Lab-on-Chip; Biomechanics; Rehabilitation
University of Ontario Institute of Technology	Electrical & Computer Engineering	10 courses OR 7 courses + project	5 courses + thesis	5 courses + thesis	n/a	Robotics
University of Waterloo	Engineering; Biology; Kinesiology	8 courses	4 courses + thesis	3 courses + thesis	n/a	Imaging; Biomechanics; Biomaterials; Lab-on-Chip; Bioprocessing

PART K EVIDENCE FOR DEMAND IN BIOMEDICAL ENGINEERING

Biomedical engineering is one of the fastest areas of growth. There is a corresponding need for associated specialized training opportunities to meet the needs of industry.

Below are a few items that provide evidence of this high demand from various academic, media, and industry sources.

1. The American Society of Engineering Education reported in the December 2015 PRISM publication that biomedical engineering was the top choice of discipline for domestic US students at the PhD level, and the tenth ranked choice at the master level.

   http://www.asee-prism.org/databytes-dec-3/

2. US Bureau of Labour Statistics

   "Employment of biomedical engineers is projected to grow 27 percent from 2012 to 2022, much faster than the average for all occupations. Demand will be strong because an aging population is likely to need more medical care and because of increased public awareness of biomedical engineering advances and their benefits."

   http://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm

3. Report prepared by the Medical Devices Innovation Institute in consultation with Canadian national stakeholders, including major manufacturers of medical devices, universities, hospital research institutes, related government organizations, and others. "Medical Devices Challenges and Opportunities for Enhancing the Health and Wealth of Canadians" (April 2011).

   "Detailed figures from the US Department of Labor forecast employment for this area to grow at a rate of 21% through 2016 (Figure 4, page 5), outperforming all other engineering disciplines. Various sector analyses have also identified major skill shortages in Canada encompassing wide ranging positions including regulatory affairs, clinical trial expertise and senior management among others. The medical devices and technology sector will thus clearly be an important source of high quality employment in future decades."

   "A successful medical devices sector requires a wide range of specialized core expertise (e.g. in medicine, engineering and business) as well as highly trained personnel from other disciplines including legal, regulatory, reimbursement, intellectual property, marketing, financial, etc. with specific expertise in the medical devices sector. With a relatively underdeveloped medical devices industry, Canada suffers an acute shortage of this type of expertise with well documented skills shortages."

   "It was further noted that in Ontario (location of 60% of medical devices companies in Canada) over 34.3% of companies have unfilled positions and 54.8% report a shortage of skilled workers. Furthermore, MEDEC, Canada's industry association for medical devices companies has previously identified considerable skills shortages noting 'a shortage of highly educated and skilled workers will limit the growth of Canada's medical devices industry.'"

   http://www.medec.org/webfm_send/1419

4. University of Victoria Biomedical Engineering Job Market Analysis.

   "now the convergence of the life sciences and engineering as Biomedical Engineering is now called the third revolution [1]. According to Massachusetts Institute of Technology's (MIT) most recent report [1], this third revolution is already having a major impact in a broad array of fields."

"Forecast for the fastest-growing occupations by percentage, 2008-2018 Occupation, May 2008: Biomedical engineer (Ranked 1st). New jobs: 11,600. % chg: 72%. Median wage: $77,400.

[1] http://web.mit.edu/dc/policy/MIT%20White%20Paper%20on%20Convergence.pdf"

https://www.uvic.ca/engineering/biomedical/assets/docs/Biomedical_Engineering_job_market_analysis_V2.pdf

5. Graduate Studies in Biomedical Engineering at the University of Calgary.

   "Industry Demand for Biomedical Engineering Graduates. In the United States, the number of biomedical engineering jobs is expected to grow twice as fast as the average rate of job growth for all industries. In Alberta, half of the 130 bioindustry companies expect significant growth in the next few years. An additional 1,500 new positions are expected to be added to the 4,500 workers already directly employed in this sector. More importantly, 37 percent of current employees have an MSc or PhD degree, highlighting the need for advanced education and research training in this field."

   http://www.ucalgary.ca/bme/graduate

6. Article in the Financial Post: "Thinking about changing careers? Go where the jobs are" (March 3, 2015).

   "According to the Department of Employment and Social Development Canada, technical and professional healthcare careers are projected to see an annual growth of more than 1.4 percent each year between 2011 and 2020. For those looking at career options in the sector, there are different in-demand avenues to pursue, including nursing, caregiving, healthcare management and even biomedical engineering — just to name a few."

   http://business.financialpost.com/executive/careers/thinking-about-changing-careers-go-where-the-jobs-are

PART L ATTACHMENTS

The following documents are attached to this Volume I brief:

- Carleton University Library Report for Graduate Studies in Biomedical Engineering Self Study
- University of Ottawa Library Support in Biomedical Engineering Final Report
- Letters of support from:
    - Dr. Yvan Labiche, Chair, Department of Systems & Computer Engineering (Carleton University)
    - Dr. Metin Yaris, Chair, Department of Mechanical & Aerospace Engineering (Carleton University)
    - Dr. Doug Howe, Director, School of Computer Science (Carleton University)
    - Dr. Gerald Oakham, Chair, Department of Physics (Carleton University)
    - Dr. Claude D'Amours, Chair, School of Electrical Engineering & Computer Science (University of Ottawa)
    - Dr. Natalie Baddour, Chair, Department of Mechanical Engineering (University of Ottawa)
    - Dr. David Taylor, Chair, Department of Chemical & Biological Engineering (University of Ottawa)

New Program Proposal

Date Submitted: 02/17/16 1:12 pm

Viewing: TBD-1402 : Biomedical Engineering PhD - Admission Requirements

Last edit: 07/26/16 9:00 am

Last modified by: lesliemacdonaldhicks

Changes proposed by: sandrabauer

In Workflow

1. **BIOM ChairDir GR**
2. **GRAD FCC**
3. **GRAD FBoard**
4. **PRE SCCASP**
5. **SCCASP**
6. **CUCQA**
7. **SAPC**
8. **Senate**
9. CalEditor

Approval Path

1. 04/08/16 3:37 pm
   Adrian Chan (adrianchan): Approved for BIOM ChairDir GR
2. 10/26/16 7:35 am
   Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
3. 10/26/16 7:42 am
   Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
4. 11/16/16 9:21 am
   Dan Begin (danbegin): Approved for PRE SCCASP
5. 11/16/16 9:23 am
   Dan Begin (danbegin): Approved for SCCASP
6. 11/17/16 2:52 pm
   Christina Noja (christinanoja): Approved for CUCQA
7. 11/17/16 2:58 pm
   Christina Noja (christinanoja): Approved for SAPC

Effective Date	2017-18
Workflow	majormod

Program Code	TBD-1402
Level	Graduate
Faculty	Faculty of Engineering and Design Faculty of Science
Academic Unit	Biomedical Engineering
Degree	Doctor of Philosophy
Title	Biomedical Engineering PhD - Admission Requirements

Program Requirements

Ph.D. Biomedical Engineering

Admission Requirements

The normal requirement for admission into the Ph.D. program is a master's degree with thesis in engineering, science, computer science, or a related discipline, with an average of at least B+.

Students registered full-time in the M.A.Sc. in Biomedical Engineering program at Carleton University, who shows outstanding academic performance and demonstrates significant promise for advanced research, may be permitted to transfer into the doctoral program, without completing the master's program, upon recommendation of the student's home academic unit.

New Resources	No New Resources
Summary	Admission requirements for new PhD in Biomedical Engineering.
Rationale	Admission requirements for new PhD in Biomedical Engineering.
Transition/Implementation	Upon recommendation of the student's home academic unit.

Program reviewer comments	**adrianchan (04/08/16 3:36 pm):** Updated "fast track" admissions from MASc BME to PhD BME to be clear that they would not have to complete the MASc to be admitted to the PhD.

Key: 1402

New Program Proposal

Date Submitted: 02/17/16 1:28 pm

Viewing: TBD-1403 : Biomedical Engineering PhD - Program Requirements

Last edit: 07/26/16 9:39 am

Last modified by: lesliemacdonaldhicks

Changes proposed by: sandrabauer

In Workflow

1. **BIOM ChairDir GR**
2. **GRAD FCC**
3. **GRAD FBoard**
4. **PRE SCCASP**
5. **SCCASP**
6. **CUCQA**
7. **SAPC**
8. **Senate**
9. CalEditor

Approval Path

1. 04/08/16 3:38 pm
   Adrian Chan (adrianchan): Approved for BIOM ChairDir GR
2. 10/26/16 7:35 am
   Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
3. 10/26/16 7:42 am
   Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
4. 11/16/16 9:21 am
   Dan Begin (danbegin): Approved for PRE SCCASP
5. 11/16/16 9:23 am
   Dan Begin (danbegin): Approved for SCCASP
6. 11/17/16 2:53 pm
   Christina Noja (christinanoja): Approved for CUCQA
7. 11/17/16 2:58 pm
   Christina Noja (christinanoja): Approved for SAPC

Effective Date	2017-18
Workflow	majormod

Program Code	TBD-1403
Level	Graduate
Faculty	Faculty of Engineering and Design Faculty of Science
Academic Unit	Biomedical Engineering
Degree	Doctor of Philosophy
Title	Biomedical Engineering PhD - Program Requirements

Program Requirements

Program Requirements

Ph.D. Biomedical Engineering (10.0 credits)		
1. 0.5 credit in:		**0.5**
BIOM 5010 [0.5]	**Introduction to Biomedical Engineering**	
2. 0.5 credit in BIOM (BMG) courses		**0.5**
3. 0.5 credit in elective courses at either Carleton University or University of Ottawa with the approval of the OCIBME Director or Associate Director		**0.5**
4. Completion of:		**0.0**
BIOM 6800 [0.0]	**Biomedical Engineering PhD Seminar**	
5. Successful completion of the comprehensive examination before the end of the fourth term of registration		
6. A written thesis proposal and oral examination to take place before the end of the sixth term of registration		
7. 8.5 credits in:		**8.5**
BIOM 6909 [0.0]	**Ph.D. Thesis**	
Total Credits		10.0

New Resources	No New Resources
Summary	Add PhD in Biomedical Engineering
Rationale	New PhD program in Biomedical Engineering
Transition/Implementation	None

Program reviewer comments	**sandrabauer (02/17/16 3:34 pm):** format

Key: 1403

New Course Proposal

Date Submitted: 07/26/16 9:37 am

Viewing: BIOM 6800 : Biomedical Engineering PhD Seminar

Last edit: 09/23/16 8:38 am

Changes proposed by: lesliemacdonaldhicks

In Workflow

1. **BIOM ChairDir GR**
2. **GRAD FCC**
3. **GRAD FBoard**
4. **PRE SCCASP**
5. SCCASP
6. Banner

Approval Path

1. 07/26/16 12:06 pm
   Andy Adler (andyadler): Approved for BIOM ChairDir GR
2. 10/26/16 7:33 am
   Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
3. 10/26/16 7:42 am
   Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard

Programs referencing this course	Biomedical Engineering PhD - Program Requirements
Effective Date	2017-18
Workflow	minormod
New Resources	No New Resources
Level	Graduate
Course Code	BIOM
Course Number	6800
Title	Biomedical Engineering PhD Seminar
Title (short)	Biomedical Engineering PhD Sem
Faculty	Faculty of Engineering and Design

Academic Unit	Biomedical Engineering
Credit Value	0.0
Course Description	This course is in the form of seminars presented by graduate students and other researchers in the area of Biomedical Engineering.
Prerequisite(s)	
Class Format	Seminar
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	

Grade Mode	Satisfactory/Unsatisfactory
Schedule Type	Seminar
Summary	Seminars presented by graduate students and other researchers in the area of Biomedical Engineering.
Rationale for new course	Required seminar course in PhD Biomedical Engineering program.

Course reviewer comments	**sandrabauer (07/26/16 5:22 pm):** Removed UO code "BMG XXXX" - not valid code. Please complete the field when valid code is obtained.

Key: 9013

New Course Proposal

Date Submitted: 02/17/16 11:43 am

Viewing: BIOM 6909 : Ph.D. Thesis

Last edit: 10/26/16 7:34 am

Changes proposed by: sandrabauer

In Workflow

1. **BIOM ChairDir GR**
2. **GRAD FCC**
3. **GRAD FBoard**
4. **CUCQA**
5. **PRE SCCASP**
6. **SCCASP**
7. **SAPC**
8. **Senate**
9. Banner

Approval Path

1. 04/08/16 3:32 pm
   Adrian Chan (adrianchan): Approved for BIOM ChairDir GR
2. 10/26/16 7:35 am
   Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
3. 10/26/16 7:42 am
   Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
4. 10/27/16 3:33 pm
   Christina Noja (christinanoja): Approved for CUCQA
5. 11/16/16 9:26 am
   Dan Begin (danbegin): Approved for PRE SCCASP
6. 11/16/16 9:26 am
   Dan Begin (danbegin): Approved for SCCASP
7. 11/17/16 11:36 am
   Christina Noja (christinanoja): Approved for SAPC

Programs referencing this course	Biomedical Engineering PhD - Program Requirements

Effective Date	2017-18
Workflow	majormod
New Resources	No New Resources
Level	Graduate
Course Code	BIOM
Course Number	6909
Title	Ph.D. Thesis
Title (short)	Ph.D. Thesis
Faculty	Faculty of Engineering and Design
Academic Unit	Department of Systems and Computer Engineering
Credit Value	8.50
Course Description	
Prerequisite(s)	
Class Format	
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Thesis/Dissertation
Schedule Type	PhD Thesis
Summary	Add PhD Thesis
Rationale for new course	Part of the new PhD Biomedical Engineering program
Course reviewer comments	**anshulsingh (04/15/16 12:30 pm):** As per discussion with Dr. Adrian Chan, updated Academic Unit to SCE.

Key: 8926

OCCQA discussant report: Biomedical Engineering PhD

Douglas J. Howe, Professor and Director
School of Computer Science
Carleton University

May 17, 2016

1 Summary

The proposal is to add a PhD to the existing Master's programs of the Ottawa Carleton Institute for Biomedical Engineering (OCIBME). The proposal has compelling strengths (see below) but the administration and structure of the program raise some substantial questions that should be addressed in the brief.

2 Strengths and weaknesses

2.1 Strengths

The program has some clear strengths that should guarantee eventual approval.

2.1.1 Strategic plans

The program builds on existing strengths, requiring no new faculty, courses or labs. It is in an area of societal need. PhD programs are essential for building research strength in an area. Together, these fact imply a strong fit with the strategic plans of both universities. At Carleton, this fits with Carleton's sustainability goal (the program costs nothing), the goal of developing new programs building on strengths in response to societal needs, and the goal of building research strength. At uOttawa, it fits squarely with the strategic research priority of Health and e-Society, builds on recognized strength in Medicine and Health, and Science and Technology, and aligns with the major goal of Research Excellence.

2.1.2 Faculty/Research

The two universities have well established research strength in the area. OCIBME currently has over one hundred members.

2.1.3 Courses

All the courses for the new program (except for the thesis course) are already in place because of the existing master's program. This includes the one "core" course on biomedical engineering, plus 14 courses in the subject that can be used as area electives.

2.1.4 Student demand

Part K of the brief gives an impressive account of evidence for student demand. To give just one example: "The American Society of Engineering Education reported [...] that biomedical engineering was the top choice of discipline for domestic US students at the PhD level"

2.2 Weaknesses

There are three areas where I think external reviewers might have some concerns.

2.2.1 Core faculty

There is no notion of core faculty here. The brief uses "core faculty" to refer to the entire list of affiliated faculty. A look at the CVs will show that they are not really "core" in the sense of having biomedical engineering as a primary research interest. I believe membership was determined largely by self-identification, possibly with the support of the relevant unit head. Some of the members have only a tangential interest in biomedical engineering.

I don't doubt that they are all capable of supervising PhDs in the area. My only concern is that there is no mechanism for ensuring that the research of students in the program is actually biomedical engineering other than the individual judgment of the supervisor.

OCIBME includes faculty from many different units and they may have very different ideas of what the field is. It seems some kind of coordination would be good. One possibility would be to have actual "core" faculty distinguished from the rest, and have a committee drawn from them check research topics and proposals.

2.2.2 Courses

The program requires three courses: one compulsory "core" course which it has in common with the existing MASc degree, one elective in biomedical engineering, and one free elective.

It is not clear what the role of the courses is. These are the same courses that are used for the Master's degree. If a student admitted to the program has done a bunch of these courses as a master's student, what is the additional value to PhD-level study of taking more of them? In particular, if a student has already taken the compulsory core course (same course at PhD and MASc levels), why do they need to replace it with another biomed course?

The learning outcomes map shows the biomedical engineering elective contributing to learning outcomes 2, 3 and 4: "develop, and/or apply in novel ways"; "develop, and/or apply in novel ways computational [...] and/or experimental [...] procedures"; "Critically analyze computational or experimental outcomes.". There are many choices for this elective. Do they all contribute to all of these outcomes? Wouldn't the usual latitude given to graduate course instructors make this problematic?

In any case, a student coming from the MASc will have taken all these courses; wouldn't they therefore already have achieved all these learning outcomes?

One reason for PhD level courses, which is mentioned in the brief, is to gain knowledge required for the particular PhD research a student is doing. But in this case, shouldn't the courses be optional? If there are no electives particularly relevant to the proposed research, why should the student have to take any?

2.2.3 Admissions

All that is required for admission is a master's degree in engineering, science, computer science or a "related discipline". If one looks at what all of these backgrounds have in common, one is probably left with not much more than basic math/stats and its subsequent application to something.

I understand the desire to cast a wide net, but admission requirements should give guidelines to students about their preparedness for the program and overly broad ones don't do this. Science in particular is too broad. E.g. are math, stats, biology, earth sciences, environmental science etc adequate preparation?

Perhaps the admission requirement could be "a Master's degree in a related area, *for example* ..." and give more precise examples. One could add a catch-all like "but master's degrees in other areas may be considered."

3 Improving the program brief

I recommend that the points made above in Section 2.2 be addressed. Below are some relatively minor points.

I think something should be said to reconcile the frequently-mentioned interdisciplinarity with the skewed enrollment. Current Carleton enrollment in the MASc is 18 in Systems and Computer Engineering, 2 in Mechanical and Aerospace Engineering, 1 in Computer Science and 1 in Physics.

Collaboration with local hospitals is mentioned several times. It might be good to give a few concrete examples.

The last point is Carleton-specific. The brief says an administrative position is being requested for the institute itself. There are economies of scale in academic unit administration, so why not put the position in the department of Systems and Computer Engineering where over 80% of the students are?

4 Questions for reviewers

None.

5 Reviewer ranking

TBD.

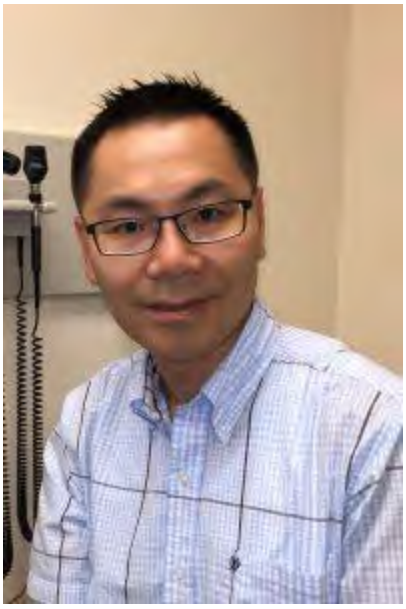
Dr. Brian Amsden
Queens University

Dr. Brian Amsden research focus is on the creation of effective biodegradable and biocompatible polymers for biomedical applications. These applications include localized growth factor delivery for therapeutic angiogenesis and for stem cell differentiation, scaffolds for soft connective tissue engineering, and ocular drug delivery. Polymer systems being developed include biodegradable elastomers,electrospun crimped fibre scaffolds, injectable thermoplastics, and mechanically enhanced hydrogels. He is interested in elucidating the mechanisms of degradation of the polymers in vivo to better design these materials for given applications, determining the mechanisms governing drug release, the role polymer biomaterial mechanical properties play in mediating cell proliferation and differentiation, and in controlling polymer surface properties to improve cellular interactions. The work is multidisciplinary and we collaborate routinely with orthopaedic and cardiovascular surgeons, and colleagues in mechanical engineering and cell biology.

Dr. Ezra Kwok
University of British Columbia

McMaster University, M.D.
University of Alberta, Ph.D., Computer Process Control
University of Alberta, B.Sc., Chemical Engineering with Distinction

Dr. Ezra Kwok is the recipient of the 2011 Outstanding Canadian Biomedical Engineer Award. His current research projects include: Clinical medicine and engineering; Diabetic modeling and control; Treatments for osteoarthritis; Assessment of prosthetic devices; Advanced model-based adaptive predictive control.



Ottawa-Carleton Institute for Biomedical Engineering
PhD Proposal – Site Visit August 31st – September 2nd

External Reviewers: Dr. Ezra Kwok, University of British Columbia
Dr. Brian Amsden, Queen's University

Internal Reviewers: Dr. Sue Aitken, Carleton University
Dr. Ousmane Seidou, University of Ottawa

Wednesday August 31st, 2016
University of Ottawa

Time	Location	Meeting Description	Attendees
8:45 am	Indigo Hotel Lobby	Jeela Jones, Director of Quality Assurance of the uOttawa Faculty of Graduate and Postdoctoral Studies (FGPS), meets the external reviewers in the lobby of Indigo Hotel and accompanies them to their first meeting	**Jeela Jones**, uOttawa Director, Quality Assurance
9:00 am	University of Ottawa 210 Hagen Hall	Introductory Meeting with the Dean and Vice-Dean of Graduate Studies from the University of Ottawa and the Vice-Provost and Associate Vice-President (Academic), Carleton University	**Claire Turenne-Sjolander**, Interim Dean and **Lynne Bowker**, Vice-Dean of the uOttawa Faculty of Graduate and Postdoctoral Studies **John Shepherd**, Vice-Provost and Associate Vice-President (Academic), Carleton University
10:00 am		Jeela Jones (uOttawa FGPS) accompanies the external and internal reviewers to their first meeting	
10:15 am	University of Ottawa CBY A-707	Meeting with Faculty Deans	**Rafik Goubran**, Dean, Faculty of Engineering and Design, Carleton University **Malcolm Butler**, Dean, Faculty of Science, Carleton University

			Ioan Nistor, Interim Dean, Faculty of Engineering, University of Ottawa
11:15 am	University of Ottawa CBY A707	Meeting with Departmental Chairs/Directors	**Xudong Cao**, Director, Ottawa-Carleton Institute for Biomedical Engineering, University of Ottawa **Adrian Chan**, Program Lead, Ottawa-Carleton Institute for Biomedical Engineering, Carleton University **Yvan Labiche**, Director, Department of Systems & Computer Engineering, Carleton University **Ronald Miller**, Director, Mechanical & Aerospace Engineering, Carleton University **Alain Bellerive**, Director, Department of Physics, Carleton University **Doron Nussbaum,** on behalf of **Doug Howe**, Director, School of Computer Science, Carleton University **Claude D'Amours**, Director, School of Electrical Engineering and Computer Science, University of Ottawa **Natalie Baddour**, Chair, Department of Mechanical Engineering, University of Ottawa **Boguslaw Kruczek**, Chair, Department of Chemical and Biological Engineering, University of Ottawa
12:15	Royal Oak Restaurant	Lunch with Departmental Chairs/Directors	

1:45 pm	University of Ottawa CBY A707	Meeting with Students from both Carleton University and the University of Ottawa	Current OCIBME students from both uOttawa and Carleton
2:45 pm	University of Ottawa CBY	Break	
3:00 pm	University of Ottawa CBY A707	Meeting with University of Ottawa Professors	Hanan Anis Natalie Baddour Daniel Benoit Xudong Cao Isabelle Catelas Marc Doumit Michel Godin Michel Labrosse Catherine Mavriplis Sidney Omelon Fabio Variola
4:30 pm	University of Ottawa	Tour of labs provided by Fabio Variola Xudong Cao Michel Godin Hanan Anis	CBY B210A and D511 CBY D316 and D317 MCD 032 ARC 338
6:00 pm	Shore Club	Dinner	Mojtaba Ahmadi Adrian Chan Xudong Cao Isabelle Catelas

Ottawa-Carleton Institute for Biomedical Engineering
PhD Proposal – Site Visit August 31st – September 2nd

External Reviewers: Dr. Ezra Kwok, University of British Columbia
Dr. Brian Amsden, Queen's University
Internal Reviewers: Dr. Sue Aitken, Carleton University
Dr. Ousmane Seidou, University of Ottawa

Thursday September 1st, 2016
Carleton University

Time	Location	Meeting Description	Attendees
8:50 am	Carleton University Minto Centre entrance	Alicia Ott, Executive Assistant to Dr. John Shepherd Carleton University, Office of the Vice-Provost and Associate Vice-President (Academic), meets the external reviewers at the front of Minto Centre	**Alicia Ott**, Executive Assistant to Dr. John Shepherd, Carleton University
9:00 am	Carleton University 2014 Minto Centre	Meet with Carleton University's Program Lead	Adrian Chan
9:30 am	Carleton University 2014 Minto Centre	Meeting with Carleton University Professors	Adrian Chan Monique Frize Eran Ukwatta Richard Dansereau
10:30 am	Carleton University 2014 Minto Centre	Meeting with Carleton University Professors	Mojtaba Ahmadi Adrian Chan John Hayes Sangeeta Murugkar Andrew Speirs Tong Xu
11:30 am	Carleton University 6107 Canal Building	Carleton University Biomedical Engineering (CUBE) Laboratory	Adrian Chan
11:45 am	Carleton University 7104 Canal Building	Biomechatronics Laboratory	Mojtaba Ahmadi
12:00	Carleton University 7103 Canal Building	Biomaterials Laboratory	Andrew Speirs
12:15 pm	Carleton University 234 Azrieli Pavillion	Motion Capture Studio	Chris Joslin
12:30 pm	Bakers Restaurant Carleton University 4th Floor University Centre	Lunch with professors	Mojtaba Ahmadi Adrian Chan Richard Dansereau Monique Frize Yuu Ono Andrew Speirs Tong Xu

2:30 pm	Carleton University 2014 Minto Centre	Wrap up with Faculty Deans	**Rafik Goubran**, Dean, Faculty of Engineering and Design, Carleton University **Dr. Yiqiang Q. Zhao**, Associate Dean (Research and Graduate Studies), Faculty of Science, Carleton University **Michel Labrosse**, Vice Dean of Graduate Studies, Faculty of Engineering, University of Ottawa
3:30 pm	Carleton University 2014 Minto Centre	Wrap up with the Vice-Provost and Associate Vice-President (Academic), Dean and Vice-Dean of Graduate Studies from Carleton University and University of Ottawa	**Claire Turenne-Sjolander**, Interim Dean and **Lynne Bowker**, Vice-Dean of the uOttawa Faculty of Graduate and Postdoctoral Studies **John Shepherd,** Vice-Provost and Associate Vice-President (Academic), Carleton University **Matthias Neufang**, Dean, Graduate Studies, Carleton University

Ottawa-Carleton Institute for Biomedical Engineering
PhD Proposal – Site Visit August 31st – September 2nd

External Reviewers: Dr. Ezra Kwok, University of British Columbia
Dr. Brian Amsden, Queen's University

Friday September 2nd, 2016
University of Ottawa

Time	Location	Meeting Description	Attendees
9:00 am	University of Ottawa HGN 202C The evaluators are welcome to use the room for the whole day if required	External reviewers meet on their own to begin preparing report	**Ezra Kwok**, University of British Columbia **Brian Amsden**, Queen's University

Ottawa-Carleton Institute for Biomedical Engineering

Biomedical Engineering PhD Proposal

Review Team Report

Reviewers

Dr. Brian Amsden, Queen's University
Dr. Ezra Kwok, University of British Columbia

Reviewers (internal)
Dr. Sue Aitken, Carleton University
Dr. Ousmane Seidou, University of Ottawa

September 1, 2016

INTRODUCTION

The following is a report of the committee that conducted a review of the Biomedical Engineering PhD degree proposal by the Ottawa-Carleton Institute for Biomedical Engineering. The review forms part of the Institutional Quality Assurance Process in the Province of Ontario. It was commissioned by the Office of the Vice-Provost and Associate Vice-President (Academic), Carleton University. The site visit took place on August 30 to September 1, 2016.

First of all, we would like to state our appreciation for the tremendous hospitality of our hosts. Everyone involved in the external review from the University side worked hard to facilitate our visit. The external review process included:

- the submission of a well-written self-study report to the reviewers,
- the submission of a complete set of CV's of all faculty members involved, to the reviewers,
- an interview with the Vice-Provost and Associate Vice-President (Academic) Dr. John Shepherd, Carleton University,
- an interview with the Dean and Vice-Dean of the uOttawa Faculty of Graduate and Postdoctoral Studies,
- an interview with the Deans of the Carleton University Faculties of Engineering and Design, and Science,
- an interview with the Dean of the University of Ottawa Faculty of Engineering,
- an interview with the Directors of all academic units associated with the Ottawa-Carleton Institute for Biomedical Engineering,
- an interview with the current graduate Masters students from the Ottawa-Carleton Institute for Biomedical Engineering,
- an interview with professors who are members of the Ottawa-Carleton Institute for Biomedical Engineering,
- an interview with the Program Lead, Dr. Adrian Chan, and,
- tours of the research facilities at both universities.

The proposed PhD degree program is desired to enhance the education opportunity for students pursuing graduate studies in the emerging discipline of Biomedical Engineering. The Ottawa-Carleton Institute for Biomedical Engineering was established in 2006 and has been offering a multi-disciplinary Master of Applied Science degree since its inception. The Institute will start offering a course-based Master of Engineering degree in September 2016.

This report begins with an executive summary and is followed by responding to the specific and relevant questions listed in the Terms of Reference of the Cyclical and New Program Review document. Explanatory remarks and recommendations are provided for questions that the reviewers deem not positive.

EXECUTIVE SUMMARY

Overall, we felt that there the need for the program was clear and well reasoned. There is a demand for this program, given the societal need for biomedical engineering research and development, the number of interested students, the existing limitations in the processes for taking in new PhD students within the existing departments, and the desire for PhD candidates to be associated with and be trained within a Biomedical Engineering program. Moreover, there is clearly capacity for the proposed PhD student intake. The proposed program fits naturally and builds logically from the currently successful MASc program.

Areas of Strength:
A number of strengths of the proposed program were noted. These include:

1. The level of collaboration between investigators, including interactions with surgeons and researchers at the Ottawa Hospital, the University of Ottawa Heart Institute, the University of Ottawa Eye Institute, the Ottawa Hospital Rehabilitation Centre, the Élisabeth Bruyère Hospital and the Children's Hospital of Eastern Ontario.
2. The quality of the existing research lab space, which ranges from good to excellent.
3. The high quality of the researchers and the research being conducted. Further, there is good interaction between researchers and industry which is of benefit to the graduates of the program.
4. The program is unique within Ontario and within Canada. This uniqueness is due to its breadth of biomedical engineering research, and the collaboration between two institutions and 7 departments in carrying out the program.
5. The two participating universities are currently engaged in hiring new professors to support the program, which is a strong indication of their level of commitment to the program.
6. A new STEM building is being built, which should provide sufficient office and lab space to accommodate the number of proposed new PhD students.
7. The new program has an internal review process (Program Assessment Committee) for assessing the learning outcomes of the program as well as for determining future improvements to the program.

Areas of weakness:
Notwithstanding the strengths noted above, some weaknesses were also identified. These are:

1. While there are many courses in signal processing/imaging, there is a need for more course selection in the biomaterials and biomechanics areas. This need is particularly relevant for PhD candidates who have already completed the MASc program within the OCIBME.
2. Many (~50%) of the graduate students in the existing MASc program are from Ottawa-Carleton as are the current PhD candidates working on biomedical engineering projects. The program is encouraged to seek to attract a greater number of graduate students from other Canadian institutions.
3. The cornerstone and compulsory course, BIOM 5010/BMG 5112, was felt to contain too much content and could be more focused. The reviewers suggest removal of the anatomy

and physiology content; these learning outcome measurements could be mapped to the comprehensive exam or other courses.

Recommendations:

1. Incorporate into the program design an advisory committee that meets with the candidate periodically during the PhD program. This advisory committee would consist of the members of the comprehensive and proposal examination committee. The purpose of this advisory committee would be to monitor the development of the student as a critical thinker and independent researcher and to monitor the student's research program to ensure that the candidate's research progresses appropriately. The findings of the advisory committee could be provided to the PhD candidate as direct feedback for them to stay on track with their proposed research.
2. The PhD candidates could be encouraged to take courses in business management, entrepreneurship, and life sciences, as well as education/teaching for those interested in an academic career.
3. Include discussion of current medical standards and regulations in BIOM 5010/BMG 5112 in place of the anatomy and physiology. These latter learning outcome measurements could be mapped to the comprehensive exam or other courses.
4. If an incoming PhD candidate has an equivalent to BIOM 5010/BMG 5112 or has already taken it as part of their MASc program within the OCIBME, consider removing the requirement for a replacement elective.
5. Provide a designated support staff member who is a not a faculty member to assist the Director and Program Lead with running the program.
6. The Director of the program should identify appropriate mentors for the new hires; new faculty members should be encouraged to participate in teaching and research workshops.

THE PROGRAM

The proposed program's intellectual profile will serve the mission, and strategic and academic plans of Carleton University and the University of Ottawa. As well, it will match the teaching and research strengths of the respective academic units. Further, they are appropriate in relation to the current international, national, and provincial profile of the discipline or interdisciplinary area. Finally, the program's intellectual profile and learning outcomes are distinctive in relation to those of comparable programs in Ontario or nationally.

The program's learning outcomes are consistent with the Graduate Degree Level Expectations and the methods for assessing program learning outcomes are appropriate. The program also contains unique curriculum aspects, program innovations or creative components in comparison to other, similar, programs in Ontario or Canada.

PROGRAM CONTENT

The program was considered to be appropriately designed and structured to achieve the learning outcomes. The program design and structure will enable suitably qualified students to complete the program in a timely fashion, which is specified to be within the normal time frame for a biomedical engineering PhD program, i.e. 4-5 years.

There is a sufficient level of education and activity in research and sufficient provision for the development of research and analytic/interpretative skills. Evidence was clearly provided that a student in the program would be required to take a minimum of two-thirds of the course requirements from among graduate level courses. A clear description of the numbers of students as well as the quantity of planned/anticipated class sizes, provision of supervision of experiential learning opportunities and the role of adjunct and part-time faculty was provided.

The program was considered to have appropriate modes of delivery and there was a clear indication of essential requirements.

GOVERNANCE

An appropriate governance and administrative structure was outlined in the self-study report.

THE FACULTY

Evidence of the quality of the faculty (e.g. qualifications, research, innovations and scholarly record, appropriateness of collective faculty experience to contribute substantively to the proposed program) were provided. The means by which supervisory loads will be distributed, and the qualifications and appointment status of faculty who will provide instruction and supervision were clearly described.

As noted above in the recommendations, the Director of the program should identify appropriate mentors for the new hires; new faculty members should be encouraged to participate in teaching and research workshops.

ADMISSION REQUIREMENTS

The admission requirements are appropriate for the learning outcomes established for the completion of the program. Moreover, a student entering the program would be expected to complete it successfully and in a timely fashion given the admission requirements. All requirements additional or alternative to the foundational requirements are appropriate, and all admission requirements were well explained.

THE STUDENTS

A website exists to provide clear communication between students, faculty and programs and university administration; however, the program could improve the visibility of entrepreneurship and teaching courses/training elements on program website. Further, there was clear evidence of verbal communication between all levels involved in the program.

There are sufficient mentoring programs and orientation days provided for in the program.

Sufficient evidence of financial assistance for students to ensure adequate quality and number of students was demonstrated.

The program structure and faculty research will ensure the intellectual quality of the student experience. As well, the program has addressed the Tri-Council's guidelines statement concerning graduate students' professional skills.

We were satisfied that, given the advising, mentoring and support provided by the program and the university more generally through its academic services, the students in the program will have a satisfactory educational experience.

The methods of student evaluation are appropriate given admission requirements, the degree level expectations, and the learning outcomes. Further, plans are outlined for documenting and demonstrating the level of performance of students consistent with the Graduate Degree Level Expectations.

The program will prepare students adequately for their chosen career path following graduation with respect to careers for which the program could reasonably be expected to provide a preparation.

RESOURCES

The program is adequately resourced, with a sufficient number of faculty with acceptable levels of teaching expertise and competence, and of continuing research and publishing activity. However, it was felt that the program required additional support staff assistance.

CRITERION SPECIFIC TO NEW PROGRAMS

The degree program's nomenclature and acronym are appropriate.

DOCTORAL PROGRAMS

It was clearly demonstrated within the brief and following questioning of the various faculty involved how the breadth of knowledge and the research skills necessary for a PhD candidate to possess would be achieved and evaluated.

FINAL REMARKS

The review process has been a very educational and enjoyable one. We feel that the proposed PhD program will be successful in advancing the knowledge base in Biomedical Engineering and the training of highly qualified personnel.

Date: September 19, 2016
To: Dr. John Shepherd, Vice-Provost and Associate Vice-President (Academic)
From: Dr. Adrian Chan, Program Lead, Department of Systems and Computer Engineering, Carleton University
Cc: Dr. Michel Labrosse, Vice-Dean (Graduate Studies, Interim), Faculty of Engineering, University of Ottawa
Dr. Peter Ricketts, Provost and Vice-President (Academic)
Dr. Rafik Goubran, Dean, Faculty of Engineering and Design,
Dr. Malcolm Butler, Dean, Faculty of Science
Dr. Matthias Neufang, Dean, Faculty of Graduate and Postdoctoral Affairs,
Dr. Ioan Nistor, Dean (interim), Faculty of Engineering, University of Ottawa
Dr. Claire Turenne-Sjolander, Dean (Interim), Faculty of Graduate & Postdoctoral Studies, University of Ottawa
Dr. Lynne Bowker, Vice Dean, Faculty of Graduate & Postdoctoral Studies, University of Ottawa; Co-Chair, Ottawa-Carleton Committee on Graduate Quality Assurance
Dr. André Loiselle, Assistant Vice-President (Academic), Office of the Vice-Provost and Associate Vice-President (Academic)
Jeela Jones, Director of Quality Assurance, University of Ottawa
Jessica DeVries, Program Review Officer (Acting), Office of the Vice-Provost and Associate Vice-President (Academic)
Leslie MacDonald-Hicks, Program Officer, Faculty of Graduate and Postdoctoral Affairs

RE: New Program proposal: PhD, Biomedical Engineering (External Reviewer Report)

On behalf of the Program Development Committee for the PhD program in Biomedical Engineering, I would like to thank the external reviewers for their time, consideration, and thoughtful comments from the site visit that took place August 30 to September 1, 2016. The observations and suggestions outlined in the report have all been fully considered. For your convenience, the comments have been copied verbatim along with each response.

Once again thank you for your feedback and support in this program development.

Sincerely,

Dr. Adrian Chan, Program Lead, OCIBME PhD in Biomedical Engineering

Areas of weakness

1. While there are many courses in signal processing/imaging, there is a need for more course selection in the biomaterials and biomechanics areas. This need is particularly relevant for PhD candidates who have already completed the MASc program within the OCIBME.

In the 2016-17 academic year, OCIBME is offering 11 BIOM/BMG graduate courses of which four are within the area of biomechanics and biomaterials. By consulting with the departments of Mechanical and Aerospace Engineering (Carleton University), Mechanical Engineering (University of Ottawa), and Chemical and Biological Engineering (University of Ottawa), we can confirm that these units are committed to continuing efforts to further expand graduate course offerings within these areas. There is already a new biomaterials graduate course (CHG8191G Biomaterials: Principles and Applications) offered by Dr. Xudong Cao in the 2016-17 academic year that can be cross-coded as BIOM/BMG course.

2. Many (~50%) of the graduate students in the existing MASc program are from Ottawa-Carleton as are the current PhD candidates working on biomedical engineering projects. The program is encouraged to seek to attract a greater number of graduate students from other Canadian institutions.

We fully agree with this item and have been initiating various efforts along these lines. For example, the OCIBME website was completely revised recently to provide an updated and more modern outward-looking face. We have also hosted booths at national and international conferences recently, including the 2015 IUPSEM World Congress on Medical Physics and Biomedical Engineering, one of the largest gatherings of biomedical engineers in the world. In 2016, the IEEE Engineering in Medicine in Biology Society International Student Conference was also held in Ottawa (hosted by Carleton), which attracted nearly 150 student delegates from across Canada, as well as international students (e.g., USA, United Kingdom, Italy, Peru, and South Korea). New research initiatives (e.g., NSERC CREATE Biomedical Engineering Smartphone Technology training program, PI Professor Natalie Baddour), along with increased exposure to potential graduate students in our outreach efforts, should help attract a greater number of graduate students outside of the Ottawa-Carleton region.

3. The cornerstone and compulsory course, BIOM 5010/BMG 5112, was felt to contain too much content and could be more focused. The reviewers suggest removal of the anatomy and physiology content; these learning outcome measurements could be mapped to the comprehensive exam or other courses.

The compulsory course BIOM 5010/BMG 5112 Introduction to Biomedical Engineering provides foundational knowledge in biomedical engineering, including biomedical research ethics, anatomy, and physiology. This course is the compulsory course in the OCIBME master's program and has been offered with good success in that program. This course is intended only for PhD students who come without a biomedical engineering background, and provides them with important foundational knowledge in the field. Students from the OCIBME master's program would have already completed

this course and students from another biomedical engineering master's program would likely have completed an equivalent course; these students would be exempt from having to take BIOM 5010/BMG 5112. Given that the course has been effective in the master's program and only targeted to PhD students without this background, there are no changes to the proposed program. The OCIBME program assessment committee will keep this reviewer's observation in mind, as the PhD program is implemented, to see if changes in the future are warranted.

Recommendations:

1. Incorporate into the program design an advisory committee that meets with the candidate periodically during the PhD program. This advisory committee would consist of the members of the comprehensive and proposal examination committee. The purpose of this advisory committee would be to monitor the development of the student as a critical thinker and independent researcher and to monitor the student's research program to ensure that the candidate's research progresses appropriately. The findings of the advisory committee could be provided to the PhD candidate as direct feedback for them to stay on track with their proposed research.

PhD students would have an advisory committee comprised of their supervisor(s) and two members of OCIBME (one from Carleton University and one from the University of Ottawa). This advisory committee would consist of the members of the comprehensive and proposal examination committee. The proposed program would have students interface with their advisory committee in Year 1 via the comprehensive examination. They would see their advisory committee in Year 2 via the thesis proposal stage. They would then see their advisory committee in Year 4 for the thesis defense. As such the student would interface with their advisory committee almost annually. It is noted that this structure is in line with the other Ottawa-Carleton engineering PhD programs.

The program committee does accept this recommendation and have added to the program requirements the calendar language: "Students are expected, at a minimum, to meet with their thesis advisory committee on an annual basis."

2. The PhD candidates could be encouraged to take courses in business management, entrepreneurship, and life sciences, as well as education/teaching for those interested in an academic career.

The structure of the PhD program allows for a free elective, permitting to PhD candidates to take courses in business management, entrepreneurship, and life sciences. These would require appropriate approvals from the unit offering the course (e.g., to ensure any prerequisite requirements are met and space is available in the course), which has not been a problem with the free electives in the OCIBME master's program. Students also have the ability to participate in non-academic skills and developing training programs (e.g., Carleton's Grad Navigate and Preparing to Teach Certificate, uOttawa's Altitude, MyGradSkills courses (www.mygradskills.ca), and the Mitacs Step workshops); these offerings can help students increase their research, teaching, and professional skills.

3. Include discussion of current medical standards and regulations in BIOM 5010/BMG 5112 in place of the anatomy and physiology. These latter learning outcome measurements could be mapped to the comprehensive exam or other courses.

Medical standards and regulations are already included in BIOM 5010/BMG 5112, though likely not to the extent suggested by the reviewers. In addition, medical standards and regulations are also part of the BIOM 5311/BMG 5311 Design of Medical Devices and Implants course. We agree with the reviewers that there may be interest from some PhD students to gain more in depth knowledge within this area. OCIBME will examine the potential of offering a standalone course on medical standards and regulations. This may be in collaboration with other programs that would have overlapping interests (e.g., public policy, health sciences) to optimize resources. OCIBME will also promote relevant events in this area to its students. In particular, the MedDev Commercialization Centre for medical devices (MDCC) is located in Ottawa, which has close ties with both the Carleton University and the University of Ottawa, offers relevant events in this area (e.g., "Early Engagement with the Regulator – Medical Devices Bureau, Health Canada", Sarah Chandler, A/Manager, Device Licensing Services Division, Health Canada).

4. If an incoming PhD candidate has an equivalent to BIOM 5010/BMG 5112 or has already taken it as part of their MASc program within the OCIBME, consider removing the requirement for a replacement elective.

The PhD in Biomedical Engineering has a program requirement of three 0.5 credit (3 credits) courses, seminar, and thesis. BIOM 5010/BMG 5112, Introduction to Biomedical Engineering, is a compulsory course that provides foundational knowledge. PhD students who come from the OCIBME MASc in Biomedical Engineering program would have already completed this course, as it is also a required course in the MASc (students from other master's program in biomedical engineering would likely have taken an equivalent course); in such cases, students would complete another course (a free elective chosen in consultation with the thesis supervisor, and with the approval of the OCIBME Director or Associate Director). A three course requirement is in line with other PhD programs in engineering at Carleton University and the University of Ottawa, and the program committee believes it to be a reasonable program requirement. The program committee believes the student would benefit from retaining the three course requirement, and a free-elective would be an opportunity aligned with Recommendation #2 to take courses in business, management, entrepreneurship, and life sciences.

5. Provide a designated support staff member who is a not a faculty member to assist the Director and Program Lead with running the program.

The proposed PhD program had requested resources for a 0.5 FTE administrative position at Carleton University and a 0.5 FTE position at the University of Ottawa. This resourcing was approved at both institutions.

6. The Director of the program should identify appropriate mentors for the new hires; new faculty members should be encouraged to participate in teaching and research workshops.

Faculty hires are not hired into OCIBME but rather into a participating academic unit. The head of the academic unit identifies appropriate mentors for new hires, as well as encouraging their development as a teacher and researcher via appropriate workshops. The OCIBME Director and Associate Director certainly collaborate with the unit heads, providing assistance in these matters. As unit heads sit on the OCIBME Board of Management, communications between the OCIBME Director and Associate Director is regular.

Discussant recommendation: Biomedical Engineering PhD

Douglas J. Howe
Director, School of Computer Science
Carleton University

October 4, 2016

The external reviewer report is very positive, highlighting the level of collaboration, quality of lab space, researchers and research, uniqueness, university commitment evidenced by hiring, and the new "STEM" building.

The areas of weakness, and the recommendations, can all, with one exception, be viewed as fine-tuning a strong program.

Weaknesses

The "areas of weakness" enumerated by the reviewers all included recommendations and should be viewed as part of the recommendation list. For these particular recommendations, detailed below, the program response is sufficient in my opinion.

1. *Need more courses in biomaterials and biomechanics.*

Four of the 11 courses offered by the program this year are in this area, and there is a new course in the area that can be cross-listed as a program course.

2. *50% of the students in the program are from the Ottawa area. Try to attract more students from elsewhere.*

The OCIBME website has been revised and the program has recently made recruiting efforts at several relevant conferences. The Biomedical Engineering CREATE program should also help with wider exposure. The program's efforts in this area seem strong by Carleton/uOttawa standards.

3. *The program's core course contains too much material and lacks focus.*

The response disagrees with this assessment, pointing out 1) that the course is intended to make sure students from differing displinary backgrounds have essential biomedical engineering foundational background, and 2) that the course has worked well for this purpose for years in the Masters program. The reviewers only give two sentences related to this weakness. One is just to assert the weakness, and the other is a suggestion that anatomy and physiology be moved to the PhD comprehensive (or other courses). As no rationale at all is given for this rather arbitrary-seeming suggestion, I can't second-guess the program's view on this.

Recommendations

I judge all responses to be adequate except for recommendations 2 and 4. For recommendation 2 there needs to be a response to what the reviewers actually recommended. The response to recommendation 4 has weak reasoning. Recommendation-by-recommendation details follow.

1. *Have an advisory committee for each PhD student.*

The program agrees to do precisely as the reviewers recommend.

2. *Encourage students to take certain kinds of relevant electives.*

The program points out that the PhD program already allows a free elective, something which I'm guessing the reviewers knew. However, the recommendation is to *encourage* students to take certain kinds of electives (e.g. business management). The response does not address this recommendation.

3. *Include medical standards and regulations in the core course.*

The program essentially disagrees with this recommendation. They say that these topics are already in the course, "though likely not to the extent suggested by the reviewers". Assuming the reviewers were aware of the existing coverage, the recommendation is for more coverage. The program points out that the topics are covered in a non-core course, and that they will look at a stand-alone course, presumably optional, on these topics. The reviewers want more coverage in the compulsory course: they view it as core material. The unit simply disagrees. Neither the program nor the reviewers give supporting arguments for inclusion/exclusion of this material, so probably the program's view should prevail.

4. *PhD students should not have to replace the core course with an elective if they've already taken it.*

The program's response here is a tad vacuous. There are two points made the response. 1) The requirement is "in line" with other programs, and is "reasonable". Why is being in line with other programs at all relevant here? 2) Keeping the elective aligns with recommendation 2. In the response to recommendation 2, the program says that there is already an elective. In any case, why should a PhD student who has already taken the core course be *required* to pursue more electives than other students in the program?

The response here is inadequate. Based only on what I've heard here, some students will be required to make a considerable investment of time simply to satisfy some nebulous (aesthetic?) desire for consonance with other programs.

5. *Provide admin staff resources.*

Done.

6. *Provide mentors for new hires, and encourage the new hires to take teaching and research workshops.*

Program response: not our responsiblity. Fair enough. All participating faculty are from other units who will have their own policies/practices.

Carleton UNIVERSITY
Canada's Capital University

Office of the Vice-Provost and Associate Vice-President (Academic)

DATE: October 28th, 2016

TO: Dr. Adrian Chan, Program Development Lead, Department of Systems and Computer Engineering, Carleton University
Dr. Ioan Nistor, Vice-Dean (Graduate Studies), Faculty of Engineering, University of Ottawa

FROM: Dr. John Shepherd, Vice-Provost and Associate Vice-President (Academic); Chair Carleton University Committee on Quality Assurance

CC: Dr. Peter Ricketts, Provost and Vice-President (Academic), Carleton University
Dr. Fred Afagh, Interim Dean, Faculty of Engineering and Design, Carleton University
Dr. Matthias Neufang, Dean, Faculty of Graduate and Postdoctoral Affairs,
Dr. Malcolm Butler, Dean, Faculty of Science, Carleton University
Dr. Claire Turenne-Sjolander, Dean, Faculty of Graduate & Postdoctoral Studies, University of Ottawa
Dr. Lynne Bowker, Vice-Dean, Faculty of Graduate & Postdoctoral Studies, University of Ottawa
Dr. André Loiselle, Assistant Vice-President (Academic), Office of the Vice-Provost and Associate Vice-President (Academic), Carleton University
Dr. Robyn Green, Program Officer, Office of the Vice-Provost and Associate Vice-President (Academic), Carleton University
Dr. Jeela Jones, Director of Quality Assurance, University of Ottawa
Christina Noja, Interim Manager, Office of the Vice-Provost and Associate Vice-President (Academic), Carleton University
Leslie MacDonald-Hicks, Program Officer, Faculty of Graduate and Postdoctoral Affairs, Carleton University

RE: New Program Proposal: PhD, Biomedical Engineering

The Ottawa-Carleton Committee on Graduate Quality Assurance (OCCGQA) reviewed the proposal for the creation of a PhD in Biomedical Engineering housed in the Ottawa-Carleton Institute for Biomedical Engineering (OCIBME). Through electronic communications conducted on October 11th, 2016, OCCGQA recommended the program be approved to commence in September 2017, with a request for a report due on June 1st, 2019, indicating whether a credit substitution for students who have already completed BIOM 5010/BMG 5112 or equivalent is necessary, or whether this requirement should be removed. This request for a report arises from the Program Development Committee's response to the External Reviewers' recommendation #4.

At its meeting of October 26th, 2016, the Carleton University Committee on Quality Assurance (CUCQA) discussed and approved the recommendation from OCCGQA.

The next step is for the Program Development Committee to revise Volume I to reflect the External Reviewers' recommendations addressed in your Response from September 19th, 2016. All revisions should be easily identifiable by using, for example, a red or bold typeface. Members of the Quality

Council's Appraisal Committee appreciate self-studies for new programs being updated in an easy to identify manner to reflect those of the external reviewers' recommendations that have been accepted.

Regarding the Response, CUCQA suggests clarifying your answer to recommendation #2 in terms of the program's willingness to proactively encourage students 'to take courses in business management, entrepreneurship, and life sciences.' CUCQA also recommends a modest number of other, very minor revisions to the Self-Study:

> B.2 - page 17. It might be worth indicating that the three courses required are at the graduate level: 'The PhD program in Biomedical Engineering, similarly to all Ottawa-Carleton joint PhD programs in engineering, requires 3 *graduate* courses and a thesis…'
>
> In the same section, it is not entirely clear what the 'modes of delivery' are for the two core courses. The Quality Council's Appraisal Committee's template includes a specific question on this issue (2.1.5). Since this is a Joint Institute between two campuses, the Appraisers might have questions about the physical location of the courses.
>
> B.3.2 - page 19. The program should be congratulated on the clarity of its learning outcomes assessment plan. The Quality Council's Appraisal Committee's template includes a question on this issue: 'Completeness of plans for documenting and demonstrating the level of performance of students, consistent with the institution's statement of its Degree Level Expectations.' To ensure that the Appraisers recognize that the assessment plan fulfills this obligation, it might be worth guiding their attention by adding a brief sentence to the paragraph near the end of the section: '*In order to document and demonstrate the level of performance of students*, the Program Assessment Committee will provide a written report every three years to the OCIBME Board…'
>
> E.1 – page 32. To clarify the Admissions requirements, indicate 'Students who are in the master's program *in Biomedical Engineering* may be admitted to the Ph.D program…'

My office would appreciate receiving the revised self-study by November 11th, 2016. Please do not hesitate to contact me should you have any questions or concerns.

Carleton UNIVERSITY
Canada's Capital University

Office of the Vice-Provost and Associate Vice-President (Academic)

memorandum

DATE: November 18, 2016

TO: Senate

FROM: Dr. John Shepherd, Vice-Provost and Associate Vice-President (Academic), and Vice-Chair, Senate Academic Program Committee

RE: MSc and PHD programs in Health Sciences – **New Program Approval**

SAPC Motion

THAT SAPC recommends to Senate the approval of the proposed MSc and PHD programs in Health Science to commence with effect from Fall 2017.

Senate Motion

THAT Senate approve the proposed MSc and PHD programs in Health Science to commence with effect from Fall 2017.

Background

Senators will note that the self-study (Appendix A) contains additions and changes using track changes. The reason for this is that the Quality Council Appraisal Committee appreciates seeing easily identifiable evidence in the self-study for a proposed program when the champions of the program have responded to recommendations made by the external academic reviewers or observations made by university committees as these committees have reviewed the documentation after the external academic reviewers have submitted their report and the program champions have responded to it.

Senators will also note that, while the Carleton University Committee on Quality Assurance unanimously recommended that the proposed programs be approved to commence, the Committee nonetheless had a significant concern about maintaining the quality of the student experience in all four programs (BHSc, MSc: HSTP, MSc and PhD) the Department of Health Science intends to deliver in 2017 given the ambitious timeline for the implementation of the MSc and PhD programs. This concern was communicated to the Department in a memorandum of November 10th (Appendix G). In response, the Department provided an addendum (Appendix H) to their original response (Appendix E) to the external academic reviewers' report (Appendix D). This addendum was considered by Senate Academic Program Committee in making its recommendation to Senate.

Attachments

Appendix A: Self-Study with Appendices
Appendix B: Discussant's Report
Appendix C: Site Visit Agenda and Brief Biographies of External Reviewers

Appendix D: External Reviewers' Report
Appendix E: Response to the External Reviewer's Report
Appendix F: Discussant's Final Recommendation Report
Appendix G: Recommendation from the Carleton University Committee on Quality Assurance
Appendix H: Addendum to Response to the External Reviewers' Report.

Quality Assurance Framework and Carleton's Institutional Quality Assurance Process (IQAP)

Upon the above motion being passed by Senate, the required documentation will be submitted to the Quality Council for its review and a decision on whether the MSc and PHD programs in Health Sciences will be authorized to commence.

Office of the Vice-Provost and
Associate Vice-President (Academic)

Institutional Quality Assurance Process

Health Sciences
MSc and PhD

(Volume I)

June 6, 2016

Approvals Table

Date June 6, 2016

Program Lead
Kristin L Connor,
Department of Health Sciences, Carleton University

Edana Cassol,
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Chair/Director
Robert Burk,
Department of Health Sciences, Carleton University

Dean(s)
Matthias Neufang,
Dean, Faculty of Graduate & Postdoctoral Affairs

Malcolm Butler,
Dean, Faculty of Science

Committees Reviews and Approvals

Vice-Presidents' Academic Research Committee	April 20, 2016
Financial Planning Group	
Curriculum Committee	
Faculty Board	
Carleton University Committee on Quality Assurance	
Senate Committee on Curriculum, Admissions on Studies Policy	
Senate Academic Program Committee	
Senate	
Quality Council	

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List of Abbreviations

Abbreviation	Explanation
BHSc	Bachelor of Health Sciences
CIHR	Canadian Institutes of Health Research
DLE	Degree Level Expectations
FGPA	Faculty of Graduate and Postdoctoral Affairs
HSTP	Health: Science, Technology, Policy
LO	Learning Outcome
MSc	Master of Science
MTCU	Ministry of Training, Colleges and Universities
NGP	New Graduate Program
NSERC	Natural Sciences and Engineering Research Council of Canada
PhD	Doctor of Philosophy
SIP	Strategic Integrated Plan
SMA	Strategic Mandate Agreement
SSHRC	Social Sciences and Humanities Research Council

PART A: The Program

A.1 Program overview

A.1.1 Background

The Department of Health Sciences was established in 2014 as an interdisciplinary department whose teaching and research activities cross traditional health disciplinary silos. Our education and research covers diverse health topics including epidemiology, perinatal health and developmental biology, immunology, metabolism, nutrition, infectious diseases, social psychology, chronic diseases, global and environmental health, and biological and psychosocial aspects of aging. Faculty and students regularly collaborate and engage with experts across academic units within Carleton University, at other universities and research institutes across Canada, and with industry, government and community partners.

The Department of Health Sciences offers an undergraduate Bachelor of Health Sciences (BHSc), a Masters (MSc) in Health: Science, Technology and Policy (HSTP) and type 2 and type 3 graduate diplomas in HSTP. The BHSc is an interdisciplinary program designed to provide undergraduate students with the skills required to succeed in the rapidly changing worlds of healthcare, health research, and health professional/allied health programs. There are five concentrations available in the BHSc (Biomedical Sciences, Health Throughout the Lifespan, Chronic Illness and Disability, Global Health, and Environmental Health), enabling undergraduates to tailor their program to their interests and career goals.

The current MSc HSTP program is a 6.0 credit degree program that involves coursework (4.0 credit) and a research project (2.0 credit). This program uses a problem-based approach and collaborative group research project to train students to work across disciplines and within teams to address current health issues. The HSTP diplomas are coursework based 2 credit programs. The required and elective courses vary by specialisation. The Type 2 diploma is designed for graduate students currently enrolled in other Carleton graduate programs. The Type 3 diploma is for individuals currently employed, or with the goal of employment, in the health sector, who are not currently registered in another Carleton graduate program. Students in these programs come from varied undergraduate backgrounds (from BSc to BA), and varied levels of professional work experience and research experience (at both the undergraduate and graduate levels). This program emphasises skill acquisition and forming partnerships with industry, government and community health experts.

A.1.2 Proposed program

Health science has been identified as an area of growth by Carleton, both in its Strategic Integrated Plan and its Strategic Research Plan. Significant investments in the new Health Sciences Building and recent and planned strategic hiring of faculty and staff in the Department of Health Sciences will see the Department more than double its size to nine faculty plus two instructors by September, 2017. These investments are in response to the high demand for health science research and education at Carleton, and indicate the University's aim to establish itself as an innovative and internationally competitive health sciences research hub. To that end,

two new graduate programs (NGP) are being proposed that leverage the existing strengths of the department, our interdisciplinary nature, and our successful undergraduate program, and build upon these to provide greater theoretical knowledge and research experiences required to understand and solve complex health problems. These NGPs will also benefit from the continued growth of our department and the on-going support of the Dean of the Faculty of Science and Carleton University, as evidenced by confirmed future senior faculty hires and two instructor hires (in 2016/2017) and the new Health Sciences Building (2017). These research-intensive programs are:

- MSc in Health Sciences (5.0 credit), and
- PhD in Health Sciences (10.0 credit)

The program structure of the MSc and PhD in Health Sciences is a combination of coursework and thesis research.

These programs align with Carleton's Strategic Integrated Plan (SIP), "Collaboration, Leadership and Resilience: Sustainable Communities – Global Prosperity", and build upon significant investments in health research and education at Carleton University (including the new Health Sciences Building and recent and planned strategic hiring of faculty and staff). Overall, these programs will directly address Goal 1 of the SIP, by enabling students to engage in research and educational opportunities to improve the health of individuals and populations nationally and internationally. More specifically, these NGPs will address additional goals in the SIP, as outlined in section 3 below.

The MSc in Health Sciences differs from the existing MSc in HSTP in terms of program goals, learning outcomes, and program structure (e.g.: the proposed MSc in Health Sciences is focused on thesis based research, whereas the MSc in HSTP is focused on coursework and a collaborative group research project).

The Department of Health Sciences has being growing rapidly since it was established in 2014. Both the University and the Faculty of Science have supported this growth. By September 2017, the department will be housed in the new Health Sciences building with 7 core faculty members (4 senior and 3 junior) who will actively supervise graduate students at both the MSc and PhD levels. By 2018/2019, the department will grow to 9 core faculty members with the capacity to support the steady state student numbers of the proposed programs. In health related fields, it is standard for faculty members to supervise anywhere from 3-5 graduate students per year without receiving teaching credits. Our faculty members are deeply invested in the success of these NGPs and in their students, because both are required to support their research endeavours.

A.1.3 Program goals

The two NGPs will complement our existing MSc in HSTP. The overall goal of the NGPs is to provide in-depth, advanced learning and hands-on health research experience in health sciences. Such programs will be essential to meet the growing demand for post-graduate health related specialisations and student interest (refer to Part K). At Carleton alone, graduate programs in health are of considerable interest to prospective students, and graduates from our own BHSc

would find a logical path to graduate studies in health sciences through the proposed NGPs. Further, with a rapidly growing aging population and increasing rates of chronic disease, there is a significant societal demand for appropriately qualified personnel in health related careers. The proposed NGPs will train graduates to acquire the skills and knowledge necessary to excel in health careers including health research and education, across public, private and non-governmental health sectors. This can be achieved through the unique approach offered by the NGPs. Like the MSc in HSTP, the research and educational activities of the NGPs will span academic disciplines. We anticipate students from varied BSc and MSc backgrounds, including biomedical sciences, health sciences, life sciences, psychological sciences, biostatistics and epidemiology, or related disciplines, will enrol in our programs. Students with degrees in other disciplines will be evaluated on an individual basis. Some of these students will be admissible to do research with supervisors whose interest lie in the social sciences. The work of Dr. Renate Ysseldyk is an example of where a student with a degree in Science Psychology would fit in well. The NGPs will enhance students' skills beyond their current foundation, and provide them with new skills and knowledge. Graduates of our proposed NGPs will be able to demonstrate their hard and soft skills and credentials through various means including, but not limited to, their published manuscripts, peer-reviewed conference abstracts and presentations, teaching evaluations from courses in which they were Teaching Assistants, and marks obtained in their grant writing and research seminar courses.

The **goals** of the MSc and PhD programs fall under three themes: interdisciplinarity, research, and communication.

The intention is that both programs will become partners with the existing collaborative specialization in Data Science. Students admitted to this collaborative specialization will be required to take the core seminar in the collaborative specialization and to undertake a thesis in the area of data science.

i) **Interdisciplinarity:** Students will be able to understand and discuss health issues and problems from multiple perspectives and disciplinary approaches. Students will be exposed to scientific literature and seminars to gain a broad view of complex health problems, evaluate the quality and impact of health sciences research across disciplines, and interpret findings from their own research in the context of their discipline and within a broader health science framework. These interdisciplinary activities and experiences will occur throughout the student's program. As such, PhD students in particular will develop a deep appreciation for, and understanding of, the complexities of health problems and solutions.

ii) **Research:** Students will be able to conduct advanced research relevant to health sciences within an established protocol or project and make original contributions to existing research projects/programs to enhance their relevance and/or scope. Students will gain the skills required to troubleshoot and enhance research methods and protocols as needed to maximise the relevance, reliability, and impact of health-related research. Further, they will gain statistical (e.g. biostatistics, bioinformatics, epidemiological, data science) skills to design studies, collect data, synthesise and interpret research findings and provide critical analyses of data merit. PhD

students in particular will conduct in-depth research with multiple aims that address a larger research question/goal, and gain extensive experience handling and interpreting comprehensive and/or complex datasets.

iii) **Communication:** Students will be able to effectively develop research proposals and protocols, summarise previous research activities with brevity and clarity, and present their, or others', research to audiences across health disciplines and to the lay public or external partners. PhD students will also have additional opportunities to develop their communication skills and implement knowledge translation strategies to engage with the scientific community, relevant stakeholders, and the lay public. Further, they will gain insight into the processes surrounding research grant proposal development and evaluation, and will acquire essential skills for the successful development and defence of a grant proposal.

A.1.4 Program structure

The Department of Health Sciences, within the Faculty of Science at Carleton University, will administer the proposed NGPs. The Department Chair and Graduate Advisor will oversee the NGPs and graduate student activities. The NGPs will cover areas of strength in our Department including biomedical sciences, lifecourse health, chronic diseases, and global and environmental health, as our Faculty research programs lay within, and at the intersection, of these areas of health research. Due to the interdisciplinary nature and goals of our NGPs, there will be a common core course that will be required for all enrolled graduate students. This course will bring students together to foster knowledge translation across health disciplines and between students with different backgrounds, to discuss topical and complex health problems, advances, and solutions. Further, all graduate students will be required to attend research seminars and present an annual seminar on their research project and progress. This research seminar will be attended by their peers, Faculty within the Department, and Faculty and trainees (students, research fellows) outside of the Department. Students may also wish to enrol in the Data Science specialisation, a collaborative program currently offered at the Master's level. These students will be required to complete the Data Science Specialization Form, which must be uploaded as part of their main application, and take DATA 5000 (0.5 credits). (See Part I below for calendar language about this specialisation). Program structure and details are outlined in Table 1, and described in more detail below:

Table 1. Health Sciences MSc and PhD program structure

Component/Activity	**MSc Health Sciences**	**PhD Health Sciences**
Core course* [0.5 credit] HLTH 5901 Advanced Topics in Interdisciplinary Health Sciences	✓	✓
Seminar course and annual research presentation* [0.5 credit] HLTH 5902 Seminars in Interdisciplinary Health Sciences for MSc HLTH 6902 Seminars in Interdisciplinary Health Sciences for PhD	✓	✓
Grant proposal and ethics course* [0.5 credit] HLTH 6903 Grant Proposal and Ethics		✓

Additional courses on admission, if required#	✓	✓
Thesis HLTH 5909 Research thesis for MSc [4.0 credit] HLTH 6909 Research thesis for PhD [8.5 credit]	✓	✓
Twice yearly committee meeting	✓	✓
Mid-program research defence and knowledge examination [0.0 credit] HLTH 6904 Mid-program PhD research defence		✓
Final research seminar presentation ("internal defence") [0.0 credit] HLTH 5905 Final research seminar presentation for MSc HLTH 6905 Final research seminar presentation for PhD	✓	✓
Written thesis and final oral exam (FGPA defence)	✓	✓

*A new course to be offered by the Department of Health Sciences

In consultation with the supervisor and Graduate Advisor prior to acceptance, the student may be required to take additional courses. These courses may be required to complement the student's research project or fill gaps in knowledge and/or practical experience that are deemed necessary by the supervisor to conduct and complete the thesis research.

Graduate Advisory Committees and Membership

Each student will be admitted into the program only after they have identified a potential supervisor, the supervisor has agreed to supervise them, and a funding package has been agreed upon. Each student will then have a Graduate Advisory Committee (GAC) that will be chosen by the Supervisor, in consultation with the student, within the first 4 weeks of the student entering the program. The student, in consultation with the supervisor, will complete a document that lists each proposed committee member and their expertise, and that describes, in brief (<500 words) the MSc or PhD project outline. This document, and the proposed composition of the GAC, must be approved and signed off by the Graduate Advisor. This committee will meet twice yearly (typically by Jan 15 and June 1) to assess the student's progress, provide expert feedback on the project direction and results (including assist with troubleshooting, if required), and assess the communication skills of the student via a written report and oral presentation. At each of these semiannual meetings, the student will be required to provide a written Summary of Progress Report (<10 pages, including tables and figures) to each committee member one week prior to the committee meeting, and orally present thesis progress at the committee meeting (typically a 20 minute presentation followed by a question period, to test the competency of the student). The Graduate Advisory Committee will evaluate the student and provide recommendations using a standard Graduate Advisory Committee Report rubric developed by the department. This evaluation, signed off by all committee members, and the student's written report, must be handed in to the Graduate Advisor for review and filing following the committee meeting.

The Graduate Advisory Committee will be composed of the student's supervisor and two additional faculty members (either internal or external to the department). The committee members may have specific expertise in the student's area of research, or with a specific

technique/analysis procedure, or expertise outside the specific area that is deemed of benefit for the student's project.

Table 2 describes the milestones and deliverables required at each of the twice-yearly GAC meetings for the PhD NGP.

Table 2. Milestones and deliverables in the PhD program

GAC Meeting	Date	Milestones and Deliverables
	Within first 4 weeks of program	Graduate Advisory Committee (GAC) composition determined by supervisor and student. Student completes and gets approval for committee and proposed project.
1	By January Year 1	Proposal Meeting Milestones: The focus of this GAC meeting will be evaluation of the student's written research proposal (including background rationale, hypothesis/research questions, proposed methodology and data analysis plan). This proposal will be written in consultation with the Supervisor. Results/data are not required for this meeting, but can be included if the student has made such progress in his/her project. Deliverables: Summary of Progress Report, presentation, GAC Report
2	By June Year 1	Methods and Research Progress Meeting Milestones: The focus of this GAC meeting will be evaluation of the student's research to date and acquisition of specific and general research knowledge. The student must have an understanding of basic research principles and methodologies within his/her field and knowledge of the literature. The student must demonstrate that his/her hypotheses are supported by a sound experimental plan and potentially novel avenues of inquiry, and that data produced can be integrated in the framework of current literature. This GAC meeting represents the first of three *formalised* decision points to determine the suitability of the student for continuing in the PhD program, or to off ramp towards completing an MSc instead. Deliverables: Summary of Progress Report, presentation, GAC Report
3	By January Year 2	Permission to Proceed with Mid-program Research Defence and Knowledge Examination Meeting Milestones: The focus of this GAC meeting will be evaluation of the student's research progress and acquisition of disciplinary knowledge. The student must have made substantial progress in his/her research

		activities, (e.g.: method development/optimisation, data acquisition and interpretation) and demonstrate a solid understanding of major concepts and basic principles in his/her field of research, and is familiar with current literature, including latest advances and controversies. The oral presentation should be clear and the student should answer questions appropriately. Should the student fail to obtain permission from the GAC to proceed with the mid-program defence, the student may be granted the option to withdraw from the PhD and enrol in the MSc program to finish up. Alternatively, the student may be asked to withdraw from the PhD program without approval to enrol in the MSc. This GAC meeting represents the second of three *formalised* decision points to determine the suitability of the student for continuing in the PhD program. Deliverables: Summary of Progress Report, presentation, GAC Report (which includes written permission from the GAC to proceed with the mid-program research defence and knowledge examination)
4	By June Year 2	Mid-program Research Defence and Knowledge Examination (HLTH 6904) Milestones: This GAC meeting will take place following the student's research seminar. The focus of this GAC meeting will be evaluation of the student's progress (including results to date and future directions/research aims) and his/her ability to proceed in the PhD program. The student should continue to show substantial progress in his/her research activities and ability to solve problems using the scientific method, and have a clear plan of future experiments that will guide the remainder of the original PhD research (including potential pitfalls and strategies to mitigate these). The student should have made substantial progress towards the composition of a manuscript. The student should demonstrate a commanding grasp of data analysis, how their data support or refute their hypotheses and findings in current literature, and how these data go towards filling knowledge gaps in their field. The oral presentation should be clear and the student should answer questions appropriately. Should the student's progress and examination be deemed marginally satisfactory by the GAC, he/she may be granted permission by the GAC to schedule another meeting, within 4 months, and face re-examination. Should the student fail to obtain permission from the GAC to proceed with the mid-program defence (i.e.: show unsatisfactory evaluation either on the first or second attempt), the student may be asked to withdraw from the PhD and enrol in the MSc program to finish up, *or* the student may be asked to withdraw from the PhD program entirely, without approval to enrol in the MSc. This GAC meeting represents the third of three *formalised* decision points to determine the suitability of the student for continuing in the PhD program. Deliverables: Summary of Progress Report, presentation, GAC Report (which includes written permission from the GAC to proceed in the PhD program, or recommendations for transfer to MSc or withdrawal, if proceeding with PhD is not approved.)

5	By January Year 3	Progress Meeting Milestones: The focus of this GAC meeting will be evaluation of the student's continued research progress and knowledge acquisition, including progress made on new research aims/directions presented in the mid-program defence. The student should continue to show substantial progress in his/her research activities and a comprehensive understanding of his/her specific area of research through significant contributions the composition of 1-2 manuscripts. Deliverables: Summary of Progress Report, presentation, GAC Report
6	By June Year 3	Progress Meeting Milestones: The focus of this GAC meeting will be evaluation of the student's continued research progress and knowledge acquisition, including substantial progress made on the thesis introduction and progress on what will become various thesis chapters, as well as demonstration of proven research outputs. For example, the student should have 1-2 manuscripts prepared or near completion, demonstrate attendance at conferences (local, national or international) through conference abstracts and poster and/or oral presentations, and/or giving invited talks. Deliverables: Summary of Progress Report (including description of research outputs), presentation, GAC Report
7	By January Year 4	Approval to Write Up Meeting Milestones: The focus of this GAC meeting will be evaluation of the student's mastery of knowledge in their research field and more broadly in health sciences, and the substantive research progress made, which should be equivalent to at least two publishable manuscripts. The student should demonstrate continued progress on the written thesis chapters. The student should be able to demonstrate the significant, novel, contributions his/her research has made to their field, interpret his/her findings in the context of the literature, highlight limitations in his/her work, and propose new hypotheses/research questions (and how to answer them) derived from his/her findings. The student should be able to present clearly and answer questions concisely and clearly. Deliverables: Summary of Progress Report (including description of research outputs), presentation, GAC Report (including formal approval to write up PhD thesis and recommendation to proceed towards Final Oral Defence [Viva])
8	By May Year 4	Final GAC Meeting Milestones: The purpose of this GAC meeting will be for the student to have an opportunity to receive input on his/her completed written thesis and oral presentation prior to submitting the thesis for examination and prior to the Final Oral Defence. The student should provide each GAC member with a copy of the thesis at least three weeks prior to the final GAC meeting for review. The thesis must be examinable. The GAC will evaluate the thesis and oral presentation in a manner that assists the student in preparing for the Final Oral Defence.

		Deliverables: Final written thesis, presentation, GAC Report (including feedback for preparation for Final Oral Defence [Viva])

Mid-program Research Defence and Knowledge Examination

For PhD candidates only, students will be required to give a mid-program (typically within 18-24 months) Departmental seminar of their research project. This 1-hour seminar (typically 45 minute presentation and 15 minute question period) will consist of results to date and future directions/research aims. The seminar will be advertised to members of the university beyond the Department, and will be attended by graduate students within the Department and the student's Graduate Advisory Committee. Following the seminar and question period, the student, Supervisor and GAC members will remain for a closed-door advanced assessment of the student's knowledge of their field of research and defence of their proposed research. The student will submit a written summary of progress and future directions (10 pages) to each committee member one week prior to the mid-program research presentation. The Graduate Advisory Committee will evaluate the student's progress and potential to determine if the student is suitable to continue forward in the PhD program, or if the student should write up an obtain an MSc instead, or if the student should withdraw from the program entirely (see milestones and deliverables table above). This represents the second of two *formalised* GO/NO-GO decision points to determine the suitability of the student for the PhD program. Within one week of the presentation, the Graduate Advisory Committee will submit a report to the Graduate Advisor on their recommendation and evaluation of the student.

Final Research Presentation

Each graduate student must give a final oral seminar of his or her thesis project within one month of his or her final oral examination (Viva). This Departmental seminar will be open to members from departments across the University and will not have any evaluation component to it. The 1-hour seminar will consist of a 45-minute presentation followed by a 15-minute question period.

Written Thesis and Final Oral Examination (Viva)

Each graduate student will have to write their thesis and give an oral defence according to the guidelines established by the Faculty of Graduate and Postdoctoral Affairs (FGPA).

A.1.5 Program distinctiveness

Despite the great demand for health sciences education at the graduate level, and the growing need for such programs to position graduates for success in the rapidly changing job market and in subsequent professional programs, few stand-alone graduate programs in health sciences exist, and fewer still are interdisciplinary, as are our proposed NGPs. Table 13 (Part J) summarises these health sciences and related graduate programs across Canada.

Our proposed NGPs will therefore fill a gap in the current need for health science and interdisciplinary health science graduate programs. The interdisciplinary nature of our department is an advantage for our NGPs and makes them distinct: Research conducted for thesis projects will span health disciplines (e.g. biomedical research will often have an epidemiological or informatics component), will be informed by expert faculty and external

partners from various health sectors and disciplines (e.g. through the composition of the student's Graduate Advisory Committee or joint research projects/graduate student co-supervision), and will be communicated to the scientific and broader community, members of which come from departments across Carleton University and beyond campus borders (e.g. through seminars, guest lectures).

Our NGPs will also be distinct from those currently offered due to relationships our Department and faculty have with local, national, and international organisations. Through these partnerships and collaborations, students will be exposed to and engage in internationally-recognised and high-impact research. Our current collaborations include:

Local partnerships:

- Age-Friendly Ottawa
- Almonte General Hospital and the Mills Community Support
- Artswell and the Alzheimer's Society of Ottawa and Renfew County
- Bruyere Continuing Care (which includes St Vincent Hospital, Elisabeth Bruyere Hospital, and Residence Saint Louis)
- Department of Biochemistry, Microbiology and Immunology, University of Ottawa
- Division of Cardiology, University of Ottawa, and University of Ottawa Heart Institute
- Department of Medicine, University of Ottawa and Ottawa Hospital Research Institute
- Ottawa Public Health
- Riverstone Retirement Communities

National partnerships:

- Cancer Care Ontario, Toronto
- Cancer Epidemiology and Prevention Research, Alberta Health Services, Calgary
- Dalla Lana School of Public Health, University of Toronto, Toronto
- Department of Environmental Science, Dalhousie University, Halifax
- Department of Epidemiology, Queen's University, Kingston
- Department of Epidemiology and Occupational Health, McGill University, Montreal
- Department of Obstetrics and Gynaecology, University of Toronto, Toronto
- Department of Oncology, McGill University, Montreal
- Department of Paediatrics, University of Alberta, Edmonton
- Department of Psychology, McGill University, Montreal
- Department of Sociology, University of New Brunswick, Fredericton
- Environment Canada, Ottawa
- Health Canada (including Environmental and Radiation Health Sciences Directorate, Population Studies Division, Air Health Sciences Division), Ottawa
- Hospital for Sick Children, Toronto
- Lunenfeld-Tanenbaum Research Institute, and Mount Sinai Hospital, Toronto
- The O'Brien Institute for Public Health and the Snyder Institute for Chronic Diseases, Division of Gastroenterology and Hepatology, Inflammatory Bowel Disease Clinic, Cumming School of Medicine at the University of Calgary, Calgary
- Ontario Occupational Cancer Research Centre, Toronto
- Public Health Agency of Canada, Ottawa
- Public Health Ontario, Toronto
- Schlegel University of Waterloo Research Institute for Aging, Waterloo
- School of Population & Public Health |Faculty of Medicine, University of British Columbia, Vancouver

- Statistics Canada, Ottawa
- The Ontario Association of Social Workers-Social Work in Aging and Gerontology (SWAG)
- Toronto Public Health, Toronto

International partnerships:

- Department of Cancer Immunology and AIDS, Dana Farber Cancer Institute, Boston, MA, USA
- Department of Environmental Health Sciences and Center for Occupational and Environmental Health Fielding School of Public Health University of California, Los Angeles, USA
- Department of Immunology, University of Pretoria Medical School, Pretoria, South Africa
- Hôpital Universitaire Necker Enfants Malades, Faculté de médecine Paris Descartes, Université Sorbonne-Paris cité, Paris, France
- Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil
- Maternal and Infant Health Care Strategies Research Unit, Department of Obstetrics and Gynaecology Department and Kalafong Hospital, Pretoria, South Africa
- Queen Elizabeth II Medical Centre and King Edward Memorial Hospital, Perth, Western Australia
- School of Medicine and Pharmacology, University of Western Australia, Perth, Australia
- School of Psychology, University of Queensland, Australia
- School of Psychology, University of Exeter, UK
- School of Women's and Infants' Health, University of Western Australia, Perth, Australia
- US National Institute of Environmental Health Science, Research Triangle Park, NC, USA
- Wellcome Trust Africa Centre for Health and Population Studies, Mtubatuba, South Africa

Our program courses will bring together graduate students across health disciplines to learn about health issues facing individuals and populations, and will expose students to varied viewpoints on these issues, and their potential solutions. This will facilitate student engagement and collaboration beyond the student's traditional discipline or group. Whilst similar types of 'seminar' courses exist within other graduate programs, to our knowledge only one is interdisciplinary (University of Toronto, Fraser Mustard Institute of Human Development), and even that focuses on interdisciplinary health in a tightly defined period: very early life health.

Moreover, we are fortunate to have an invaluable resource to accelerate the interdisciplinary and collaborative health sciences research and learning opportunities we provide to our students: the new Health Sciences Building. This building, scheduled for completion in June 2017, marks a significant investment by Carleton University and other stakeholders, their belief in the value of health sciences research and education, and the potential for our students and faculty to make real impact on health issues. The Department of Health Sciences will share the research and learning spaces with the Department of Neuroscience, and have already formed partnerships with each other. This highlights the willingness of both departments to work together to conduct vital health research and enable Neuroscience students to take Health Sciences classes. This new home will provide our graduate students with state-of-the-art laboratory facilities that are designed to maximise interactions between people and across groups, modular learning classrooms, and student/faculty office space for individual and small group work.

Therefore, interdisciplinarity and collaboration is embedded in our NGPs, in the design and functioning of the new Health Sciences Building, and in our department, itself. These features are

currently unmatched by any other Department or School in Canada, and position Carleton University and the graduate programs in Health Sciences as distinct leaders and innovators in providing educational and research opportunities that will make an impact on the health and well-being of Canadians and populations globally.

A.2 Mission and strategic direction

The NGPs in Health Sciences are named in **Carleton's Strategic Mandate Agreement** (2014-2017). In this agreement, the Ministry of Training, Colleges and Universities (MTCU) confirmed Carleton's institutional strengths in Life and Health Sciences and proposed Health Sciences as an area of growth. This growth is within Carleton's focus and priorities (Strategic Integrated Plan and Strategic Research Plan, see below) and will be designed to be complementary to other biological and health related programs at Carleton University (e.g., graduate programs in Biology, Neuroscience, Biomedical Engineering) and programs available at the University of Ottawa.

A.2.1 Carleton's Strategic Integrated Plan (2013-2018)

Academic Strengths (Goal 1-1): The new Health Sciences MSc and PhD programs will build upon the interdisciplinary strengths of our current undergraduate (Bachelor of Health Sciences) and graduate (MSc in HSTP) programs and contribute to the breadth of health-related research and expertise at Carleton. These programs will utilise our existing network of national and international collaborators and expand upon our existing relationships with municipal, provincial and federal health agencies (e.g., Ottawa Public Health, Health Canada, Public Health Agency of Canada) and community-based partners.

Societal Needs (Goal 1-1): With a rapidly expanding aging population and increasing rates of chronic disease, there is a significant demand for appropriately qualified candidates in health related careers including: health research and education, epidemiology, and environmental and global health. The proposed structure of the NGP will provide students with disciplinary and technical expertise (thesis) as well interdisciplinary knowledge and skills (core courses), which are required for a variety of health related careers and employment outcomes, across public, private and non-governmental health sectors. Student's research activities and outputs will also contribute to the development of strategies that may prevent disease and injury, protect and promote healthy living and improve well-being across the lifecourse.

Management of Resources (Goal 1-2): The proposed NGPs will build upon Carleton University's institutional strengths in Life and Health Sciences. The University has made a significant investment in developing the new Department of Health Sciences and in the construction of the new Health Sciences Building. This infrastructure will provide state-of-the-art training and research opportunities for both undergraduate and graduate students. The proposed NGPs will leverage these existing and newly acquired resources (new faculty members and the new Health Sciences Building) to deliver quality programs in an effective manner.

Research-intensive institution (Goal 2-1): Faculty within the Department of Health Sciences have a strong record of research excellence, demonstrated by various indicators such as research publications, grants, community engagement, and knowledge translation activities. Research

interests of Health Sciences faculty members are closely aligned with Carleton University's strategic research plan including health and well-being and human development across the lifespan (Priority 1: The human condition and evolving societies), environmental exposures (e.g. infections, diet, xenobiotics, air pollution) (Priority 2: The changing environment) and development of technologies and data analytics (Priority 3: Foundational sciences and technological innovative).

Employability and future success (Goal 3-1): The Department of Health Sciences is strongly committed to the student experience and experiential learning. The proposed programs will provide students with a foundation in interdisciplinary health research as well the disciplinary expertise associated with their thesis projects. Core and seminar courses will provide MSc and PhD students with an interdisciplinary understanding of complex health problems through group and individual projects. Class presentations as well as required annual research seminars will help students develop critical skills in interdisciplinary communication. To complement these courses, PhD students will also take a grant writing and ethics course. This course will provide advanced training in scientific communication required for more research-focused careers or those with deliverables requiring proposal development or project/business plans. Collectively, these core courses combined with the research thesis, will help MSc and PhD students develop a disciplinary and interdisciplinary understanding of complex health issues and provide them with a variety of important skills required for employment in health related fields. These skills include the ability to evaluate the quality and impact of health sciences research across disciplines (MSc and PhD: seminar course, thesis), interpret findings from their own research in the context of their discipline and within a broader health science framework (MSc and PhD: thesis and research presentation) and the ability to communicate scientific information to a variety of stakeholders using a variety of formats (MSc: seminar course and research presentation; PhD: seminar course, grant writing and ethics course, research presentation). Our faculty have a track record of initiating and supporting trainee activities outside of the formal program activities, including running journal clubs and techniques seminars, hosting community engagement and outreach events, and organising local, national and international conferences and seminars. These supplementary activities will provide opportunities for students to develop and practice skills acquired throughout their graduate program, and to foster networks that will be of benefit to their employability and future career success.

A.2.2 Carleton's Strategic Research Plan

Research conducted within the Department of Health Sciences is closely aligned with the four research priorities outlined in Carleton's Strategic Research Plan. Our faculty's research programs are most directly related to health and well-being and human development across the lifespan. This relates to (Priority 1 - The human condition and evolving societies) and environmental determinants of disease vulnerability or resilience (e.g.: infections, diet, xenobiotics and the environment), exemplified by the work of Drs. Connor, Cassol and Ysseldyk (Priority 2 – The changing environment). Additionally, our epidemiological, biostatistic, systems biology and research method approaches utilise advanced technologies and data analytics, and have important implications for further development and application of these tools beyond our own laboratories, which relate to (Priority 3: Foundational sciences and technological innovativion),

exemplified by the work of Dr. Villeneuve. Finally, through our collaborations and partnerships established through the MSc HSTP program, we are positioned to translate our research discoveries and knowledge to key stakeholders within and beyond the Carleton community. These stakeholders include public health leaders and government (impacting policy development), clinical teams and institutional health leaders, health educators and health care suppliers and knowledge users (impacting health systems and health economies) (Priority 4: Policy, governance, and economic activity).

A.3. Relationship to other academic programs

The NGPs will leverage existing strengths in the Department of Health Sciences and build upon these to provide greater theoretical knowledge and research experiences required to understand and solve complex health problems. These programs will play an important role in the development of the research profile of the Department of Health Sciences and in supporting the BHSc program by providing teaching assistants for upper level Heath Sciences courses.

Our NGPs are not expected to have a negative impact on any other graduate programs currently available at Carleton University, including the existing MSc in Health, Science, Technology and Policy, which has a quite different professionally-oriented focus to the proposed MSc in Health Sciences. Students who apply to these programs would not be interested in a more general graduate program in Biology or Chemistry or a more specialised program in Neuroscience. These students are interested in obtaining a comprehensive understanding of the complexity of human health. They are looking for the opportunity to participate in research and to work with human disease models (cellular, animal) as well as clinical biospecimens and cohorts. These research-intensive programs are significantly different from our course based HSTP MSc program, which has a group capstone project and focuses on skills such as networking and knowledge mobilisation. Students applying to the NGP want to develop the understanding and skills required to perform relevant health based research. The Department of Health Science was established to expand upon the current biological and health-related expertise available at Carleton University. There is little overlap in the expertise (e.g., developmental origins of health and disease, epidemiology, immunology) or research programs of faculty in Department of Health Sciences compared to other related Departments in the Faculty of Science (Biology, Chemistry, Neuroscience). The Department of Health Sciences and the NGPs will only serve to recruit new students to Carleton who would not have applied otherwise. In support of this, the new BHSc and HSTP programs have had no measurable effect on enrolment into undergraduate and graduate programs in the Departments of Biology, Chemistry or Neuroscience. The relationship between the NGPs and other Health Sciences programs found locally and nationally can be found in Table 13.

Given the interdisciplinary nature of the NGPs and diversity of research performed in the Department, some students may be required to take additional courses to support their disciplinary training. These courses will be chosen in consultation with their thesis supervisor and the Graduate Advisor prior to acceptance to the program. Enrolment in these courses will require permission from the program offering the course and course instructor.

We have obtained letters of support from the following units:
Dr. John Stead, Chair, Department of Neuroscience
Dr. Myron Smith, Chair, Department of Biology
Dr. David Amundsen, Acting Director, School of Mathematics and Statistics
Dr. Joanna Pozzulo, Chair, Department of Psychology
Dr. Robert Crutchley, Chair, Chemistry
Dr. Anatoli Ianoul, Director, Institute of Biochemistry

PART B: Program Learning Outcomes and Assessment

B.1 Program learning outcomes and degree level expectations

The Council of Ontario Universities has established a framework of Degree Level Expectations (DLEs) that specify what students should know, and be able to do, after successfully completing MSc and PhD programs. The DLEs for graduate programs are:

1. Depth and breadth of knowledge
2. Research and scholarship
3. Level of application of knowledge
4. Awareness of limits of knowledge
5. Level of communications skills
6. Professional capacity / autonomy

Tables 3-4 describe the learning outcomes for the MSc and PhD programs in Health Sciences. Graduates will have gained advanced skills and knowledge to be able to propose, design, execute and troubleshoot research relevant to health sciences, generating new knowledge and making original contributions to research projects/programs. Graduates will also have the skills to understand and approach health issues from an interdisciplinary lens, and to evaluate the quality and impact of health research, including that of their own. Moreover, graduates will gain the skills required to communicate with brevity and clarity, and apply these skills to work effectively within multidisciplinary teams and with partners within and across health disciplines. The breadth of disciplines is already large even though we have only four research-intensive faculty members. These disciplines include epidemiology, social determinants of health, maternal and other factors affecting health, and immunology. We recently advertised for three more senior faculty members in the areas of big data, global health, and lifecourse approach to health. In Tables 3-4, each learning outcome is mapped to the DLEs above, and the program activities that contribute to each learning outcome are also indicated.

The learning outcomes for MSc and PhD students are similar. However, PhD students will acquire a higher level of learning and mastery of their skills compared with MSc students. For learning outcomes associated with depth and breadth of knowledge and knowledge application, PhD students will develop a deep appreciation for, and understanding of, the complexities of health problems and solutions, and their limitations. For learning outcomes related to research and scholarship, PhD students will conduct in-depth research with multiple aims that address a larger research question/goal, and gain extensive experience handling and interpreting comprehensive and/or complex datasets. For learning outcomes related to communication and professional capacity, PhD students will also have additional opportunities to develop their communication skills and implement knowledge translation strategies to engage with the scientific community, relevant stakeholders, and the lay public. Further, they will gain insight into the processes surrounding research grant proposal development and evaluation, and will acquire essential skills for the successful development and defence of a grant proposal.

Table 3. Learning outcomes, degree level expectations, and program mapping for the MSc program

Learning Outcomes Graduates of the MSc in Health Sciences will be able to:	**Degree Level Expectation**	**Program Mapping**
1. Understand and discuss (written and oral) health issues and problems from multiple perspectives and disciplinary approaches. These include a range of perspectives from the social determinants of health to global health to environmental health and epidemiology.	1,5	HLTH 5901 (Advanced Topics in Interdisciplinary Health Sciences), HLTH 5902 (Seminars in Interdisciplinary Health Sciences), thesis (HLTH 5909)
2. Design and conduct research relevant to health sciences to generate new knowledge and/or make original contributions to existing research projects/programs to enhance their relevance and/or scope.	2,3,4,6	Thesis (HLTH 5909)
3. Troubleshoot and/or enhance research methods and protocols to maximise the relevance, reliability, and impact of health-related research.	2,3,4,6	Thesis (HLTH 5909), committee meetings
4. Employ statistical (e.g. biostatistics, bioinformatics, epidemiological, data science) approaches to design studies, collect data, synthesise and interpret research findings.	2,3	Thesis (HLTH 5909), committee meetings,
5. Critically analyse research outcomes and data merit.	2,3	Thesis, committee meetings, research and final seminars (HLTH 5905)
6. Develop a solid understanding of research concepts and fundamental theories in their discipline. Identify research gaps and evaluate the quality and impact of health sciences research across disciplines. Interpret research findings (including from their own work) in the context of their discipline and within a broader health science framework.	1,3,4	HLTH 5901 (Advanced Topics in Interdisciplinary Health Sciences), committee meetings, thesis (HLTH 5909), research and final seminars (HLTH 5905)
7. Develop research protocols, summarise previous research activities with brevity and clarity.	1,2,5	Thesis (HLTH 5909), research and final seminars (HLTH 5905)
8. Communicate (written and oral) scientific ideas, problems, methods and outcomes to the scientific community, relevant stakeholders, and the lay public.	2,5	HLTH 5901 (Advanced Topics in Interdisciplinary Health Sciences), HLTH 5902 (Seminars in Interdisciplinary Health Sciences), committee meetings, thesis (HLTH

		5909), research, and final seminar presentations (HLTH 5905)

Table 4. Learning outcomes, degree level expectations, and program mapping for the PhD program

Learning Outcomes Graduates of the PhD in Health Sciences will be able to:	**Degree Level Expectation**	**Program Mapping**
1. Understand and discuss (written and oral) health issues and problems from multiple perspectives and disciplinary approaches. Develop a deep appreciation for, and understanding of, the complexities of health problems and solutions, and their limitations	1,5	HLTH 5901 (Advanced Topics in Interdisciplinary Health Sciences), HLTH 6902 (Seminars in Interdisciplinary Health Sciences), HLTH 6903 (Grant proposal and ethics course), thesis (HLTH 6909)
2. Propose, design and conduct in-depth, advanced research with multiple aims relevant to health sciences, to generate new knowledge and make substantial original contributions to existing research projects/programs to enhance their relevance and/or scope.	2,3,4,6	HLTH 6903 (Grant proposal and ethics course), thesis (HLTH 6909)
3. Troubleshoot and/or enhance research methods and protocols to maximise the relevance, reliability, and impact of health-related research.	2,3,4,6	HLTH 6903 (Grant proposal and ethics course), thesis (HLTH 6909), committee meetings
4. Employ statistical (e.g. biostatistics, bioinformatics, epidemiological, data science) approaches to design studies, collect data, synthesise and interpret research findings. Gain extensive experience handling and interpreting comprehensive and/or complex datasets.	2,3	HLTH 6903 (Grant proposal and ethics course), thesis (HLTH 6909), committee meetings
5. Critically analyse research outcomes and data merit.	2,3	Thesis, committee meetings, research and final seminars (HLTH 6905)
6. Develop a deep understanding of research concepts and fundamental theories in their discipline. Evaluate the quality and impact of health sciences research within their discipline and across disciplines. Interpret research findings (including from their own work) in the context of their discipline and within a broader health science framework, and propose new lines of inquiry.	1,3,4	HLTH 5901 (Advanced Topics in Interdisciplinary Health Sciences), committee meetings, thesis (HLTH 6909), research and final seminars (HLTH 6905)
7. Develop research proposals and protocols, summarise previous research activities with brevity and clarity.	1,2,5	HLTH 6903 (Grant proposal and ethics course), thesis (HLTH 6909), research and final seminars (HLTH 6905)

8. Develop and implement knowledge translation strategies to engage and communicate (written and oral) scientific ideas, problems, methods and outcomes to the scientific community, relevant stakeholders, and the lay public. Develop grantsmanship skills to successfully devise, defend and evaluate new lines of research inquiry and/or new points of view to address a health sciences problem.	2,5	HLTH 5901 (Advanced Topics in Interdisciplinary Health Sciences), HLTH 6902 (Seminars in Interdisciplinary Health Sciences), HLTH 6903 (Grant proposal and ethics course), committee meetings, thesis (HLTH 6909), research, and mid (HLTH 6904) and final research presentations (HLTH 6905)

B.2 Program structure and curriculum map

The MSc program in Health Sciences requires two courses, a thesis, twice-yearly committee meetings and a final research seminar. In addition to the MSc program requirements, the PhD program in Health Sciences requires a third course on grant writing and ethics, and a mid-program research seminar. In consultation with the Supervisor and departmental Graduate Advisor, prospective students may be required to take additional courses to complement their research project or fill gaps in knowledge and/or practical experience that is deemed necessary by the supervisor to conduct and complete their research. Refer to section A.1.4 for additional program structure details.

B.2.1 Articulation of the learning outcomes

Table 5 details the learning outcomes (LO) and maps these to the program elements and activities. Descriptions below provide more context to the details in Table 5.

Learning Outcome 1: The core course in Advanced Topics in Interdisciplinary Health Sciences (HLTH 5901) provides fundamental knowledge in health research evaluation, interpretation, impact and dissemination across, and at the intersection of, multiple health disciplines. In contrast to other health sciences courses, this course is taught from an interdisciplinary perspective (e.g.: social, biomedical *and* environmental aspects of health). Additionally, the research seminar courses (HLTH 5902 and 6902) will further expose students to interdisciplinary health sciences research and reinforce the learning experiences in the core course. Students must complete written papers/summaries and oral presentations in these courses. Thus, these courses are critical elements to providing students with a depth and breadth of knowledge in health sciences, and go towards their mastery of oral and written communication skills.

Learning Outcome 2: The grant proposal and ethics course (HLTH 6903) and thesis research (HLTH 5909/6909) (including the student's presentation of his/her research activities during the required seminars) ensure students gain the capabilities to design and execute research with *a priori* knowledge (gained from LO1 and various program elements). Importantly, this grant course will also introduce students to research ethics, including ethical conduct of research (using humans, animals and biohazards), institutional/governmental policies and societal

considerations. Evaluation of deliverables (oral and written) from this course and the thesis activities will ensure students meet this learning outcome.

Learning Outcome 3: The grant proposal course, thesis research, and compulsory committee meetings, provide the mechanisms through which students will learn to evaluate, troubleshoot and/or enhance research methodologies, including those employed in their own research. Other program elements, including mandatory attendance at departmental seminars or conference talks, will expose students to additional and/or complementary research methods and protocols, enabling students to gain new knowledge on methodologies and to critically analyse research methods beyond those used by the student. Students will be evaluated on these learning objectives through their written reports and oral communications, particularly with their Supervisor, Graduate Advisory Committee, and course instructor.

Learning Outcome 4: Similar to program elements in LO3, the grant proposal course, thesis research activities and committee meetings will provide students a basis for using and evaluating statistical approaches to conduct research and interpret outcomes. These program elements will expose students to, and give them practical experience with, all aspects of quantitative research including designing a data analysis plan, collecting and cleaning data, synthesising and critically analysing outputs, and data presentation.

Learning Outcome 5: Seminar attendance and discussions with the research Supervisor and Graduate Advisory Committee members will position students to have the skills to critically analyse research outcomes and evaluate data merit. These skills can be applied and reinforced through their evaluation of research presented at the required departmental seminars.

Learning Outcome 6: Students will have numerous opportunities to apply their knowledge and skills to evaluate health sciences research in a detailed manner (e.g.: for research specific to their discipline) and in a broad context. In particular, the core course (HLTH 5901), seminar attendance courses (HLTH 5902 and 6902), thesis activities (including thesis research, committee meetings and research presentations), and the written and oral evaluations required for each of these elements, will assess the student's capabilities to appraise health research and use this knowledge to develop, formulate, and/or investigate questions that could be applied to a health science framework or even within their own research project.

Learning Outcome 7: All program elements are designed to provide students with skills to develop research proposals and protocols, and to write with brevity and clarity. Students will first be formally introduced this learning outcome through the grant proposal course, but will have multiple opportunities to reinforce these skills throughout the program activities, through both oral and written communications.

Learning Outcome 8: All program elements have either a written or oral communication component to them, from which student progress and skill mastery are evaluated. To that end, students will have on-going opportunities to understand, apply, analyse and evaluate health science problems, solutions and outcomes, and master their communications skills to translate

their understanding and knowledge of health sciences to various end-users. These users include discipline-specific experts, the broader scientific/health research community, and the lay public.

Table 5. Program mapping and deliverables

	Deliverable	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8
HLTH 5901 [0.5 credit] Advanced Topics in Interdisciplinary Health Sciences (core course)	W, O	I	I	I	I	I	R	I	R
HLTH 5902 [0.5 credit] (MSc) HLTH 6902 [0.5 credit] (PhD) Seminars in Interdisciplinary Health Sciences (research seminar course and annual research presentation)	W, O	R	I			R	I		R
HLTH 6903 [0.5 credit] Grant proposal and ethics course (PhD only)	W, O	R	R	I	I			R	R
HLTH 5909 [4.0 credit] (MSc) HLTH 6909) [8.5 credit] (PhD) Thesis	W, O	M	M	M	M	M	M	M	M
Twice yearly committee meeting	W, O	R	R	R	R	R	R	R	R
HLTH 6904 [0.0 credit] (PhD) Mid-program research defence and knowledge exam	W, O	R	R	R	R	R	R	R	R
HLTH 5905 [0.0 credit] (MSc) HLTH 6905 [0.0 credit] (PhD) Final research seminar presentation ("internal defence")	O	M				M	M	M	M
Written thesis and final oral exam (FGPA defence)	W, O	M	M	M	M	M	M	M	M

Deliverable: W – written document; O – oral presentation
Level of skill: I – introductory; R – reinforcement; M – mastery

B.3 Program learning outcomes assessment plan

B.3.1 Program Assessment Committee

The Department of Health Science has a Graduate Program Committee that will be responsible for assessing the learning outcomes for the Health Sciences MSc and PhD programs. The

departmental Graduate Program Committee will consist of the Graduate Advisor and 2-3 faculty members from the Department of Health Sciences.

B.3.2 Program assessment methodology

During the first four years of the program, the initial success in achieving the learning outcomes will be assessed by both students and faculty participating in the MSc and PhD programs. Each source of data will provide an indicator of the level of achievement for each learning outcome, using a four-point rubric (i.e., does not meet, minimally meets, meets, exceeds). Assessment tools may include:

Students

- Self-evaluation surveys, which ask students to describe their improvement in attaining or exceeding the learning outcomes
- Assessment of student deliverables, such as course assignments, presentations and exams
- Faculty evaluation of the mid-program research presentation and final research seminar
- Graduate Advisory Committee evaluation of student progress, the thesis dissertation and final oral exam (viva)

Faculty

- Course instructor evaluations based on course work
- A questionnaire that asks Instructors to evaluate whether students are achieving learning outcomes. If learning outcomes are not being met, instructors will provide suggestions to the Graduate Committee on how improve achievement rates and success.
- Focus groups with faculty members supervising students in the Health Sciences MSc or PhD programs. These focus groups will discuss the strengths and weaknesses of the program.

The Graduate Committee will consider these assessment criteria to evaluate the success of the MSc and PhD programs in meeting their outcomes. They will provide a report to Chair of the Department every four years. The Chair, in consultation with the Graduate Advisor and other faculty members, will provide direction and oversight to program changes, and use the outcomes of the program learning assessments for continual program improvement. Program changes will be operationalised by the Graduate Advisor and the graduate committee.

B.4 Program essential requirements

Requirements essential for a student's success in completing the program will fall under three main categories: 1) Disciplinary and Interdisciplinary Health Knowledge, 2) Scientific and Interdisciplinary Communication and 3) Advanced Health Research. They include:

Disciplinary and Interdisciplinary Health Knowledge

- A strong foundation in at least one discipline relevant to health science (e.g., epidemiology, perinatal health and developmental biology, immunology, metabolism,

nutrition, infectious diseases, social psychology, chronic diseases, global and environmental health, and biological and psychosocial aspects of disease).

- An ability to understand and discuss health issues and problems from multiple perspectives and disciplinary approaches as well as interpret findings from their own research in the context of their discipline and within a broader health science framework.

Scientific and Interdisciplinary Communication

- Capacity to effectively communicate scientific ideas and findings from their project (e.g., methodology, results, conclusions) to audiences in the field.
- Effectively develop research proposals and protocols, summarise previous research activities with brevity and clarity, and present their, or others', research to audiences across health disciplines and to the lay public or external partners.

Advanced Health Research

- Ability to conduct advanced research relevant to health sciences within an established protocol or project and make original contributions to existing research projects/programs to enhance their relevance and/or scope.
- Capacity to conduct systematic research, including the ability to integrate and critique the literature related to their field of research.
- Capacity and commitment to learning, including independent learning and lifelong learning; this includes a willingness for learning outside their original field of expertise.
- Intrinsic motivation and responsibility, including internal accountability, in organising their work and fulfilling the obligations related to the program.
- Behaviour consistent with academic integrity and the use of procedures for responsible, safe, and ethical conduct of research.

The program essential requirements of the MSc and PhD in Health Sciences have been reviewed in consultation with the Paul Menton Centre to ensure capacity for reasonable academic accommodation of students with disabilities, in accordance with the Carleton University Academic Accommodation Policy. The learning outcomes can be attained as outline in the program description with the use of appropriate academic accommodations.

PART C: Governance

The Chair of the Department of Health Sciences, the Graduate Advisor, and the Graduate Program Administrator are responsible for the administration of the HSTP program, and will have similar responsibilities for the Health Sciences NGPs. They work closely with the program's faculty and students and represent the program when dealing with other services/units on campus. For the purposes of managing the graduate programs, the Graduate Program Administrator reports to the Graduate Advisor, who in turn reports to the Chair.

C.1 Chair

The Chair is appointed for a three-year term and is responsible for the day-to-day management of the Department including all of its undergraduate and graduate programs. The Chair is responsible for hiring faculty and contract instructors for all programs, and each academic year the Chair confirms the course offerings and teaching assignments. The Chair prepares the annual budget for the Department and monitors expenditures. The Chair assists the faculty by responding to their queries; dealing with departmental issues; informing the department about administrative and other deadlines, and any changes/additions to university-wide policies and procedures; and represents the Department and the program at senior-level meetings.

C.2 Graduate Advisor

The Graduate Advisor is likewise appointed for a three-year term, and is responsible for all aspects of the graduate programs (MSc HSTP and the proposed NGPs). The Graduate Advisor, in collaboration with FGPA, sets annual targets for intake of new students into the program, and liaises with FGPA, the Chair, and other faculty members during the admissions process to ensure such targets are met. The Graduate Advisor, in consultation with the student's Supervisor, assigns extra courses as deemed necessary for entry into the program or in the case of a qualifying year, determines the courses that must be taken. The Graduate Advisor monitors the progress of each student through the program, ensuring that all necessary courses are taken, and that the twice-yearly meetings of students with their thesis Graduate Advisory Committee and the mid-program research presentations to the Department take place. The Graduate Advisor is responsible for convening meetings as necessary to review and renew the graduate curriculum to update the list of courses as necessary, and to recommend to the Chair which courses are to be offered each year. The Graduate Advisor, in conjunction with the Graduate Program Administrator, ensures the accuracy and completeness of each students' academic audit on an annual basis, or whenever necessary to enable graduation.

C.3 Graduate Program Administrator

The Graduate Program Administrator is a full time permanent staff position. The Graduate Program Administrator carries out all administrative tasks associated with running the graduate programs, including liaising with FGPA regarding financial offers to students, ensuring that students payroll profiles are up to date, assisting students with registration as needed, and scheduling courses, thesis Graduate Advisory Committee meetings, mid program reviews, thesis defences, and other events related to graduate studies in the Department. The Graduate Program Administrator is normally the first point of contact for students needing information regarding their status, funding, enrolments, and audits.

PART D: The Faculty

D.1 Faculty appointed to the unit or program

Table 6 lists all faculty associated with the Department of Health Sciences, including five current core faculty with primary appointments, cross-appointed faculty (0% cross-appointment), and adjunct faculty. Within the current hiring plan for the Department of Health Sciences, we will be

hiring three new faculty members in the coming two years (2016/2017). Each will be research-focused, senior Principle Investigators, and one will be the new Chair. By 2018 we will be hiring two more faculty members. Part G details resource requirement including more information on the new faculty hires. We will also be hiring two instructor positions to support the Department's current programs and the proposed NGPs.

Table 6. Faculty associated with the Department of Health Sciences and its programs.

Faculty Name	Rank	M/F	Appointment Status	Unit*	Supervision Privileges**	Area of Specialisation/Field Affiliations
Robert Burk	Associate	M	Tenure	CH	D	Analytical and Physical Chemistry
Edana Cassol	Assistant	F	Tenure Track	HS	D	Immunology and Infectious Diseases
Kristin Connor#	Assistant	F	Tenure Track	HS	D	Developmental Origins of Health and Disease
Paul Villeneuve	Associate	M	Tenure	HS	D	Epidemiology, Environmental and Occupational Health, Longitudinal Studies, Case-control studies and record linkage.
Renate Ysseldyk	Assistant	F	Tenure Track	HS	D	Exploration of ideas merging social and lifespan developmental approaches to health psychology, applied within a stress and coping framework
Susan Aitken	Professor	F	Tenure	IS	D	Enzymology and Sulfur Amino Acid Metabolism
Shawn Hayley	Professor	M	Tenure	NS	D	How interactions between the brain and immune system influence the development of psychiatric and neurological conditions
Susan Braedley	Associate	F	Tenure	SW	D	Political Economy of Health Care and Social Services Work; Race, class, and gender in everyday caring work
Dwight Duego	Associate	M	Tenure	CS	D	Mobile Computing, Eclipse, Peer-to-Peer Computing, Evolutionary Computation (Genetic Algorithms, Genetic Programming, Artificial Life), Object-Oriented Systems, Software Patterns and Open Source Software

Mary Gick	Associate	F	Tenure	PS	D	Health psychology, individual difference factors associated with health, health behaviours, singing, health and well-being.
Stuart Murray	Professor	M	Tenure	EN	D	Canada Research Chair in Rhetoric & Ethics
Stephen Prus	Associate	M	Tenure	SA	D	Social gerontology, epidemiology, and statistics, namely applied statistics and general and generalized linear models
Tom Sherratt	Professor	M	Tenure	BI	D	Evolution of behavioural and morphological trait. How individual behaviour helps to shape the spatio-temporal dynamics of populations.
Michael Hildebrand	Assistant	M	Tenure Track	NS	D	Pain Research
Paul Mkandawire	Assistant	M		IS	D	Social and environmental determinants of health
Natalina Salmaso	Assistant	F	Tenure	NS	D	Postnatal development and plasticity across the lifespan
Alex Wong	Assistant	M	Tenure Track	BI	D	Genetic consequences of adaptation
James Green	Associate	M	Tenure	SC	D	Bioinformatics, Data mining
Erika Adams	Adjunct	F			CDM	
Bernard Choi	Adjunct	M			CDM	Epidemiology
David Clements	Adjunct	M			CDM	
Adrian Guta	Adjunct	M			CDM	
Tim Hutchinson	Adjunct	M			CDM	

*HS = Health Sciences; CS = Computer Science; PS = Psychology; SW Social Work; EN English; SA Sociology and Anthropology; IS Interdisciplinary Studies; BI Biology; SC Systems and Computer Engineering; CH Chemistry
**D=full privileges; M=full privileges at master's level only; CD=co-supervision privileges at doctoral level, full privileges at master's level; CDM=co-supervision privileges only at both doctoral and master's level; CM=co-supervision privileges at master's level, no privileges at doctoral level.
#New hire.

D.2 Faculty research funding

Research funding data for the past two years are provided in Table 7, as the department was only formed in 2014. These data indicate a high level of funding in such a short period of time. The level of funding will increase dramatically as new senior research faculty are hired over the next 2-3 years.

Table 7. Research Funding from Carleton University

Year	Canadian Sources	Internal (Carleton) Grants/Awards	International Sources (excluding USA)	Tri-Council (including CRC)	Grand Total
2015	132,000	265,000	73,916	583,480	1,054,396

2016	1,059,817	138,166		615,467	1,813,450
Grand Total	**1,191,817**	**403,166**	**73,916**	**1,198,947**	**2,867,845**

D.3 Distribution of thesis supervision

Table 8 provides a summary of the supervision of the Department faculty members for which we could obtain data. These data suggest that faculty are active in graduate student supervision through their cross-appointments with other units. However, the current supervisions by the four full-time Health Science faculty members (Ysseldyk, Villeneuve, Cassol and Connor) are all co-supervisions of group projects, and only of students in the HSTP program. Such students would not normally count as HQP in the NSERC system.

Table 8. Distribution of supervision (co-supervision in brackets for Health Sciences Faculty only)

Faculty Name	Rank	Completed				Current			
		MSc HSTP[1]	MSc	PhD	PDF	MSc HSTP[1]	MSc	PhD	PDF
Robert Burk	Associate		6	4	0		0	0	0
Edana Cassol	Assistant	(13)	0	0	0	(5)	0	(1)	0
Kristin Connor	Assistant	0	0	0	0	(4)	0	0	0
Paul Villeneuve	Associate	(20)	(2)	(1)	1	(4)	0	0	1
Renate Ysseldyk	Assistant	(18)	0	0	0	(5)	(1)	(1)	0
Susan Aitken	Professor		12	4	0		2	1	0
Shawn Hayley	Professor		16	2	1		4	7	o
Susan Braedley	Associate		9	0	0		6	2	0
Dwight Duego	Associate		18	0	0		1	1	0
Mary Gick	Associate		21	2	0		0	0	0
Stuart Murray	Professor		13	3	2		0	1	0
Stephen Prus	Associate		0	0	0		0	0	0
Tom Sherratt	Professor		8	10	12		3	1	1
Michael Hildebrand	Assistant		0	0	0		0	0	0
Paul Mkandawire	Assistant								
Natalina Salmaso	Assistant								
Alex Wong	Assistant		2	0	0		6	1	0
James Green	Associate		10	2	2		4	2	1
Erika Adams	Adjunct								
Bernard Choi	Adjunct		19	1	6		1	0	0
David Clements	Adjunct								
Adrian Guta	Adjunct								
Tim Hutchinson	Adjunct								

[1]The HSTP MSc involves a group-based thesis capstone project. Each group typically consists of 4-5 students.

D.4 Current teaching assignments

Table 9 provides a list of teaching assignments of the core faculty members. In general, faculty members have the normal teaching load associated with their unit (typically three 0.5-credit courses), plus supervision of fourth year projects. We will offer two new courses for the NGPs that will be taught by existing faculty in the Department, or planned hires (three faculty and two instructors for 2016/2017; refer to Part G).

Whilst not a typical 'course', a 0.5-credit teaching assignment (weighted over the two terms) will dedicate a faculty member to oversee the *Seminars in Interdisciplinary Health Sciences* course (HLTH 5902/6902) and ensure students have a positive experience with this course. This faculty will certify students have attended the mandatory introductory lectures, have submitted their seminar summaries, and have given their departmental seminar. Our Graduate Administrator will also perform tasks in support of the course and the faculty member tasked with its oversight.

Table 9. Distribution of teaching assignments

Faculty Name	Rank	Courses	Credit Value	2015-2016	2014-2015	2013-2014
Aitken, Susan-Marie	Full Professor	HLTH5400A - Interdisciplinary Probl Health	1.0	x	x	
		HLTH5500F - Collaborative Grp Rsrch Projec	2.0		x	
	Assoc Professor	HLTH5400A - Interdisciplinary Probl Health	1.0			x
		HLTH5500F - Collaborative Grp Rsrch Projec	2.0			x
		Total Credit Weight		**1.0**	**3.0**	**3.0**
Hayley, Shawn P.	Full Professor	NEUR3401A - Environme Toxins& Mental Health	0.5	x		
		NEUR5100T - Fundamentals in Neuroscience	1.0	x		
	Assoc Professor	NEUR3305A - Immune-Brain Interactions	0.5		x	
		NEUR5100T - Fundamentals in Neuroscience (taught with 6100T)	1.0		x	x
		NEUR5800W - Special Topics in Neuroscience	0.5			x
		NEUR6100T - Advanced seminar Neuroscience	1.0			
		Total Credit Weight		**1.5**	**1.5**	**1.0**
Sherratt, Tom	Full Professor	BIOL3604A - Analysis of Ecol Relationships	0.5	x	x	x
		BIOL3604T - Analysis of Ecol Relationships	0.5	x	x	x
		BIOL3612A - Comp. Meth. in Ecology & Evol.	0.5		x	x
		BIOL5407T - Quantitative Ecology	0.5	x	x	
		BIOL5409F - Modeling for Biologists	0.5			x
		HLTH 5700A: Special Topics in Biostatistics and Epidemiology	0.5		x	
		HLTH5700T - Sp. Tops in Biostats & Epidemi	0.5	x		
		Total Credit Weight		**2.0**	**2.5**	**2.0**
Braedley, Susan	Assoc Professor	SOWK2100A - Political Economy: of Welfare	0.5	x		
		SOWK5000F - Found. in Structural Socl Wrk	0.5	x		
		SOWK5106W - Women and Social Policy	0.5	x		
		SOWK5306T - Adv Theory for Social Welfare	0.5	x		
	Assist Professor	PECO6000W - Pol. Economy: Core Concepts	0.5		x	x
		SOWK2100A - Political Economy: of Welfare	0.5		x	x
		SOWK5000F - Found. in Structural Socl Wrk	0.5		x	
		SOWK5106F - Women and Social Policy	0.5			x

		Total Credit Weight		**2.0**	**1.5**	**1.5**
Burk, Robert	Assoc Professor	CHEM1001A - General Chemistry I	0.5	x	x	x
		CHEM1001N - General Chemistry I	0.5	x	x	x
		CHEM1001T - General Chemistry I	0.5	x	x	x
		CHEM1002A - General Chemistry II	0.5	x	x	x
		CHEM1002N - General Chemistry II	0.5	x	x	x
		CHEM1002V - General Chemistry II	0.5	x	x	x
		CHEM2103A - Physical Chemistry I	0.5	x		x
		CHEM2800A - Foundations Environmental Chem	0.5	x	x	x
		CHEM3100A - Physical Chemistry II	0.5	x		x
		CHEM4502A - Radiochemistry	0.5	x	x	x
		CHEM4800A - Atmospheric Chemistry	0.5	x		x
		CHEM5905A - Radiochemistry	0.5	x	x	
		CHEM5905W - Radiochemistry	0.5			x
		Total Credit Weight		**6.0**	**4.5**	**6.0**
Deugo, Dwight	Assoc Professor	COMP1601A - Intro to Mobile Applic Develop	0.5	x	x	x
		COMP3601A - Social Networking	0.5	x	x	x
		Total Credit Weight		**1.0**	**1.0**	**1.0**
Gick, Mary	Assoc Professor	PSYC2301A - Introduction to Health Psych	0.5		x	
		PSYC2301B - Introduction to Health Psych	0.5		x	
		PSYC3300B - Health and Illness (Hon Sem)	1.0	x	x	
		Total Credit Weight		**1.0**	**1.0**	
Green, James	Assoc Professor	BIOM5405W - Pattern Classif & Expermt Design	0.5	x	x	x
		BIOM5800F - Biomedical Engineering Seminar	0.5	x	x	x
		BIOM5800W - Biomedical Engineering Seminar	0.5	x	x	x
		SYSC2001A - Computer Systems Foundation	0.5	x	x	x
		SYSC5405W - Pattern Classif & Experim Design	0.5	x	x	x
		Total Credit Weight		**2.5**	**2.5**	**2.5**
Murray, Stuart	Assoc Professor	ENGL4005A - Studies in Literary Theory	0.5			x
		ENGL5002F - Studies in Theory I	0.5		x	x
		ENGL5002G - Studies in Theory I	0.5	x		
		CLMD6903F - Spec Top in Cultural Med	0.5	x		x
		Total Credit Weight		**1.0**	**0.5**	**1.5**
Prus, Steven G.	Assoc Professor	SOCI2001A - Intr Qualitative Rsrch Methods	0.5			x
		SOCI2002A - Intr Quantitative Rsrch Method	0.5			x
		SOCI2002B - Intr Quantitative Rsrch Method	0.5		x	
		SOCI3003A - Studies in Res. Design & Data	1.0		x	
		SOCI3050A - Stud. in the Socio. of Health	0.5		x	
		BIOL5407S - Quantitative Ecology	0.5			x
		Total Credit Weight			**2.0**	**1.5**
Villeneuve, Paul J.	Assoc Professor	HLTH2001A - Health Research Methods/Skills	0.5	x		
		HLTH3201A - Epidemiology	1.0	x		
		HLTH5500F - Collaborative Grp Rsrch Projec	2.0		x	
		HLTH5700B - Sp. Tops in Biostats & Epidemi	0.5	x	x	
		HLTH5400A - Interdisciplinary Probl Health	1.0			x
		Total Credit Weight		**2.0**	**2.5**	**1.0**
Cassol, Edana	Assist Professor	HLTH1000A - Fundamentals of Health	0.5	x	x	
		HLTH1001A - Principles of Health	0.5	x		

		HLTH5400A - Interdisciplinary Probl Health	1.0	x		
		HLTH5500F - Collaborative Grp Rsrch Projec	2.0		x	
		Total Credit Weight		**2.0**	**2.5**	
Connor, Kristin	Assist Professor					
		Total Credit Weight				
Ysseldyk, Renate	Assist Professor	HLTH2003A - Social Determinants of Health	0.5	x		
		HLTH5100A - Fundamentals Research Methods	0.5	x		
		HLTH5400A - Interdisciplinary Probl Health	1.0		x	
		HLTH5500F - Collaborative Grp Rsrch Projec	2.0		x	
		HLTH5501A - Group Research Project	2.0	x		
		Total Credit Weight		**3.0**	**3.0**	
Hildebrand, Michael	Assist Professor	NEUR3202A - Sensory Processes	0.5	X	x	x
		NEUR4200A - Cur Res in Neuroscience	0.5	x	x	
		NEUR4200D - Cur Res in Neuroscience		x		
		Total Credit Weight		**1.5**	**1.0**	**0.5**
Mkandawire, Paul	Assist Professor	AFRI5000W - Historical & Current Perspecti	0.5	x		
		AFRI5100W - African Studies Abroad	0.5	x		
		CHST3303A - Childrens' Rights	0.5		x	x
		HUMR2202A - Power Relations & Human Rights	0.5		x	x
		HUMR3001A - Special Topics in Human Rights	0.5		x	x
		HUMR3301A - Racialism, Racism & Human Righ	0.5	x	x	x
		HUMR3303A - Child Rights	0.5		x	x
		HUMR3504A - Health Policy and Human Rights	0.5	x		
		HUMR4907A - Special Topic in Human Rights	0.5	x	x	x
		Total Credit Weight		**2.5**	**3.0**	**3.0**
Salmaso, Natalina	Assist Professor	NEUR2200D - Biol Foundations of Behav	0.5	x	x	
		NEUR3302A - Sex and the Brain	0.5	x		
		Total Credit Weight		**1.0**	**0.5**	
Adams, Erika	Instructor 1	PADM5229W - The Health of Populations	0.5		x	
		HLTH5201A - Fund of Policy I: Policy Analy	0.5		x	
		HLTH5701A - Sp. Top. in Hlth Policy&Admin	0.5		x	
	Contract Instr	PADM5229W - The Health of Populations	0.5	x		x
		PADM5272C - Policy Sem. (Poli. Analy. Con)	0.5			x
		HLTH5200F - Fundamental Policy:Health Sect	0.5			x
		HLTH5500F - Collaborative Grp Rsrch Projec	2.0			x
		Total Credit Weight		**0.5**	**1.5**	**3.5**
Choi, Bernard	Adjunct Prof					
		Total Credit Weight		**0**	**0**	**0**
Clements, David	Adjunct Prof	HLTH5704A - Spec Top in the Sci of Disease	0.5	x		
		Total Credit Weight		**0.5**		
Guta, Adrian	Adjunct Prof					
		Total Credit Weight		**0**	**0**	**0**
Hutchinson, Tim	Adjunct Prof					
		Total Credit Weight		**0**	**0**	**0**

D.5 Contract Instructors

Full time faculty members in the Department normally teach HLTH undergraduate courses. Full time faculty members in the Department will also teach the new HLTH courses offered in

conjunction with the NGPs. From time to time, we may require contract instructors to address intermittent teaching shortages (e.g. sabbaticals, faculty with teaching release), but this would primarily relate to our BHSc and MSc HSTP. The Department of Health Sciences has made use of contract instructors to fill in any gaps created as the program grows and the number of courses offered increases rapidly. It is expected that full time faculty members will be increasingly responsible for teaching courses in the Department as the number of faculty members increases over the next few years. The graduate courses proposed for the NGPs will be taught/overseen by full time faculty members. Contract instructors employed to date the Department, and their teaching assignments, are shown in Table 10.

Table 10. Contract Instructors in the Department of Health Sciences.

Contract Instructor	2012-2013	2013-2014	2014-2015	2015-2016
Erika Adams	HLTH 5200	HLTH 5200 HLTH 5500 HLTH 5701		
Geri Briggs	HLTH 5300	HLTH 5300		
Daniel Burnside				HLTH 3301
David Clements				HLTH 5704
Elizabeth Dyke			HLTH 5300	
Deepika Grover	HLTH 5400			
Krystal Kehoe MacLeod				HLTH 5201
Robin McQuaid			HLTH 5100	
Katherine Raspopow		HLTH 5100		

PART E: Program Admission and Enrolment

E.1 Admissions requirements

The normal requirement for admission into the MSc program is a BSc degree in a relevant field (e.g.: Science, Life/Health Sciences, Psychology, Biostatistics, or related discipline) with a B+ average in the last two years of study and a B average overall. Applicants who do not meet these requirements may be accepted into the program, but may be assigned courses extra to the program requirements.

The normal requirement for admission into the PhD program is an MSc degree in a relevant field (e.g.: Science, Life/Health Sciences, Psychology, Biostatistics, or related discipline).

E.1.2 Fast-Tracking from MSc to PhD

As per FGPA's Fast-Track Guidelines, exceptional Health Sciences NGP MSc students (not to be confused with HSTP MSc students) can be admitted into the PhD program without completing their MSc program. These students should show outstanding academic performance, demonstrate significant promise for advanced research, and have made substantial progress in their research. Courses completed as part of the MSc program will be used as part of the basis of

admissions to the PhD when fast-tracking; however, up to 1.0 credit of course work completed in the MSc program could be considered for advanced standing towards the PhD (e.g.: completion of the core course HLTH 5901 and seminar course 5902). Advanced standing would be for courses that fulfil the PhD program requirements and contribute to the PhD program's learning outcomes. The request for fast-tracking must be submitted to the departmental Graduate Program Committee and Graduate Advisor within 18 months of starting the MSc program, upon the recommendation of the student's Graduate Advisory Committee. As MSc students are completing their course requirements (HLTH 5901 and 5902) in their first year, they may not have made enough progress in their research by the 12th month (3rd term) to assess their capability to excel in the PhD program. As such, an additional 6 months may be required before requesting to fast-track into the PhD program. The student, at a formal Graduate Advisory Committee meeting, will secure the Committee's recommendation for fast-tracking. These students should have fulfilled all course requirements of the MSc with at least an A- average prior to fast-tracking. Following approval of the fast-tracking request, the student will have to complete an exam, similar to the PhD mid-program research defence and knowledge examination requirements. This includes a written document of progress and future directions for the PhD research, demonstrating that this research will continue, or is consistent with, research currently underway in the student's MSc project (~10 pages). The examination will typically consist of a 45-minute presentation of results to date and future directions/research aims, followed by a question period from the examiners. The Transfer Examination Committee will consist of the student's Graduate Advisory Committee, two field experts and a non-voting Chair. The Department Graduate Program Committee and Graduate Advisor must approve the composition of this Committee before the examination can proceed. The final recommendation to fast-track will be made by the Examination Committee and be submitted to the Graduate office.

E.2 Class sizes and course and program capacity

E.3 Projected enrolment

The projected enrolment over the next 5 years can be found in Table 11.

Table 11. Projected yearly new enrolments in the proposed MSc and PhD programs

	2017	2018	2019	2020	2021
MSc					
Domestic	5	7	9	8	8
International	0	0	0	0	0
PhD					
Domestic	2	3	4	4	4
International	0	0	0	0	0
Cumulative numbers (current enrolment)					
MSc	5	12	16	17	16
PhD	2	5	7	13	15

PART F: Student Experience and Satisfaction

F.1 Student orientation, advising, and mentoring

The home unit of the students is the Department of Health Sciences. Collaborators and/or co-supervisors of the student's research may reside in departments outside of the home unit. Graduate student orientation will be delivered through the Faculty of Graduate Studies and Postdoctoral Affairs (FGPA). The Department of Health Sciences, overseen by the Graduate Advisor, will also provide a department-specific graduate orientation for all new graduate students.

Each MSc and PhD student will have a Supervisor who will advise and mentor the student throughout his/her program and research activities. Each student will also have a Graduate Advisory Committee that will be chosen by the Supervisor, in consultation with the student, and signed off by the Graduate Advisor. This committee will assess the student's progress, provide expert feedback on the project direction and results, assess the communication skills of the student, and may play a general or supplementary role in advising the student on career goals.

Our current MSc HSTP students and Health Sciences BHSc students are highly engaged in departmental and university activities. Currently, our students participate in Carleton Grad Student clubs, the Science Student Success Centre, run and participate in health research outreach events and attend seminars and networking events on and off campus, in part identified through Grad Navigate. We anticipate that students enrolled in the NGPs will be similarly active within and external to our department. Further, the core course Advanced Topics in Interdisciplinary Health Sciences and the mandatory attendance of graduate students at their peer's research seminars will provide on-going opportunities for the graduate students to interact with each other and members of our department.

F.2 Student funding

As per the Business Plan, FGPA has made a commitment to fund a cumulative steady state of 17 MSc and 15 PhD students over the first five years. Students are funded through a combination of Scholarships, Teaching and Research Assistantships. Teaching Assistantships in PhD programs are normally supported for eight terms. Scholarships are normally dispersed over three terms per year. Additional funding may result from external awards and faculty research grants.

We expect students to apply for competitive scholarships offered through the Tri-Councils, Ontario Graduate Scholarships, MITACS, and other funding and charitable organisations, as applicable. To maintain active and sustainable research programs, core faculty are expected to continually apply for external operating grant funding to support research activities and salaries/stipends of their personnel.

F.3 Career paths of graduates

There is an increasing demand for health care nation-wide and this has resulted in the creation of various employment opportunities in fields related to health research, innovation, technology

and delivery. A key objective of the Health Sciences NGP is to provide students with the skills and knowledge (disciplinary and interdisciplinary) to make them highly marketable within the health sector. Our students will be immersed in a culture of collaboration and inter-professional learning. These diverse interdisciplinary opportunities will allow students to develop the important professional skills that become the foundation for future career successes and life-long learning.

Career paths of graduates of the NGPs are anticipated to be diverse, given the interdisciplinary nature of the program and research performed in the Department of Health Sciences. Table 12 outlines possible career paths for our graduates.

Table 12. Potential career paths following graduation from an MSc or PhD in Health Sciences

Educational	Public Sector	Private Sector	Non-Profit
• teacher • University/College instructor or Professor • academic researcher (Senior Scientist, Principle Investigator, Research Associate, Laboratory Manager) • medicine • dentistry • nursing • allied health professions • veterinary medicine • law • business	• regulatory agencies (e.g.: public health inspector, health product regulator, epidemiologist, scientist, health information analyst) • public health researcher (e.g.: Health Canada, Public Health Agency of Canada) • worker in international non-governmental health organisations (WHO, Gates Foundation) • Tri-Council research agencies (e.g.: grant administration, management and research promotion)	• pharmaceutical research and sales • medical/scientific device sales • food science and food quality assurance and promotion • patent analyst	• medical research institutions (e.g.: research scientist, laboratory manager, clinical research coordinator) • health charities and foundations (e.g.: fundraiser, global health advocate, project manager) • health communications expert

PART G: Resources

G.1 Support and technical staff

There are no new support or technical staff required for the NGPs. The Department of Health Sciences currently has two staff members that will be involved in different ways in the NGPs. The Graduate Program Administrator assists the Graduate Advisor as described in Part C of this brief (Governance). The Workshop and Research Coordinator, although primarily involved with undergraduate affairs, has been invaluable in helping set up research laboratories, and plan for the eventual move into the new building (in the fall of 2017). When the new program is up and running, the combination of the Chair, the Graduate Advisor, and the Graduate Program Administrator will be sufficient for day to day operation of the program.

G.2 Teaching resources

Rapid growth at the undergraduate level in Health Sciences has strained the available teaching resources to the point that several contract instructors (CIs) have been necessary in any given academic year. The number of courses that need to be offered at the undergraduate level is increasing rapidly as the first cohort of undergraduate students moves into its third year in 2016-17. Even with CIs, this limits the ability of faculty members to teach all of the courses needed at the graduate level. The result is that CIs are also needed at the graduate level. So far this has not been a major problem because of the interdisciplinary nature of the program and the availability of high quality instructors on campus or from within the Ottawa region. Within the current hiring plan for the Department and with commitment from the Dean of Science, we will hire three new research-focused senior faculty members (in 2016/2017) and two new instructor-level positions (in 2016). These five new positions will greatly reduce the number of CIs needed to teach the required courses at all levels in the Department.

The three new courses proposed (HLTH 5901 Advanced Topics in Interdisciplinary Health Sciences, HLTH 5902/6902 Seminars in Interdisciplinary Health Sciences, and HLTH 6903 Grant Proposal and Ethics) could be taught by most faculty members, affording the Chair some flexibility in making teaching assignments from one year to the next.

G.3 Space

The Department of Health Sciences is currently housed in office space in the Herzberg Building, as well as research space on loan from the Department of Neuroscience in the Life Sciences Research Building. Both of these departments will be moving to the new building scheduled for completion in summer of 2017. The building includes research, teaching (laboratory and classroom) and office space. Any issues related to lack of space, or lack of suitable space, should be resolved by this move.

G.4 Library resources

Ensuring students have access to major biomedical and health journals will be essential for their research and preparations for the NGP courses. Whilst Carleton does provide access to many top biomedical journals, there is still a great need for access to those our department has deemed essential. Further, our students will require timely access to articles contained within biomedical/health journals within the University's current holdings, for which currently there are embargos (ranging from 6-12 months). The attached Library Report captures some of the

essential library holding needs of our department and details the associated annual, on-going costs of $27688. The Library has confirmed they will undertake all costs (both one-time and on-going) of our library needs.

PART H: Development of the Self-Study

A Programme Development Committee from the Department of Health Sciences that consisted of the following members developed the self-study:
Dr. Kristin Connor
Dr. Edana Cassol
Dr. Robert Burk

With contributions and advice from:
Dr. Adrian Chan (Associate Dean Programs and Awards, Faculty of Graduate and Postdoctoral Affairs)

PART I: Calendar Language

I.1 Admissions requirements

I.1.1 MSc in Health Sciences

Academic Requirements
All candidates are required to obtain a grade of B or higher in each course in the program.

Admission Requirements
The normal requirement for admission into the MSc program is a BSc degree in a relevant field with a B+ average in the last two years of study and a B average overall. Applicants who do not meet these requirements may be accepted into the program, but may be assigned courses extra to the program requirements. Applicants can apply for entry directly into the PhD program if they have an MSc in a relevant field. Students who are in the MSc program may be admitted to the PhD program if they show outstanding academic performance and demonstrate significant promise for advanced research, upon recommendation of the student's Graduate Advisory Committee and approval by the Graduate Advisor.

Fast-track from MSc to PhD
Students registered full-time in the MSc in Health Sciences who show outstanding academic performance, demonstrate significant promise for advanced research, and have made substantial progress in their research, may be permitted to fast-track into the PhD program, without completing the MSc, upon approval by the Graduate Advisor and Graduate Program Committee. Request for transfer must be made within 18 months of starting the MSc program.

Students should have fulfilled all course requirements of the MSc with at least an A- average prior to transfer and must successfully complete a research defence and knowledge examination.

I.1.2 PhD in Health Sciences

Academic Requirements

All candidates are required to obtain a grade of B or higher in each course in the program.

Admission Requirements

The normal requirement for admission into the PhD program is an MSc degree in a relevant field. Students who are in the Health Sciences MSc program may be admitted to the PhD program if they show outstanding academic performance and demonstrate significant promise for advanced research, upon recommendation of the student's Graduate Advisory Committee and approval by the Graduate Advisor.

I.2 Program Requirements

I.2.1 MSc in Health Sciences (5.0 credits)

1. 1.0 credits in:

HTLH 5901 [0.5]	Advanced Topics in Interdisciplinary Health Sciences
HLTH 5902 [0.5]	Seminars in Interdisciplinary Health Sciences

2. Completion of:

HLTH 5905 [0.0]	Final research seminar presentation for MSc

3. 4.0 credits in:

HLTH 5909 [4.0]	MSc Thesis

4. Twice-yearly meetings with their thesis Graduate Advisory Committee, with students reaching a level of satisfaction as determined by the Committee.

Footnote: The final research seminar presentation must be completed within one month of the thesis defence.

I.2.2 MSc in Health Sciences with Specialisation in Data Science (5.5 credits)

1. 1.0 credits in:

HTLH 5901 [0.5]	Advanced Topics in Interdisciplinary Health Sciences
HLTH 5902 [0.5]	Seminars in Interdisciplinary Health Sciences

2. 0.5 credits in:

DATA 5000 [0.5]	Data Science seminar

3. Completion of:

HLTH 5905 [0.0] Final research seminar presentation for MSc

4. 4.0 credits in:
HLTH 5909 [4.0] MSc Thesis

5. Twice-yearly meetings with their thesis Graduate Advisory Committee, with students reaching a level of satisfaction as determined by the Committee.

Footnote:
The final research seminar presentation must be completed within one month of the thesis defence.

I.2.3 PhD in Health Sciences (10.0 credits)

1. 1.5 credits in:
HTLH 5901 [0.5] Advanced Topics in Interdisciplinary Health Sciences
HLTH 6902 [0.5] Seminars in Interdisciplinary Health Sciences
HLTH 6903 [0.5] Grant Proposal and Ethics

2. Completion of:
HLTH 6904 [0.0] Mid-program research defence and knowledge examination
HLTH 6905 [0.0] Final research seminar presentation for PhD

3. 8.5 credits in:
HLTH 6909 [8.5] PhD Thesis

4. Twice-yearly meetings with their thesis Graduate Advisory Committee, with students reaching a level of satisfaction as determined by the Committee.

Footnote:
If the student fails to satisfy the requirements of HLTH 6904, he/she will be withdrawn from the program.
The final research seminar presentation must be completed within one month of the thesis defence.

I.3 Courses
I.3.1 New Courses
HLTH 5901 [0.5 credits]
Advanced Topics in Health Sciences
Discussion of current health problems and exploration of innovative interdisciplinary solutions. Development of skills required to perform critical analyses of health research to evaluate the quality, interpret the findings, and assess the impact of health sciences literature across disciplines.

HLTH 5902 [0.5 credits]
Seminars in Interdisciplinary Health Sciences for MSc
Seminar course in interdisciplinary health research. Development of scientific communication skills through attendance at interdisciplinary seminars and by the student presenting a seminar on their own thesis research. Topics have specific or broad relevance to health sciences.

HLTH 5905 [0.0 credits]
Final research seminar presentation for MSc
Final seminar of MSc thesis research. Seminar presentation should occur within one month of the final oral thesis defence.

HLTH 6902 [0.5 credits]
Seminars in Interdisciplinary Health Sciences for PhD
Seminar course in interdisciplinary health research. Development of scientific communication skills through attendance at interdisciplinary seminars and by the student presenting a seminar on their own thesis research. Topics have specific or broad relevance to health sciences.

HLTH 6903 [0.5 credits]
Grant Proposal and Ethics
Advanced course in writing successful grant proposals in Tri-Council (CIHR, NSERC, SSHRC) formats. Discussion of ethics associated with conducting health sciences research, including the preparation of ethics proposals for human and animal studies in health sciences research.

HLTH 6904 [0.0 credits]
Mid-program research defence and knowledge examination for PhD
Departmental seminar and Graduate Advisory Committee meeting on PhD research including results to date and future research aims and directions, and on field-specific knowledge. Presentation and Committee meeting should occur by the end of year 2 in the program.

HLTH 6905 [0.0 credits]
Final research seminar presentation for PhD
Final seminar of PhD thesis research. Seminar presentation should occur within one month of the final oral thesis defence.

I.3.2. Existing Courses
HLTH 5100 [0.5 credit]
Fundamentals of Research Methods
Experimental design, statistical analysis and interpretation of results in health science research, principles and methods of epidemiology, fundamentals of research ethics.
Prerequisite(s): university-level statistics.

HLTH 5201 [0.5 credit]
Fundamentals of Policy I: Policy Analysis

Policy analysis and policy processes with an emphasis on the stages of the policy process, as well as the influences of institutions, ideas and interests.

HLTH 5202 [0.5 credit]
Fundamentals of Policy II: The Health Sector
Canadian health policies and programs with emphasis on the economics, politics and public administration of the healthcare sector.

HLTH 5300 [0.5 credit]
Knowledge Mobilization
This course focuses on knowledge mobilization, translation, transfer and exchange in the formulation of policy and the development of the skills required to maximize the impact of scientific findings through real world programs and policies and communication skills for diverse audiences.
Prerequisite(s): HLTH 5100, HLTH 5200.

HLTH 5400 [1.0 credit]
Interdisciplinary problems in Health
Development of an understanding of the scope and interdisciplinary nature of issues that impact the health of Canadians is the focus of this course.
Prerequisite(s): to be taken concurrently with HLTH 5100, HLTH 5200 and HLTH 5300.

HLTH 5501 [2.0 credits]
Collaborative Group Research Project
Student teams, supervised by a cross-disciplinary team of faculty, will collaborate on a project that addresses a real-world health concern.
Prerequisite(s): HLTH 5400.

HLTH 5600 [0.25 credit]
Special Topics in Biostatistics and Epidemiology
Selected topics in biostatistics and epidemiology, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5601 [0.25 credit]
Special Topics in Health Policy and Administration
Selected topics in health policy and administration, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5602 [0.25 credit]
Special Topics: Social and Behavioural

Selected topics in the social and behavioural sciences, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5603 [0.25 credit]
Special Topics in Environmental Health
Selected topics in environmental health, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5604 [0.25 credit]
Special Topics in the Science of Disease
Selected topics in the science of disease, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5605 [0.25 credit]
Special Topics: Engineering, Design and Computer Science
Selected topics in applications of engineering, design or computer science in health, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5700 [0.5 credit]
Special Topics in Biostatistics and Epidemiology
Selected topics in biostatistics and epidemiology, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5701 [0.5 credit]
Special Topics in Health Policy and Administration
Selected topics in health policy and administration, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5702 [0.5 credit]
Special Topics: Social and Behavioural
Selected topics in the social and behavioural sciences, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5703 [0.5 credit]
Special Topics in Environmental Health

Selected topics in environmental health, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5704 [0.5 credit]
Special Topics in the Science of Disease
Selected topics in the science of disease, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5705 [0.5 credit]
Special Topics: Engineering, Design and Computer Science
Selected topics in applications of engineering, design or computer science in health, focusing on areas of specific relevance to the health sector, not available in regular program offerings. These courses are designed to provide depth of expertise and/or specific skills relevant to the workplace.

HLTH 5800 [0.5 credit]
Directed Studies in Health: Science, Technology and Policy
One-to-one instruction in selected aspects of specialized Health: Science and Technology subjects not covered by other graduate courses. Students may not take this course from their project supervisor(s), and are limited to one directed studies course per program.
Prerequisite(s): permission of the director of Health: Science, Technology and Policy.

HLTH 5909 [4.0 credit]
M.Sc. Thesis in Health Science

HLTH 9909 [8.5 credit]
Ph.D. Thesis in Health Science

DATA 5000 [0.5 credit]
Data Science Seminar
Cloud based distributed systems, statistics, machine learning, use of complex ecosystems of tools and platforms, and communication skills to explain advanced analytics. Students choose a project in Big Data management and/or analysis, deliver a paper and give a class presentation on their findings.

PART J: Health Sciences Programs in Canada

Table 13. Health Sciences graduate programs in Canada

University	Unit	MSc	MHSc	PhD	Approx. enrolment	Research Area
Proposed Program						
Carleton University	Health Sciences*	seminar course + seminar attendance + thesis	n/a	core course + seminar attendance + grant writing course + thesis		Interdisciplinary health sciences covering: biomedical science, lifecourse health, epidemiology, global health, social determinants of health, etc.
Standalone Programs within Health Sciences Units (School/Department/Institute)						
University of Ottawa	Faculty of Health Sciences – Interdisciplinary School of Health Sciences *	n/a	2.5 courses + 2 seminars + thesis	PhD in Population Health – 6 courses + exam + thesis	MHSc – 15-20 /yr PhD – 10-15/yr	
Simon Fraser University	Faculty of Health Sciences *	4 courses + thesis	Master of Public Health – (4 different concentrations) 6 courses + practicum + seminar + master's project or thesis	2 courses + exam + thesis	MPH - 40-45/yr MSc – 10/yr PhD – 10/yr	Chronic & Infectious Diseases, Global Health, Mental Health & Addictions, Environmental & Occupational Health, Population & Public Health, Social & Health Policy Sciences, Social Inequities & Health
Standalone Programs within Other Units						
none						
Options within Other Programs						
University of British Columbia	School of Population and Public Health	10 courses + thesis	10 courses + major essay *MUST HAVE AN MD TO APPLY	7 courses + thesis		Epidemiology, Biostatistics & Public Health Practice; Health in Populations; Health Services & Policy; Occupational & Environmental Health
University of Guelph	Human Health & Nutritional Sciences	MSc by Thesis 3 courses + thesis MSc by Course/ Project 8 courses + project	n/a	coursework established through discussion with advisor + thesis	MSc (thesis) – 11/yr MSc (course) – 30/yr PhD – 9/yr	Obesity and Diabetes; Health Promotion & Disease Prevention; Biomechanics and Neuromuscular Physiology; Genomic and Metabolic Effects of Nutrients in health and disease; Dietary Fatty Acids in Health and Disease; Regulation of the Cardiovascular System in health and disease; Knowledge Transfer research
University of Toronto	Fraser Mustard Institute of Human Development*	n/a	n/a	2 courses + seminar attendance + attend research day and present + thesis		Collaborative program in human development integrative, transdisciplinary program that brings together PhD students from diverse

						backgrounds to approach human development questions from a holistic perspective. Open to any PhD student already enrolled in a participating degree program from: Biomedical Engineering Dev. Psychology and Education Ecology and Evolutionary Biology Immunology Medical Science Medical Biophysics Music Nutritional Sciences Pharmacology Physiology Psychology Public Health Sciences Social Work
University of Waterloo	School of Public Health and Health Systems	MSc in Public Health and Health Systems 6 courses + thesis	n/a	PhD in Public Health and Health Systems 10 graduate courses (4 beyond masters level) + exam + thesis		Chronic Disease Prevention and Management; Health and Aging; Health Care Integration and Efficiency; Food and Water Safety, Security and Governance; Reducing Health Inequalities; Health and the Environment
Western University	Health & Rehabilitation Sciences	Coursework + seminars + thesis	n/a	coursework + seminars + exam + thesis	MSc & PhD around 50 total each year	Health & Aging, Health Professional Education, Health Promotion, Hearing Science, Measurement & Methods, Occupational Science, Physical Therapy, Rehabilitation Science, Speech & Language Science

* indicates an interdisciplinary program

Additional notes on health sciences or related graduate programs in Canada:

- Dalhousie University has a School of Health Sciences however they only offer a BHSc program as well as a post diploma program and a certificate program in MRI.
- Queen's University has a School of Medicine, School of Nursing and School of Rehabilitation Therapy with respective graduate programs, however they do not offer an MHSc program.
- University of Alberta, a major biomedical and health institution, does not offer a Masters or PhD in Health Sciences.
- McMaster University has seven distinct research-oriented graduate programs in the Faculty of Health Sciences: Biochemistry; Health Research Methodology – MSc (thesis-based: 5 courses + thesis; or course-based: 7 courses + research internship); PhD (3 courses + exam + thesis); Health Science Education; Medical Sciences; Nursing; Public Health – MPH (thesis based: 7 core courses + 2 electives + thesis; or practicum based: 7 core courses + 4 electives + capstone paper); Rehabilitation Science

PART K: Evidence for Demand in Health Sciences

With a rapidly expanding aging population and increasing rates of chronic disease, there is a significant demand for appropriately qualified candidates in health related careers including: health research, health education, epidemiology, environmental health, information technology, biostatistics, public and global health and health policy development. The proposed structure of the NGP will provide students with disciplinary and technical expertise as well interdisciplinary knowledge and skills, which are required for a variety of health related careers and employment outcomes. Student's research activities and outputs will also contribute to the development of strategies that may prevent disease and injury, protect and promote healthy living and improve well-being across the life course.

Demand externally

US Bureau of Labour Statistics

The projected number of employees required in health related professions is expected to increase dramatically in the United States between 2008 and 2017. (http://www.bls.gov/opub/mlr/2015/article/industry-employment-and-output-projections-to-2024.htm)

"The aging population also will lead to increased demand for healthcare services, which is projected to result in strong employment growth in the healthcare and social assistance sector, as well as in occupations related to healthcare."

"The health care and social assistance sector is projected to have the largest growth, an increase of nearly 3.8 million jobs, and will reach almost 21.9 million jobs by 2024. The health care and social assistance sector is projected to grow at a 1.9-percent annual rate, which is more than 3 times faster than the overall annual growth of jobs in the entire economy."

Human Resources and Skills Development Canada

Similar trends are expected in Canada. A large excess demand (more job openings than job seekers) is projected in health sector occupations. Particularly for those with post-graduate training. (HRSDC Looking-Ahead: A 10-Year Outlook for the Canadian Labour Market [2008-2017])

"Higher health care needs due to population ageing will increase demand for several health care occupations. Over the medium term, additional pressures will come from retirements in the health occupations. The number of job openings resulting from retirements will surpass those from new job creation. Therefore, despite the increase in the supply of new workers, the strong labour demand in health occupations is expected to exceed markedly the expected supply over the projection period."

"Over the next ten years, approximately three-quarters (75.2%) of the 1.4 million new nonstudent jobs created are expected to be in occupations usually requiring postsecondary education (university or college) or in management. This proportion is higher than the ratio

recorded over the past 20 years – when 7 out of 10 jobs created were in high-skilled occupations. Job creation will continue to remain firm for high-skilled occupations, driven mainly by health-related occupations."

Demand at Canadian Universities and Carleton University

The demand for post-graduate health related specialisation and student interest is illustrated by the Association of Universities and Colleges of Canada (AUCC) listing of 134 graduate-level, health-related programs offered by Canadian Universities. These programs exist at both the MSc and PhD levels.

At Carleton, programs in health are of considerable interest to prospective students as demonstrated by the ~30% increase in applications to Biology resulting from the new Health Science undergraduate stream, and the over 30 applications to the graduate program in Neuroscience (despite no advance advertisement), both of which were introduced for the 2011/12 academic year. Since the introduction of the HSTP and BHSc programs we have consistently seen an increasing number of applicants applying to, and enrolling in, our programs (Table 14). As Carleton becomes increasingly recognised for our health programs this number will continue to grow. For the 2016/17, we received 593 applications to the BHSc program. We are expecting a >30% increase in total admitted students to the undergraduate program.

Table 14. Number of applications and admissions to the HSTP and BHSc programs

Program	2012/2013	2013/2014	2014/2015	2015/2016
Graduate Program				
HSTP MSc	20 (9)	72 (17)	73 (15)	64 (18)
HSTP Diploma (type 2)	1 (1)	4 (4)	1 (1)	1 (1)
HSTP Diploma (type 3)	1 (1)	10 (3)	2 (1)	1 (1)
Undergraduate Program				
BHSc	n/a	n/a	501 (66)	535 (66)

Total Applicants (total admitted)

Further, a number of students currently enrolled in the BHSc program and other undergraduate programs have expressed significant interest in pursuing a graduate degree in Health Sciences. As currently designed, there is a logical progression from the BHSc into these NGPs. However, the NGPs are not limited to health science students. We anticipate students from varied BSc and MSc backgrounds, including biomedical sciences, life sciences, psychological sciences, biostatistics and epidemiology, or related disciplines, will enrol in our programs.

PART L: Attachments

The following documents are attached to this Volume I brief:

Carleton University Library Report for Graduate Studies in Health Sciences

Letters of Support from the following units: Biochemistry, Biology, Chemistry, Mathematics and Statistics, Neuroscience, and Psychology.

Discussant's Report, MSc and PhD in Health Sciences

Richard Mann, June 19, 2016

Section A: The Program and the proposed new graduate programs

Carleton University currently offers an undergraduate Bachelor of Health Sciences (BHSc) degree that has five concentrations, a Masters (MSc) in Health: Science, Technology and Policy (HSTP) and two graduate diplomas in HSTP. They propose adding an MSc in Health Sciences and a PhD in Health Sciences. The proposed MSc (5.0 credit) and PhD (10.0 credits) will both be structured around a combination of coursework and thesis research. Both proposed programs are research-intensive and designed to build on the current strengths of the department as well as the additional building and faculty resources that the department will gain between 2017 and 2019.

The Department of Health Sciences was established as an interdisciplinary department and it will be housed in the new Health Sciences building by September 2017. It currently has seven core faculty members and anticipates growing to nine core faculty members by 2018/2019. The Self-Study does a good job of explaining the current programs, stressing the interdisciplinary focus of the program and its orientation "to provide undergraduate students with the skills required to succeed in the rapidly changing worlds of healthcare, health research, and health professional/allied health programs". This section of the Self-Study also carefully explains the unit's alignment with the Strategic Integrated Plan and the Strategic Research Plan. The self-study also explains the differences between the extant MSc in HSTP and the proposed MSc in Health Sciences: the MSc in Health Sciences has a stronger research component (thesis) and the MSc in HSTP is based more in coursework and a collaborative group research project. The goals of the MSc and PhD are presented as falling under three themes (interdisciplinarity, research, and communication). The proposed new graduate programs will be administered by the Department of Health Sciences, within the Faculty of Science. The structure of the proposed new programs is also documented in this section stressing the interdisciplinary nature of the proposed programs and hence the need for a mandatory common core course and a rigorous process of Graduate Advisory Committee meetings and evaluations twice a year along with the milestones and deliverables expected for the Graduate Advisory Committee meetings for each six month period of the PhD. The document also notes that students may also enroll in the Data Science specialization.

Comments:

I have little to say about this section of the document. It provides a clear understanding of the programs in the unit, its current and future role at Carleton, and the rationale behind the proposed new graduate programs and their structure are carefully explained.

Section B: Program Learning Outcomes and Assessment

Section B1 of the Self-Study on Table 3 lists the Learning Outcomes for the MSc and maps them to Degree Level Expectations and to the elements of the program that deliver the outcomes. Eight Learning Outcomes (LOs) are listed: 1) Understand and discuss (written and oral) health

issues and problems from multiple perspectives and disciplinary approaches, 2) design and conduct research relevant to health sciences to generate new knowledge and/or make original contributions to existing research projects/programs to enhance their relevance and/or scope, 3) Troubleshoot and/or enhance research methods and protocols to maximise the relevance, reliability, and impact of health-related research, 4) Employ statistical (e.g. biostatistics, bioinformatics, epidemiological, data science) approaches to design studies, collect data, synthesise and interpret research findings, 5) Critically analyse research outcomes and data merit, 6) Develop a solid understanding of research concepts and fundamental theories in their discipline. Identify research gaps and evaluate the quality and impact of health sciences research across disciplines. Interpret research findings (including from their own work) in the context of their discipline and within a broader health science framework, 7) Develop research protocols, summarise previous research activities with brevity and clarity, 8) Communicate (written and oral) scientific ideas, problems, methods and outcomes to the scientific community, relevant stakeholders, and the lay public. The LOs for the PhD are presented on table four (page 22). Many of the LOs for the PhD are basically the same as those of the MSc except the expectations for the degree of understanding and mastery of the subject matter are greater in the PhD. Only LO #8 is significantly different: Develop and implement knowledge translation strategies to engage and communicate (written and oral) scientific ideas, problems, methods and outcomes to the scientific community, relevant stakeholders, and the lay public. Develop grantsmanship skills to successfully devise, defend and evaluate new lines of research inquiry and/or new points of view to address a health sciences problem. The charts are then followed by section B.2.1, Articulation of the learning outcomes, which explains how the courses identified in the charts deliver the LO associated with them. Table five on page 25 then charts the courses in relation to the introduction, reinforcement and mastery of the eight LOs.

Comments:

Again, much of this section is very well done and clearly thought through. It is, however, worthwhile noting the central place the biannual committee meetings have in ensuring that the LOs are achieved. It should be noted that these meetings appear to be rigorous with students being required to give a 20 minute presentation to the committee and to submit a 10 page report. The achievement of LOs is also somewhat dependent on the thesis itself. In both cases, the use of committee meetings and the reliance on the thesis to deliver LOs seems appropriate in that it is not hard to see how lab work and critical feedback from a supervisory committee would lead to the mastery of some of the LOs, but that is less clear for LO 4 (Employ statistical approaches). In the case of a mastery of statistics one might think that a course in statistics would be a requirement of the program. It may well be the case that the intended meaning of the employment of statistical approaches has been misinterpreted by the discussant, but perhaps more clarity on how some of the specific skill sets like statistics and clarity of writing can be achieved without required courses specific to that skill set/LO being part of the MA and PhD. Generally, though, the LOs appear to have been well designed and the various charts and explanations cover most of the details well.

Section B.3 discusses the learning outcomes assessment plan. The Health Science Graduate Program Committee (composed of the Graduate Advisor and 2-3 faculty members) will develop a plan for the assessment of LOs. Over the first four years of the new graduate programs they

plan to develop a four-point rubric (does not meet, minimally meets, meets, exceeds) based on data they receive from a variety of sources (student self-evaluation surveys, assessment of student deliverables, committee evaluation reports, instructor questionnaires, faculty focus groups and instructor evaluations). Based on this data the Graduate Committee will write a report to the Chair, who, in consultation with faculty members, will use the outcomes to propose program changes if they are required.

Comments:

This section is clearly something the unit hopes to develop overtime once the program has begun. They may be encouraged to think over some of the data sets they hope to employ such as course evaluations, but they do seem to recognize the need for the continual assessment of LOs and there does appear to be a plan to achieve that end.

Section B.4 addresses program essential requirements. In this section the unit identifies three main requirements "essential for a student's success in completing the program". They are: 1) Disciplinary and Interdisciplinary Health Knowledge, 2) Scientific and Interdisciplinary Communication, and 3) Advanced Health Research. Each of these is expanded upon with bullet point notes as is there a note that these have been reviewed with the Paul Menton Centre.

Comments:

I am unclear on the need for this section, or the role it is designed to play in the self-study. Many of the 'program essential requirements' are similar to the LOs listed, but they are not identical and the role this section plays on the self-study is not clear. Perhaps the unit could be encouraged to delete this section or to simply explain what they hope to convey in it in a clearer manner.

Section C addresses Governance. Here the roles of the Departmental Chair, Graduate Advisor and Graduate Program Administrator are briefly discussed.

Comments: This section is fine.

Section D addresses the faculty. Here a series of charts indicate the faculty associated with the department either as housed in the unit or as cross-appointed faculty. The charts indicate the supervisory privileges of the faculty members, their home units, ranks and so on. Other charts provide information on the distribution of supervision, research grant funding, the distribution of teaching assignments and CIs used to teach certain courses.

Comments: This section also appears to be fine. Like most units there tends to be some faculty members supervising a higher proportion of students than others, but this seems common in most units on campus.

Section E addresses Program Admission and Enrolment. This section discusses the admission standards for students applying for the programs. This section also outlines a fast-track system for MSc students who are interested in the PhD. Table 11 (page 36) also provides data on projected enrolments over a five year span (2017-2021). Enrolment into the MSc is projected to average about 7-8 new students each year and the PhD about 3-4 new students each year. All of the projected student numbers are for domestic students.

Comments: There is little to report here. The admission standards are in line with most of the admission standards for Masters and PhD programs at Carleton and other institutions. The fast-track program is also modeled after existing fast-track programs at Carleton. While projected enrollments can be difficult to evaluate, Section K of the self-study provides considerable data on demand for Health Sciences programs in Canada and the projected enrolments appear to be justified.

Section F addresses Student Experience and Satisfaction. This section discusses the guidelines for student orientation, advising and mentoring. How new students will find their supervisor and how their Graduate Advisory Committee is formed is also covered here, and in other sections of the self-study. Student funding and potential career paths for graduates are also discussed in this section. Table 12 on page 38 presents these potential career paths in a chart format.

Comments: Again, there is little to discuss in relation to this section. Given the important role played by each student's Graduate Advisory Committee it is good to see that the program has a plan for establishing this committee in the first four weeks of the start of both proposed graduate programs.

Section G addresses Resources. This section notes that no new support or technical staff for the proposed new programs is required. The program notes rapid growth in their undergraduate enrollments that has resulted in the increased use of CIs in the program. The unit, however, has a commitment from their Dean to hire three new researched focused senior faculty members in 2016/2017 and two new instructor level positions in 2016. These hires will reduce the courses in the unit taught by CIs. The three new courses (HLTH 5901, HLTH 5902/6902, and HLTH 6903) have been designed so that most of the faculty members can teach them. This section also briefly discusses space and library resources.

Comments: It is not clear from the self-study if the unit has or had a problem with the number of CIs teaching in it, but some of the current graduate level courses are taught by some CIs which may not be ideal. With that said, the new hires as well as the nature of the proposed new courses will likely ensure that all of the graduate courses will be taught by fulltime faculty members. The space requirements of the proposed programs will be met by the new Health Sciences building currently under construction, and an agreement has been made between the library and the unit to acquire new library resources for the proposed programs.

Section H addresses the development of the self-study.

Part I lists the calendar language for the new programs.

Comments: No comments; these sections looks fine.

Part J lists the other Health Sciences programs in Canada. This section helps to justify an earlier statement in the self-study that while there are other graduate programs in the country that have courses related to the interdisciplinary nature of the proposed programs, the proposed programs at Carleton would be unique in the country.

Comments: No comments.

Park K addresses evidence for demand in Health Sciences in Canada and the US based on data from the US Bureau of Labour Statistics, Human Resources and Skills Development Canada, and increases in science disciplines related to Health Sciences since the launching of the extant Health Sciences programs.

Comments: This section seems well researched and helps to justify the new hires and projected enrollments found earlier in the self-study.

Ranking of External Reviewers

1. John O'Neil
2. Howard Hu
3. Shahin Shooshtari
4. Michael Hayes
5. Gilles Paradis

The program lists ten potential external reviewers. I have narrowed the list to five based on two criteria: administrative experience, and the potential external's fit in evaluating an interdisciplinary program.

R. Jane Rylett
Chair and Professor, Physiology and Pharmacology
University of Western

PH.D. University of Western Ontario
B.Sc. University of Western Ontario

"Research in my laboratory is in cellular and molecular neurobiology, focusing predominantly on presynaptic function of cholinergic neurons. We address fundamental questions aboutthe regulation of cholinergic neurons, and how neurochemical communication may be altered in aging and disease. Cholinergic neurons control diverse physiological processes including learning and memory, sleep and movement, and their degeneration early in Alzheimer disease is key to the loss of cognitive function and attentional processing or in neuromuscular disease results in a loss of motion and respiratory failure. We have also been actively involved in collaborative studies of changes in cholinergic neuron function in subjects with mild cognitive impairment and early Alzheimer disease, evaluation of effects of treatments using advanced imaging approaches and development of imaging approaches to improve diagnostic accuracy and track disease progression."

Michael Hayes
Professor
University of Victoria

PhD, McMaster Unviersity

I joined the faculty at the University of Victoria in July, 2010 as the inaugural Director of Health Education and Research. Prior to coming to UVic, I spent 22 years at Simon Fraser University in the Department of Geography and, in 2004, as a founding member of the Faculty of Health Sciences. I was co-founding editor of the journal Health and Place.

At UVic, I have appointments in the School of Public Health and Social Policy in the Faculty of Human and Social Development, in the Division of Medical Sciences, in addition to my appointment in the Department of Geography.

I was a non-governmental representative on the Federal- Provincial- Territorial Advisory Committee on Population Health (2001-2006) and a member of the Public Health Agency of Canada Expert Advisory Committee on Population Health Promotion (2006-2008).

Health Sciences
MSc and PhD
September 7th and 8th, 2016

Time	September 7th, 2016	Location
9:00 - 9:30	Dr. John Shepherd, Vice-Provost and Associate Vice-President (Academic)	421D Tory Building
9:45 - 10:15	Dr. Matthias Neufang, Dean of Graduate and Postdoctoral Affairs	512 Tory Building
10:30 – 11:00	Dr. Peter Ricketts, Provost and Associate Vice-President (Academic)	503 Tory Building
11:15 – 11:45	Dr. Malcolm Butler, Dean of Science	3215 Herzberg
12:00 – 2:00	Lunch Dr. Robert Burk Dr. Kristin Connor Dr. Edana Cassol Dr. Paul Villeneuve Dr. Renate Ysseldyk	Baker's Grill
2:00 – 4:00	Meeting with Dept Health Sciences Faculty Dr. Robert Burk Dr. Kristin Connor Dr. Edana Cassol Dr. Paul Villeneuve Dr. Renate Ysseldyk	506 Tory Building
4:00 – 4:30	Tour labs with Dr. Robert Burk & Kristin Connor	Chemistry Superlab Health Sci labs (HP, LSRB)
6:00	Dinner	TBD
Time	**September 8th, 2016**	**Location**
9:30 – 10:30	Meeting with undergraduate health sciences students	Health Sciences Boardroom
10:30 – 11:30	Meeting with graduate students from the Master's degree in Health Science, Technology and Policy (HSTP)	Health Sciences Boardroom
11:30 – 1:00	Lunch Dr. Robert Burk Dr. Kristin Connor Dr. Edana Cassol Dr. Renate Ysseldyk	Baker's Grill
1:00 – 2:00	External Reviewers Meeting to prepare report	506 Tory Building
2:00 – 2:30	Meeting with Dr. John Shepherd, Vice-Provost and Associate Vice-President (Academic)	421D Tory Building

Report from External Reviewers
September 7th, 2016

Visit Itinerary

Drs. Michael Hayes and Jane Rylett visited Carleton University on September 7 and 8, 2016 for the purpose of reviewing the proposed new MSc and PhD programs in Health Sciences. Meetings were held with several senior university officials including Dr. John Shepard [Vice-Provost and Associate Vice-President, Academic], Dr. Mathias Neufang [Dean of Graduate Studies and Postdoctoral Affairs], Dr. Peter Ricketts [Provost and Associate Vice-President, Academic] and Dr. Malcolm Butler [Dean of Science]. These meetings were followed by extensive discussion with members of the Department of Health Sciences, Drs. Robert Burk [Interim Chair], Kristin Connor, Edana Cassol, Paul Villeneuve and Renate Ysseldyk. Meetings were also held with small groups of undergraduate Health Sciences students currently in years 2 and 3 of the program, and graduate students in the MSc program in Health: Science, Technology and Policy [HSTP] and one PhD student in the Department of Biology who is supervised by a faculty member in the Department of Health Sciences. Of these MSc HSTP students, two had recently graduated from the program and two were entering the second year of the program. A tour of newly-renovated undergraduate chemistry laboratories and representative research laboratories for members of the Department of Health Sciences was included. A final meeting was held at the end of the second day of the visit with Dr. John Shepard to debrief and provide a preliminary verbal report of the findings and proposed content of the written report.

Findings and Recommendations

The review team was recruited to assess the merits of two new graduate programs (MSc and PhD in Health Sciences) proposed by the Department of Health Sciences against criteria outlined in Carleton's Institutional Quality Assurance Process. Reviewers were charged with the responsibility of commenting on both strengths and weaknesses of the proposal and offering a fair and frank assessment. In the spirit of this responsibility, we offer the following comments.

The Department of Health Sciences is a very recent addition to academic programming at Carleton, established in 2014. The Department has two existing/emerging academic programs (a MSc in Health: Science, Technology and Policy (HSTP) and a Bachelor of Health Sciences (BHSc)). The HSTP program is a two-year course-based Masters with a culminating group research project. The fifth cohort entered this program in September, 2016. The BHSc is entering its third year, so third year courses are being offered for the first time in 2016 and fourth year courses will be offered for the first time in 2017. A small compliment of junior faculty has been recruited over the past 4 years into the core of the program with appointments occurring in 2013 (1), 2014 (2), 2015 (1), and 2016 (1). Of these, the first 4 appointments are tenure-track research faculty while the most recent is a lecturer position. Five new positions are supposed to be filled over the next two years with the expectation that some of these would be more senior appointments, including a

Department Chair. To date, leadership has been provided by established faculty members with appointments in other units. Several adjunct faculty from across the university are also associated with the program, as are contract instructors – typically professionals working in areas aligned with the HSTP program. A new building, currently under construction, is scheduled to open in mid-2017 and will house the Department, the Neuroscience program and the animal care facility.

We have identified a number of strengths associated with the Department. The core faculty compliment is particularly impressive – most are emerging scholars who are very talented and in the process of establishing their careers. The one tenured faculty member has a very impressive record of publication and grant support and has ten years of experience working in the public service (Statistics Canada) in addition to having held academic appointments. As a group, they appear to work very well together in developing courses, program proposals, research collaborations and sharing administrative responsibilities. The Interim Chair is very approachable and supportive of his colleagues. Unfortunately, we did not have the opportunity to speak to Adjunct faculty members.

In speaking to both undergraduate and graduate students, we were impressed by the enthusiasm with which they spoke about their respective programs. The undergrads were particularly effusive in their comments about how great their instructors are, the feelings of genuine concern for their learning needs and career aspirations expressed by faculty, responsiveness to their needs, approachability of faculty and administrative staff, opportunities for hands-on research experience, the benefits of relatively small classes, the camaraderie that has developed within their two cohorts, and the intellectual power of discovery they are engaged in. Reference was also made to glitches they've experienced as the program has unfolded, but they were very understanding of the fact that the program is new and hiccups are to be expected. They gave a clear impression that the benefits of the new program more than compensate for the costs of being program pioneers.

The Grads we spoke with were also very enthusiastic about the HSTP program, citing opportunities for community/stakeholder engagement, opportunities to work together in groups on research projects, exposure to people engaged in real-world activities, such as policy processes, and opportunities for professional development and employment. They also identified some concerns about the program. While part of the program title, some felt that discussion of technology, role(s) of technology, opportunities to pursue interests in 'technology', etc. were not really present in the program – to paraphrase, the Technology part of the title seemed to be missing. Other concerns related to the choice-set of capstone projects (set by faculty without student input), IP ownership of projects, and timing associated with developing their research questions (would be better initiated in year 1 instead of year 2?).

Another strength of the Department is the level of support it receives from the senior administration and both the Dean of Science and the Dean of Graduate Studies. The new building is one obvious manifestation of this support, as are the five proposed new positions, the promise of guaranteed funding for both MSc and PhD students entering the proposed grad programs, and the enthusiasm with which the Department and it's programs

were spoken about. Carleton clearly sees the value and potential of greater involvement in health programming and research, as well as significant opportunities for greater integration/collaboration in related activity across campus and with the wider community.

Against this backdrop, the proposed new graduate programs seem very promising. Clearly, there is great new energy, excitement and commitment behind the proposal. We have found some relatively minor concerns with the specifics of the proposal, which we will address below. That said, we do have significant concerns about the timing of the proposal and the proposed implementation timeline.

In our view, the University is ill advised to take this proposal forward at the present time for the following reasons:

1. Recruitment of the Department Chair has not yet happened. While it is anticipated that this person will be appointed in the coming year, there is no guarantee that this appointment will be made in that time frame. It is our understanding that the candidate will be identified through an external search. The job ad is in preparation, but there is no indication of the depth of the applicant pool. Moreover, given the ambitious undertaking that is the new Department and the fact that some junior faculty are in place, it might be difficult to find the right person to lead the unit. Even if the right person is identified, there is no certainty that s/he will be able to take up the position within the next year as highly skilled and engaged researchers often have plans and commitments that extend several months into the future. Also, the recruit will need time to develop relationships with faculty colleagues and get to know the institution. We presume that the person recruited would like to participate in shaping the graduate program alongside colleagues and moving ahead with the proposal at this time would preclude such participation (and may contribute to difficulty with recruitment). This person will also play a key role in creating processes relating to the graduate program (chairing the application committee or at least guiding its structure; welcoming students and establishing the basis for school expectations; and various other process-related activities).

2. Other components of academic programs in the Department are still being developed – such as the third and fourth year courses in the BHSc program. Course development takes time and the existing faculty compliment is already stretched (more on this below). Adding the need to develop new grad courses will place even more demands on them. Moreover, based on feedback from the HTSP students, some adjustment to that Master's program may be required. These matters should take priority over adding new elements to the program offering.

3. While the faculty members that have been recruited are most impressive, all but one are untenured. The time line for tenure at Carleton (in the fourth year of appointment) places considerable pressure on these members to get their research programs established and to publish their work in advance of going up for review. This places tremendous pressure on them, in addition to the various other pressures already identified. There is concern that they might simply burn out or not be successful in their tenure cases due to the already substantial administrative and teaching burdens placed upon them. Additional pressures

arising from a new grad program could at least be postponed and alleviated by delaying the launch of the proposed programs.

4. The building is still under construction and the configuration of space has not, from our understanding, been settled. Given the interdisciplinary nature of the program, it is imperative, in our view, that dry and wet lab space be proximately located within the new building. Creating a culture of collaboration and understanding of the diversity of research pursuits, and opportunities for serendipitous meetings/conversations will be facilitated by co-location to a far greater extent by locating everyone's research activity in the same building. Sorting this out in the near term is another demand on faculty time.

5. In addition to the Chair position, two other positions are supposed to be filled in the coming year. Recruitment takes a considerable amount of time to be done carefully. Yet another time demand upon the existing faculty members.

Summary Statement

We are very concerned that our suggestion to delay implementing the two new grad programs might be interpreted that we have concerns about their quality, coherence and/or value. This is simply not the case. It is apparent that considerable effort has gone into thinking the proposal through, and we have clearly stated our views about the quality of existing faculty recruits. While we do have some concerns about aspects of the proposal – for example, specification of the standard for the PhD qualifying process (it is impossible to use the term 'comprehensive' in a meaningful way in the context of an interdisciplinary health program) which is currently identified as a 10 page report and we think this is not sufficient – these are relatively minor and easily addressed. Suggested points of clarification of the document are listed below. We do not understand the need to rush the graduate program this year. It is apparent that faculty members already have access to some grad students (we met a PhD student already working in the laboratory of one faculty member) and the undergrad program (a potential source of MSc students) will not even produce the first graduates for another two years. Presumably, there is a mechanism at Carleton to allow admission of a grad student if recruitment is desired in advance of formally establishing the grad program (special arrangements?).

Response to specific criteria for assessment

The Program

- Do the program's intellectual profile and learning outcomes serve the mission, and strategic and academic plans of Carleton University or Dominican University College? **YES**

- Do the program's intellectual profile and learning outcomes match the teaching and research strengths of the academic unit(s)? **YES. Five new faculty members will be**

recruited to unit over the next two years with the goal of expanding and strengthening expertise.

- Are the program's intellectual profile, curriculum and learning outcomes appropriate in relation to the current international, national, provincial profile of the discipline or interdisciplinary area? **YES**

- Are the program's intellectual profile and learning outcomes distinctive in relation to those of comparable programs in Ontario and nationally? **SOMEWHAT – difficult to say yes unconditionally as there are many academic programs in this space across the country. The specific configuration of faculty interests and proposed courses makes it unique to Carleton and this will develop further with the planned recruitment of new faculty members to unit**.

- Are the program's learning outcomes consistent with the Graduate Degree Level Expectations? **Mostly. The reviewers have raised some concerns above re: candidacy process for PhDs.**

- Are the methods for assessing program learning outcomes appropriate (please see also 3.8.8.7. below)? **YES, with the exception of PhD candidacy.**

- Does the program contain any unique curriculum, program innovations or creative components? **YES – see above narrative report.**

Program Content

- Is the program appropriately designed and structured to achieve the learning outcomes? **YES**

- In the case of graduate programs, will the program design and structure enable suitably qualified students to complete the program in a timely fashion; the program proposal will establish the time period within which completion will be normally be expected, together with a rationale for this time period? **YES, timelines clearly articulated in proposal.**

- In the case of graduate programs, is there a sufficient level of education and activity in research; is there sufficient provision for the development of research and analytic/interpretative skills? **YES, though see above re: role of humanities and qualitative research strategies.**

- In the case of graduate programs, is there evidence that a student in the program is required to take a minimum of two-thirds of the course requirements from among graduate level courses? **YES**

- Does the program have an appropriate mode or modes of delivery? **YES**

- Is there a clear indication of essential requirements? **YES**

Governance

- Does the program have an appropriate governance and administrative structure? **Not at this time. In particular, the Chair of the unit has yet to be recruited. See above narrative report.**

The Faculty

- Are there definitions and use of indicators that provide evidence of quality of the faculty (e.g. qualifications, research, innovations and scholarly record, appropriateness of collective faculty experience to contribute substantively to the proposed program)? **YES**

- Is there evidence of how supervisory loads will be distributed, and the qualifications and appointment status of faculty who will provide instruction and supervision? **YES. See narrative above.**

- Is there evidence of adequate mentoring programs for junior faculty? **No. See narrative above.**

Admission Requirements

- Are the admission requirements appropriate for the learning outcomes established for the completion of the program? **YES**

- Are the admission requirements such that a student entering the program can expect to complete it successfully and in a timely fashion; are requirements additional or alternative to the foundational requirements (for example, second language competence) appropriate; are all admission requirements (e.g., minimum graduate point average, language proficiency, previous degrees) sufficiently well explained? **YES**

The Students

- Is there evidence of clear communication between students, faculty and programs and university administration (e.g., handbook for students with program details, processes, important deadlines, etc.; a web site; listserv)? **YES in relation to initial processes and program timelines. Details including student handbook, program websites, etc are not developed at this point.**

- Are there sufficient mentoring programs and orientation days for graduate students? Based on student input, **NO. The program is not yet in place and orientation days have not been established. Based on interaction of faculty members in the**

HSTP MSc program, sufficient mentoring of students will be in place for the proposed programs

- In the case of graduate programs, is there evidence that financial assistance for students will be sufficient to ensure adequate quality and number of students? **YES**

- Is there evidence of program structure and faculty research that will ensure the intellectual quality of the student experience? **YES, though see above re: qualifying process for PhDs**.

- In the case of graduate programs, is there evidence that the program has addressed the Tri-Council's guidelines statement concerning graduate students' professional skills? **YES**

- Given the advising, mentoring and support provided by the program and the university more generally through its academic services, will students in the program have a satisfactory educational experience**? YES**

- Are the methods of student evaluation appropriate given admission requirements, degree level expectations, and learning outcomes; are there sufficient plans for documenting and demonstrating the level of performance of students consistent with the Graduate Degree Level Expectations and Undergraduate Degree Level Expectations? **YES, though see above re: qualifying process for PhDs.**

- Will the program prepare students adequately for their chosen career path following graduation with respect to careers for which the program could reasonably be expected to provide a preparation? **YES**

Resources

- Is the program adequately resourced, including a sufficient number of faculty with acceptable levels of teaching expertise and competence, and of continuing research and publishing activity? **See narrative above.**

- Does the program have sufficient support staff, sufficient space, and sufficient library, laboratory and technological resources? **See narrative above.**

Postdoctoral Fellows

- Is there an adequate account of the number and length of appointment of postdoctoral fellows who can contribute to the program and of the character of their contribution? **N/A**

CRITERION SPECIFIC TO NEW PROGRAMS

- Are the degree program's nomenclature and acronym appropriate (for example, Master's of Cognitive Science, M.Cog.Sci.)? **YES**

CRITERIA SPECIFIC TO EXISTING PROGRAMS

- Is there evidence of student input into undergraduate and graduate program improvement and development (e.g., exit surveys, student representation on committees, etc.)? **YES, though aspects of the processes are still under development prior to implementation of the programs.**

- Is there evidence of initiatives to be taken to enhance the quality of the program and the associated teaching and learning environment? **YES**

ADDITIONAL CRITERIA FOR GRADUATE PROGRAMS

In addition to the generic instructions for undergraduate and graduate programs, the attention of the review committee will be drawn to some matters specific to graduate programs.

General

- A graduate degree must ensure that the holder has achieved an appropriate level of intellectual development beyond that acquired during the undergraduate program. For those programs that also serve the purpose of professional or vocational training, it is essential that the intellectual and professional outcomes and content be more advanced than those of the undergraduate degree. **Clear evidence of this**.

Master's Programs

- Master's degrees and graduate diplomas must include a component whereby research and analytical/interpretive skills are developed. This component can take the form of a thesis, a major research paper or short research papers within the courses required for the degree, a comprehensive examination, or other specified activity appropriate for the discipline or interdisciplinary area and designed to test the acquisition of analytical/interpretive skills. It is incumbent on the program to demonstrate in the brief that the requirements are appropriate for the discipline or interdisciplinary area and how their outcomes are achieved**. Clear evidence of this.**

- The research-oriented master's program in an academic discipline offered to the graduate with an honours undergraduate degree in that discipline is the most traditional sequence. Research-oriented master's programs in interdisciplinary areas have recently become more common, allowing innovative opportunities for students from a range of honours undergraduate degree programs. Advanced courses and the challenge of doing intensive research, usually resulting in a thesis, research project, major research paper or cognate essay, are provided as a means of

developing the skills and intellectual curiosity required for doctoral studies and/or a leadership role in society. **Clear evidence of this.**

Doctoral Programs

- Independent original research and the preparation of a thesis are considered to be the essential core of doctoral studies. However, because thesis research is highly specialized, it is important that some mechanism be in place to ensure that breadth of knowledge and skills is acquired by doctoral students. This outcome can be achieved by course work, participation in colloquia, a comprehensive examination or other means. The brief needs to show clearly how breadth and research skills are achieved and evaluated[i]. **Clear evidence of this with noted concerns.**

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[i] The six paragraphs under section 3.9.2 have been taken from the previous OCGS bylaws and adapted slightly for the purposes of this IQAP.

Proposed Graduate Programs in Health Sciences

Response to the Report of the External Reviewers

Introduction

This response to the Report of the external reviewers of the proposed master's and doctoral programs in health sciences is submitted by the Dean of the Faculty of Science, and the Chair and faculty of the Department of Health Sciences.

We are grateful for the detailed and positive Report submitted by the external reviewers. They are clearly of the opinion that the faculty already hired into the Department of Health Sciences are of more than a suitable calibre to deliver the program, and that the program has been well designed. As they observe, 'While we do have some concerns about aspects of the proposal . . . these are relatively minor and easily addressed.' In this respect, it is pertinent that the external reviewers are concerned that their recommendation to delay implementation of the programs for one year to 2018 will be interpreted as a concern about the quality, coherence and value of the programs (please see below). Their principal concern – then – is not with the profile or ability of the faculty, or with the program itself. It is with the proposed date of implementation: September 2017.

This concern is a serious one. Because we have a different view of it than the external reviewers, this response focusses upon it exclusively. Our responses to the recommendations which are 'relatively minor and easily addressed' are evidenced in a revised self-study. To aid easy identification, changes to the self-study are entered in red type. We would, of course, be happy to answer questions or address any concerns that arise from these changes.

Advice received from Carleton's Office of the Vice-Provost is to be brief in this response on the positive aspects of the external reviewers' Report, and to concentrate on recommendations for improvement. Since these recommendations are 'relatively minor' and 'easily addressed,' and because of the seriousness of the external reviewers' principal concern we do, however, wish to stress the positive aspects of the Report as the context for seeing implementation of the programs in 2017 as being both appropriate and beneficial for the existing faculty as well as for the hiring of faculty in 2017.

The positive aspects of the programs are as follows:

THE PROGRAM

We are very concerned that our suggestion to delay implementing the two new grad programs might be interpreted that we have concerns about their quality, coherence and/or value. This is simply not the case. It is apparent that considerable effort has gone into thinking the proposal

through, and we have clearly stated our views about the quality. While we do have some concerns about aspects of the proposal . . . these are relatively minor and easily addressed.

THE FACULTY

The core faculty compliment is particularly impressive – most are emerging scholars who are very talented and in the process of establishing their careers. The one tenured faculty member has a very impressive record of publication and grant support and has ten years of experience working in the public service (Statistics Canada) in addition to having held academic appointments.

STUDENTS IN EXISTING HEALTH SCIENCES PROGRAMS

Undergraduates

The undergrads were particularly effusive in their comments about how great their instructors are, the feelings of genuine concern for their learning needs and career aspirations expressed by faculty, responsiveness to their needs, approachability of faculty and administrative staff, opportunities for hands-on research experience, the benefits of relatively small classes, the camaraderie that has developed within their two cohorts, and the intellectual power of discovery they are engaged in.

Graduates

The Grads we spoke with were also very enthusiastic about the HSTP program, citing opportunities for community/stakeholder engagement, opportunities to work together in groups on research projects, exposure to people engaged in real-world activities, such as policy processes, and opportunities for professional development and employment.

SUPPORT FROM THE UNIVERSITY

Another strength of the Department is the level of support it receives from the senior administration and both the Dean of Science and the Dean of Graduate Studies. The new building is one obvious manifestation of this support, as are the five proposed new positions, the promise of guaranteed funding for both MSc and PhD students entering the proposed grad programs, and the enthusiasm with which the Department and its programs were spoken about. Carleton clearly sees the value and potential of greater involvement in health programming and research, as well as significant opportunities for greater integration/collaboration in related activity across campus and with the wider community.

The external reviewers provide five reasons for their recommendation to delay implementation of the programs for one year. The most significant of these is the negative effect it could have on the existing faculty, in particular those who have yet to obtain tenure: 'The time line for tenure at Carleton (in the fourth year of appointment) places considerable pressure on these

members to get their research programs established and to publish their work in advance of going up for review.'

This is where we differ most fundamentally from the views of the external reviewers. In NSERC-eligible laboratory disciplines, of which health sciences is one, research is carried out in laboratories by teams of postdoctoral fellows and doctoral and master's students under the supervision of faculty members. The level of productivity and quality of this research as represented in publications depends crucially on the work and contribution of graduate students. Without access to graduate students, faculty have markedly more work to undertake, and this clearly delays the development of the faculty members' research careers and impedes other activities for which faculty are responsible. While in some disciplines other than those in science and engineering the presence of graduate students might add to faculty workload, there is no doubt that in disciplines such as health sciences their contribution to lab-based research will greatly improve faculty productivity. It is true, as the external reviewers observe, that one Health Sciences faculty member is supervising a doctoral student. However, this constitutes one exception to the current situation in which the existing faculty do not have access to graduate students. Delaying implementation of the programs for one year will not help the development of the existing faculty members' research careers. It will hinder it.

Over and above allaying this individual concern, we feel that the positives for implementing the programs in 2017 far outweigh any negatives. While we recognize that additional effort on our parts will be needed in order to launch and then run these new programs, these efforts are not onerous, are manageable, and will not diminish our ability in any way to carry on with the current undergraduate and graduate programs.

Our more detailed responses to the five concerns of the external reviewers appear below.

Concern #1. *Recruitment of the Department Chair has not yet happened. While it is anticipated that this person will be appointed in the coming year, there is no guarantee that this appointment will be made in that time frame. It is our understanding that the candidate will be identified through an external search. The job ad is in preparation, but there is no indication of the depth of the applicant pool. Moreover, given the ambitious undertaking that is the new Department and the fact that some junior faculty are in place, it might be difficult to find the right person to lead the unit. Even if the right person is identified, there is no certainty that s/he will be able to take up the position within the next year as highly skilled and engaged researchers often have plans and commitments that extend several months into the future. Also, the recruit will need time to develop relationships with faculty colleagues and get to know the institution. We presume that the person recruited would like to participate in shaping the graduate program alongside colleagues and moving ahead with the proposal at this time would preclude such participation (and may contribute to difficulty with recruitment). This person will also play a key role in creating processes relating to the graduate program (chairing the application committee or at least guiding its structure; welcoming students and establishing the basis for school expectations; and various other process-related activities).*

Response to Concern #1: The chair position in the department is key to its future success. In order to maintain the current momentum of the department, to continue with anticipated hirings, and to oversee the move into the new building, experienced leadership is essential. The intention is to hire a new chair as one of three new faculty members anticipated to begin July 1, 2017. These three positions have been advertised (the advertisement is attached). We have every reason to believe that this will be an attractive position for a senior faculty member interested in helping to build a vibrant department that offers unique programs, is very attractive to students, and will soon occupy brand new facilities. Indeed, the Dean of Science has already been approached informally by a number of potential applicants.

The actual program structure has been deemed by the reviewers to be fine, as long as some minor changes are made. Thus we see no reason to delay the onset of the program in order to allow a new chair to reshape what has already been accepted. In the future, if changes are required, these can take place according to well-established procedures for minor and major program modifications as set out in Carleton's IQAP.

The reviewers were also concerned that a new chair would be responsible for and therefore want to participate in creating processes relating to admissions and so on. These procedures at the graduate level are already in place for the HSTP program and are working well. Changes have, for instance, recently been made to the HSTP program requirements, effective September 2017. These have already been passed by Carleton's Graduate Faculty Board. If changes are needed in the future, the chair at that time can make these changes through the well-established procedures of the University.

If for some reason it proves difficult to hire a new chair by July 1, 2017, there is no reason to doubt the ability of the University to offer the new programs. First, the department has pulled itself up from nothing in a very short time and now boasts 22 graduate students in the HSTP program, 141 undergraduates (and growing quickly), six faculty members, including an interim chair, and two staff members. The addition of new graduate programs, which will likely admit only a handful of students in the first year of operation, will not represent a major change in faculty workloads, and it is important to recognize that at least three new faculty members will have been appointed by then who can contribute as well to the delivery of the graduate programs.

There are also two serious problems with not beginning the graduate programs in September 2017. **First, without such programs in place, it may prove very difficult to attract suitable faculty members this year, including the chair. As in most physical science programs, graduate students are essential for researchers to make any progress in their research programs.** Senior researchers will undoubtedly want to move their research program into a department that can provide access to new programs (as well as new facilities) for existing graduate students so as to avoid delays in productivity. **Second, the current researchers have no access to graduate students and their research programs are suffering as a result. Indeed, many are taking on research tasks that would normally be performed by graduate students.** Delaying the onset of these new graduate programs will have exactly the opposite effect of

what the reviewers feared; without a graduate program, the burdens on the existing (and anticipated) faculty members will increase significantly, not decrease.

Concern #2*. Other components of academic programs in the Department are still being developed – such as the third and fourth year courses in the BHSc program. Course development takes time and the existing faculty compliment is already stretched (more on this below). Adding the need to develop new grad courses will place even more demands on them. Moreover, based on feedback from the HTSP students, some adjustment to that Master's program may be required. These matters should take priority over adding new elements to the program offering.*

Response to Concern #2: Reshaping of the undergraduate program has already taken place. Some major changes in program structure and course offerings have already been approved by the Science Faculty Board. The same is true for the existing HSTP graduate program. These undergraduate and graduate (HSTP) changes are due to take effect in September of 2017. The work involved in making these changes has already taken place, and will not therefore place any new demands on faculty members going forward. As for the development of new graduate courses, the new programs include only three, two of which are seminar-based. With the addition of three new faculty members before the onset of these new graduate programs, the department will be easily able to offer these courses without an increase in workload to any faculty member.

The Department has also carefully considered the teaching loads of existing and anticipated faculty members. At the moment, the loads are normal for Science faculty members in lab-based programs (and have been slightly reduced in past years to compensate for work associated with implementing the new undergraduate program). As the first cohort of undergraduate students move into their fourth year in 2017-18, we will have to offer six new HLTH courses, but only on a rotating annual basis. Typically this will mean two or three more HLTH courses per year than we currently offer, a number easily accommodated by three new faculty members. We also have the benefit of access to a wealth of professionals in the National Capital Region who are interested in teaching as contract instructors. For these reasons, the teaching loads of current and anticipated faculty members will not be onerous.

Concern #3*. While the faculty members that have been recruited are most impressive, all but one are untenured. The time line for tenure at Carleton (in the fourth year of appointment) places considerable pressure on these members to get their research programs established and to publish their work in advance of going up for review. This places tremendous pressure on them, in addition to the various other pressures already identified. There is concern that they might simply burn out or not be successful in their tenure cases due to the already substantial administrative and teaching burdens placed upon them. Additional pressures arising from a new grad program could at least be postponed and alleviated by delaying the launch of the proposed programs.*

Response to Concern #3*.* The response to this concern has been anticipated in the Introduction above. There are salient points missed in the expression of this concern. First is the fact that the

researchers are currently very burdened by not having access to graduate students. In science programs such as those proposed, graduate students are essential to the gathering and interpretation of data. Researchers work collaboratively with their graduate students to solve problems that cannot be addressed by one researcher alone. The research and dissemination of the research require teamwork involving the faculty member, postdoctoral fellows, graduate and even undergraduate students. Graduate students are at the heart of such an operation. At present, researchers are forced to spend considerable extra time in the lab themselves gathering data instead of overseeing the work of a team of graduate students. **This alone is a major impediment to the researchers that can only be remedied by giving them access to graduate students, and that can only happen under the umbrella of the proposed new programs.** Second, the ability of researchers to attract funding into their research programs depends heavily on their historical success and future plans for the training of highly qualified personnel (HQP). Without a track record of having trained HQP, the chances of attracting future government sponsored funding are drastically diminished. Furthermore, tenure and promotion decisions are partly based on the researcher's success at attracting external research funding and training HQP. **Researchers in the Health Science program therefore need the new graduate programs to be in place as soon as possible in order to establish themselves as effective producers of HQP and to be successful in attracting grants and in obtaining tenure and promotion.**

Concern #4. *The building is still under construction and the configuration of space has not, from our understanding, been settled. Given the interdisciplinary nature of the program, it is imperative, in our view, that dry and wet lab space be proximately located within the new building. Creating a culture of collaboration and understanding of the diversity of research pursuits, and opportunities for serendipitous meetings/conversations will be facilitated by co-location to a far greater extent by locating everyone's research activity in the same building. Sorting this out in the near term is another demand on faculty time.*

Response to Concern #4*.* Any issues pertaining to configuration of space are currently being worked on, since these issues must be solved in the very near future, well before new faculty members or the new chair arrive. Delaying the introduction of new graduate programs will have no bearing on the workload of the current faculty members with respect to this issue. Furthermore, the configuration of space in the new building is a complex issue that involves the participation of several units on campus and is guided by the Office of the Dean of Science. The role of the current Health Sciences faculty members in this issue is small and is not in any way burdensome to them.

Concern #5*. In addition to the Chair position, two other positions are supposed to be filled in the coming year. Recruitment takes a considerable amount of time to be done carefully. Yet another time demand upon the existing faculty members.*

Response to Concern #5. We agree that recruitment takes time and needs to be done carefully. However, we have the resources at hand to hire these new people, and as with other issues identified above, delaying the onset of the graduate programs will not change the workloads of

the current faculty members. Indeed, the hiring process should be completed in spring 2017, well before the desired program launch date of September 1, 2017. However and whenever these hiring decisions are made, it will be the responsibility of the current faculty members to make them. Delaying the graduate program makes it less likely that we can make successful hires in the near future, with the result that the current faculty members would be involved in the hiring process for a longer period of time, further reducing their research output.

Conclusion

For all these reasons, it is our considered conclusion that the positives for implementing the programs in 2017 far outweigh any negatives. Both the Department of Health Science and its faculty are enthusiastic about moving forward expeditiously with implementation and are committed to the 2017 timeline. Any delay would serve to undermine an admirable level of motivation as well as the impressive momentum that has characterized the development of the Department thus far.

Discussant Report: Proposed Graduate Programs in Health Studies, External Review

Richard Mann

November 3, 2016

Summary:

The external reviewers' report for the proposed MSc and PhD in Health Sciences is mostly positive, but it contains one major recommendation: "In our view, the University is ill advised to take this proposal forward at the present time". They go onto provide five reasons for delaying the start of these programs. The unit was developed an extensive reply to the external report questioning the rationale for delaying the start of the programs in 2017. In doing so the unit presents meaningful critiques of the reviewers' reasons for delaying the start of these programs. The unit also proposes revising their self-study before it goes to the Appraisal Committee to address some of the concerns raised by the external examiners. It is my view that the unit has demonstrated some significant flaws in the reasoning provided by the external reviewers and that their recommended delay of the start of the program by one year will not only fail to address some of the reviewers' key reasons for delaying the program, but may weaken the ability of the unit to successfully launch these new graduate degrees. It is, then, my recommendation to the committee that we permit the unit to revise their self-study to address the concerns of the external reviewers and that we recommend that the external reviewers' recommendation to delay the start of the MSc and PhD by one year be rejected in light of the response provided by the unit. In what follows I will summarize the external reviewers' reasons for delaying the program and the unit's response. In my view, the unit has done exceptional work in demonstrating the weaknesses in the arguments presented by the external reviewers and these proposed graduate programs should proceed on their current schedule.

In what follows I will briefly summarize the reasons provided by the external reviewers to delay the start of the program and response of the unit with my own comments added to the narrative:

The First Reason: The Department Chair has yet to be recruited. The external reviewers are concerned that this hire may not happen in good time and even if it does happen quickly that the new hire will not have time to integrate into the program and will not have a role in shaping the new graduate programs, and structuring the admissions process.

The Unit's Response: First the unit notes that the job advertisements for the three new faculty members are already in circulation and it clearly states that one of these new hires (one of the senior positions) will become the chair of the department. The unit points out that if the new Chair does want to make changes to the program he or she may do so through Carleton's IQAP system; in other words that proposed structure of these programs is not set in stone and they can

be adjusted. In relation to the reviewers' comments about the desire of the Chair to help shape the admissions process, the unit notes that it already has an admissions process for the HSTP program and that it works well; there is not a need to invent a new process for the new degrees. The unit also indicates that even if a Chair is not found through the current job searches that this is not a reason to delay the launch of the new graduate programs. To justify this claim the unit notes that it pulled itself together as a department in a short period of time and launched the HSTP graduate and undergraduate programs on its own initiative. While the unit acknowledges the need for experienced leadership, they do demonstrate that the search for such leadership is currently underway and even if unsuccessful the unit has demonstrated the ability to organize itself with remarkable success. In short, I think that the unit has demonstrated that 1) the search for a departmental chair is underway, 2) that this chair can implement changes to the program through the existing structure at Carleton, and 3) that this unit has demonstrated a strong capacity to organize itself and shows the ability to continue to function well even if the search for a new chair is unsuccessful, though, there is no current indication that this search will not succeed. Finally, the unit stresses that their ability to hire full and associate professors through their current job call is dependent on the existence of the graduate program. The ability to attract established faculty members from other universities will depend on the existence of the proposed graduate programs which will ensure that the labs conducting the research for such new hires are staffed by graduate students with the specific training necessary to conduct research in this field.

The Second Reason: The reviewers note that other elements of the BHSc program, such as third and fourth year courses, have yet to be developed and that such course development will stretch the time of the existing faculty complement limiting their ability to produce their research. The development of new graduate courses will also add to the time pressures on the existing faculty.

The Unit's Response: Here the unit notes that some reshaping of the undergraduate and graduate (HSTP) programs has already been approved by Science faculty board and will be implemented in the fall of 2017. The program also notes that they have been very conscious of faculty teaching loads and with the new hires they see no issue in putting on the new courses required for these proposed programs. Again, while the concerns of the external reviewers seem valid, the unit has demonstrated that there is a plan in place to deal with the extra work involved in bringing about these new programs and the external reviewers appear to have ignored the impact of the three new hires for the program and its ability to offer new courses.

The Third Reason: Here the reviewers express concern for the workload placed on the mostly untenured faculty in the unit. They claim to be concerned "that they [the current faculty] might simply burn out or not be successful in their tenure cases due to the already substantial administrative and teaching burdens placed upon them". Simply put, the reviewers think that the current faculty will be so busy launching these new graduate programs that they will not publish enough to gain tenure.

The Unit's Response: A compelling argument the unit raises a number of times in their response is that a team of graduate students is needed in the program so that the current and incoming professors can conduct the research they need in their labs. External funding is also largely dependent upon producing HQP (highly qualified personnel) and this is clearly tied to graduate students. Hence, the unit persuasively argues throughout the response that the launch of these new graduate programs is not an impediment to hiring new faculty and for facilitating the success of current faculty, but actually an essential component of the grant application, research and tenure process for the current faculty. Indeed, they view their ability to successfully attract and hire senior scholars in this field to be dependent upon the existence of the new graduate programs and a delay in their start may result in a weakened pool of applicants. Here I would also note that if this concern for work load and tenure prospects had come directly from the current faculty members I would be more inclined to accept the externals reviewers' read of the situation, but there is no indication that this was a concern raised by the faculty currently in the program, and they make a convincing case that their success as scholars is best helped with the timely launch of these graduate programs.

The Fourth Reason: The building that will house the new program and its labs is still under construction and the allocation of space has yet to be determined. Given the interdisciplinary nature of the program they are concerned that if the "wet" and "dry" labs are not located near each other then there will not be "opportunities for serendipitous meetings/conversations". They are also concerned that sorting out these issues of space allocation will be another drain on faculty time.

The Unit's Response: Here the unit notes that these spacing issues are currently being worked on and are primarily an issue for the Office of the Dean of Science and the other units involved. In terms of the drain of the faculties' time they note that their role in this issue of space allocation is small and not burdensome. I would also add to this that this unit is currently pulled together from a variety of different units on campus and seems rather skilled at generating opportunities to meet and discuss their program and, presumably, their shared research interests. Once they are housed in the same building on campus I would imagine that such sharing of ideas will only be enhanced. Here I would also note that the construction of a new building to house this program does not strike me as a problem for a unit, but rather a sign of the university's significant investment in this program to make it a substantive graduate program in this field.

The Fifth Reason: Not only does the unit need to hire a Chair, but it also needs to hire two other positions. The reviewers note that it takes time and care to hire new faculty members and this will place another burden on current faculty members.

The Unit's Response: The unit agrees that it takes time and care to hire new faculty members, but the unit sees no issue with completing this process by the spring of 2017. Indeed, they note again, that the greatest impediment to hiring new senior faculty would be a delay in launching the new graduate programs because such a delay would also generate delays in the research

agendas of the prospective new hires. Here I would also note that I know of few faculty members who would begrudge the time needed to participate in the hiring of new faculty members in their unit. As with reason number four, it is difficult to see the logic of the external reviewers concerns that these new resources allocated to this program will create a burden on the existing faculty.

Conclusion: While I think it is an unusual measure to suggest that we reject the one major recommendation put forward by external reviewers, the unit has carefully demonstrated the flaws in the logic of the external reviewers and there appears to be no evidence that these concerns are based on issues that cannot be easily fixed, or, as the unit persuasively argues, the delay of the start of these graduate programs will not solve the issues the reviewers present, but rather generate more problems than they claim to resolve.

Carleton UNIVERSITY
Canada's Capital University

Office of the Vice-Provost and Associate Vice-President (Academic)

memorandum

DATE: November 10th, 2016

TO: Dr. Robert Burk, Interim Chair, Department of Health Sciences
Dr. Edana Cassol, Program Lead, Department of Health Sciences
Dr. Kristin Connor, Program Lead, Department of Health Sciences

FROM: Dr. John Shepherd, Vice-Provost and Associate Vice-President (Academic); Carleton University Committee on Quality Assurance

CC: Dr. Peter Ricketts, Provost and Vice-President (Academic)
Dr. Malcom Butler, Dean, Faculty of Science
Dr. Matthias Neufang, Dean, Faculty of Graduate and Postdoctoral Affairs
Dr. Adrian Chan, Associate Dean (Programs and Awards), Faculty of Graduate and Postdoctoral Affairs
Dr. André Loiselle, Assistant Vice-President (Academic)
Dr. Andrea Thompson, Program Assessment Coordinator, Office of the Vice-Provost and Associate Vice- President (Academic)
Christina Noja, Interim Manager, Office of the Vice-Provost and Associate Vice-President (Academic)
Dr. Robyn Green, Program Officer, Office of the Vice-Provost and Associate Vice President (Academic)
Leslie MacDonald-Hicks, Program Officer, Faculty of Graduate and Postdoctoral Affairs

RE: **Proposed MSc and PhD Programs in Health Sciences – Response to the External Reviewers' Report**

At its meeting of November 9th, 2016, the Carleton University Committee on Quality Assurance (CUCQA) discussed your Response to the External Reviewers' Report on the proposed MSc and PhD programs in Health Sciences. The Committee was impressed with the thoroughness of the Response, especially in terms of the detailed answer addressing the Reviewers' main recommendation to postpone the launch of the programs until 2018-19. As a result, CUCQA unanimously approved the programs to commence in September 2017.

However, the committee also expressed considerable concern about possible negative effects on the quality of the student experience in the existing undergraduate program, the

HSTP program and the proposed graduate programs given this ambitious timeline. While the External Reviewers' Report did not raise this issue, and the program did present convincing counterarguments to the Reviewers' concerns, CUCQA believes that it would be prudent to address the issue of student experience prior to submission of the brief to Senate Academic Program Committee (which meets on November 17th), and Senate.

The Committee thus advises the program to provide an addendum to their Response demonstrating that, with the three new hires, there will be no reduction in the quality of education for students in any of the four health sciences programs. A mapping in tabular form of how teaching duties will be allocated to the seven faculty members for the 2017-18 academic year would help support this argument.

Finally, a related concern expressed by CUCQA is the possibility that one or more of the three searches might not be successful. The Committee thus suggests that the addendum to the Response also include a discussion of the contingency plan that could be put in place to ensure the quality of education with less than the ideal faculty complement. This should address, for instance, the availability of sufficient qualified contract instructors to deliver the programs.

My office would appreciate receiving the addendum to the Response by November 14th, 2016.

Please do not hesitate to contact me should you have any questions or concerns.

MEMORANDUM

Date: November 13, 2016

To: Dr. John Shepherd, Vice-Provost and Associate Vice President (Academic)

From: Dr. Robert Burk, Interim Chair of Health Sciences

Re: Proposed MSc and PhD Programs in Health Sciences – Addendum to the Response to the External Reviewers' Report

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Some clarification is needed with respect to the expected student experience in the existing undergraduate BHSc and graduate HSTP programs, as well as in the proposed M.Sc. and Ph.D. programs, should the new programs be approved. It is our belief that the student experience in the existing programs will continue to be excellent, and those in the new programs will be as well. This statement is made on an analysis of the current and planned activities in the Department of Health Sciences, taking into consideration the need for:

- providing the undergraduate students with excellent instruction in their courses by using a mix of existing faculty members and expert contract instructors.
- allowing faculty members time to perform research and other scholarly activities.
- ensuring that graduate students, which are so vital to scientific research, are available to the faculty members.

Data From The Current Year

The data in Table 1 show the distribution of teaching assignments for HLTH courses among faculty members in the department, outside the department, and contract instructors for the current academic year. Details of the courses offered this year are presented in Appendix 1.

Table 1. HLTH Courses Taught in 2016-17

Courses Taught in 2016-2017	By HTLH Faculty	By Other Faculty	By Contract Instructors	Total	% By Contract Instructors
Undergraduate	13	1	5	19	26
Graduate	3	0	0	3	0
Total	16	1	5	22	23

Note: The number of graduate level courses does not include those that are piggybacked with undergraduate courses (so as to avoid double counting).

We thus currently employ contract instructors to teach 23% of our courses, all at the undergraduate level. The real-world experience these instructors bring to the classrooms is invaluable and typically cannot be matched by full time faculty members. Whenever we advertise for a contract instructor in any one course, we receive multiple high-quality applicants. We therefore are confident that any increased need for contract instructors will be met by an increased number of applications, and that the quality of teaching will remain very high. Appendix 3 lists the qualifications of the contract instructors employed in the current or recent academic years, for instance. Appendix 4 lists the qualifications of recent applicant for upcoming contract instructor positions, and again demonstrates the quality of the applicants (e.g. MD, Ph.D.'s in various related disciplines, etc.).

The Teaching Plan for 2017-18

In the 2017/18 academic year (Table 2), we will need to offer nine new undergraduate courses and one net new graduate course. Details of the teaching plan are presented in Appendix 2. Note that two piggybacked courses are offered at the undergraduate level and, with extra requirements, at the graduate level. The number of courses and consequently the number of required instructors is therefore smaller (by two) than what it appears to be in Appendix 1. The plan is that the four existing faculty members will each teach three courses, as well as share HLTH 5502 and 5503 (the research project components of the proposed programs), the instructor will teach four, and the three new faculty members will collectively teach four courses (to afford them some teaching relief in their first year), for a total of 22. One course will be taught by a faculty member outside of the Health Sciences Department. This leaves a total of eight courses that will need to be taught by contract instuctors, i.e. three more than the current number.

Table 2. HLTH Courses to be Taught in 2017-18

Courses to be Taught in 2017-2018	By HTLH Faculty	By Other Faculty	By Contract Instructors	Total	% By Contract Instructors
Undergraduate	14	1	8	23	35
Graduate	8	0	0	8	0
Total	22	1	8	31	26

Note: The number of graduate level courses in the table above (8) does not include those that are piggybacked with undergraduate courses. In other words, such piggybacked courses are counted only once. The number of piggybacked courses is thus 2 out of 10 i.e. 20% of graduate courses.

Contingency Plan

In the unlikely event that one or more of the planned three new hires does not happen, the likely result is that we will hire more contract instructors, but only for the 2017-18 academic year. The teaching loads of new faculty members will also be increased to the norm (three courses each per year) by 2018/19.

Summary

We are certain that the student experience, both undergraduate and graduate, will not suffer at all from beginning the proposed new graduate programs in 2017-18 because:

- We have a plan for teaching all required courses in the undergraduate, M.Sc. HSTP, and proposed new graduate programs using a mix of existing faculty, expected new faculty and contract instructors.
- Experienced, professional contract instructors are readily available in the Ottawa area for all courses that need one.
- The number of contract instructors will decrease rapidly after 2017 as new faculty members assume more teaching responsibility, and as more faculty members are hired.
- Having the new graduate programs in place will allow faculty members to rely on their graduate students to do the lab work, as is the norm in science, rather than having to spend time themselves in the lab.

Appendix 1. Courses offered in 2016/17
(all are one-term 0.5 credit courses except HLTH 5400 which runs over two terms)

Course Number	Term	Name	Type of Instructor
HLTH 1000	Fall	Fundamentals of Health	Faculty
HLTH 2001	Fall	Health Research Methods and Skills	Faculty
HLTH 2004	Fall	Microbiology and Virology	CI
HLTH 3101	Fall	Global Health	Faculty
HLTH 3104	Fall	Regulatory Issues and Human Health	CI
HLTH 3901	Fall	Emerging Issues in Biomedical Sciences	Faculty
HLTH 4401	Fall	Maternal and Prenatal Determinants of Health	Faculty
HLTH 5100	Fall	Fundamentals of Research Methods	Faculty
HLTH 5201	Fall	Fundamentals of Policy I: Policy Analysis	CI
HLTH 5400	Fall	Interdisciplinary problems in Health	Faculty
HLTH 1001	Winter	Principles of Health	Faculty
HLTH 2003	Winter	Social Determinants of Health	Faculty
HLTH 3201	Winter	Epidemiology	Faculty
HLTH 3302	Winter	Immunity and Immune-Related Disorders	Faculty
HLTH 3402	Winter	Diseases of Aging	CI
HLTH 3501	Winter	Diseases and Disabilities Related to Sensory Processes and Movement	CI
HLTH 3502	Winter	Trauma Related Illness and Disability	Faculty
HLTH 4201	Winter	Advanced and Quantitative Epidemiology	Faculty
HLTH 4701	Winter	Knowledge Translation	Faculty (non-HLTH)
HLTH 5400	Winter	Interdisciplinary problems in Health	Faculty
HLTH 5501	Winter	Group Research Project	Shared by all faculty
HLTH 5700	Winter	Principles of Epidemiology	Faculty

Appendix 2. Courses to be Offered in 2017/18

Course Number	Term	Name	Type of Instructor	Notes
HLTH 1000	Fall	Fundamentals of Health	Faculty	
HLTH 2001	Fall	Health Research Methods and Skills	Faculty	
HLTH 2004	Fall	Microbiology and Virology	CI	
HLTH 3101	Fall	Global Health	Faculty	
HLTH 3104	Fall	Regulatory Issues and Human Health	CI	
HLTH 3404	Fall	Psychosocial and Biological Interactions in Health	Faculty	New Course
HLTH 3503	Fall	Chronic Illness and Disability	Faculty	New Course
HLTH 3901	Fall	Emerging Issues in Biomedical Sciences	Faculty	
HLTH 3904	Fall	Emerging Issues in Health Throughout the Lifespan		New Course
HLTH 4101	Fall	Global Health and Governance	New Faculty Member in Global Health	New Course
HLTH 4401	Fall	Maternal and Prenatal Determinants of Health	Faculty	
HLTH 5100	Fall	Fundamentals of Research Methods	Faculty	
HLTH 5201	Fall	Fundamentals of Policy I: Policy Analysis	CI	
HLTH 5401	Fall	Interdisciplinary problems in Health	Faculty	
HLTH 1001	Winter	Principles of Health	Faculty	
HLTH 2003	Winter	Social Determinants of Health	Faculty	
HLTH 2002	Winter	Molecular and Cell Pathology	CI	New Course
HLTH 3102	Winter	Indigenous Health in a Global World	CI	New Course
HLTH 3201	Winter	Epidemiology	Faculty	
HLTH 3302	Winter	Immunity and Immune-Related Disorders	Faculty	
HLTH 3401	Winter	Diseases of Childhood	CI	New Course
HLTH 4102	Winter	New Health Technologies	CI	New Course, piggybacked with HLTH 5350
HLTH 4201	Winter	Advanced and Quantitative Epidemiology	New Faculty Member in Big Data	
HLTH 4301	Winter	Pandemics and Infectious Diseases	New Faculty Member in Lifespan	New Course
HLTH 4503	Winter	Trauma-Related Illness and Disability	CI	
HLTH 4701	Winter	Knowledge Translation	Faculty (non-HLTH)	Piggybacked with HLTH 5300
HLTH 5100	Fall	Fundamentals of Research Methods	Faculty	

HLTH 5150	Winter	Statistics for Health Sciences	Faculty	
HLTH 5300	Winter	Knowledge Translation	Faculty (non-HLTH)	Piggybacked with HLTH 4701
HLTH 5350	Winter	New Health Technologies	CI	Piggybacked with HLTH 4102
HLTH 5502	All terms	Interdisciplinary Health Research Project - Group	Shared by all Faculty	
HLTH 5503	All terms	Interdisciplinary Health Research Project - Individual	Shared by all Faculty	
HLTH 5151	Winter	Principles of Epidemiology	Faculty	

Notes:

(1) The fourth year capstone courses are not included in this list – administration of these courses is part of the teaching duties of the instructor, and is accounted for in this person's teaching load (which is four courses plus administration of the capstones).

(2) The number of graduate level courses does not include those that are piggybacked with undergraduate courses. In other words, such piggybacked courses are counted only once.

(3) The number of piggybacked courses is thus 2 out of 9 i.e. 22% of graduate courses.

Appendix 3. Qualifications of Current and Previous Contract Instructors

Course Number	Course Name	Contract Instructor	Qualifications
HLTH 3104	Regulatory Issues and human	Michelle Boudreau	President of the Fisheries Council of Canada, former Executive Director of the Patented Medicines Prices Review Board
HLTH 5700	Statistics for Health Sciences	Thomas Sherratt	Full Professor of Biology at Carleton University
HLTH 5704	Change Management for Health systems	David Clements	Master of Public Administration from Queen's University
HLTH 5300	Knowledge Mobilization	Elizabeth Dyke	Ph.D. in Population Health from UPEI, former sessional lecturer at University of Ottawa
HLTH 5201	Fundamentals of Policy I: Policy Analysis	Krystal Kehoe-MacLeod	Ph.D. in Public Policy from Carleton University

Appendix 4. Qualifications of Recent Applicants for Forthcoming Contract Instructor Positions

Course Number	Course Name	Contract Instructor Applicant Qualifications
HLTH 3402	Diseases of Aging	Ph.D. in Biochemistry Ph.D. in Pharmacology Ph.D. in Cellular and Molecular Medicine
HLTH 3101	Global Health	Ph.D. in Public Health, CIHR Global Health Fellow
HLTH 3501	Diseases and Disabilities Related to Sensory Processes and movement	M.D.
HLTH 3502	Trauma Related Illness and Disability	PDF in Prevention Science, National Institute on Alcohol Abuse and Alcoholism. M.D.

New Program Proposal

Date Submitted: 11/11/16 9:29 am

Viewing: TBD-1520 : MSc in Health Sciences

Last edit: 11/17/16 3:08 pm

Last modified by: sandrabauer

Changes proposed by: lesliemacdonaldhicks

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. **SCCASP**
9. **SAPC**
10. Senate
11. CalEditor

Approval Path

1. 11/11/16 9:46 am Claire MacArthur (clairemacarthur): Approved for HLTH ChairDir GR
2. 11/11/16 10:06 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/11/16 2:54 pm Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/14/16 9:16 am Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 11:30 am Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/17/16 2:56 pm Christina Noja (christinanoja): Approved for CUCQA
7. 11/17/16 3:08 pm Sandra Bauer (sandrabauer): Approved for PRE SCCASP

Effective Date	2017-18
Workflow	majormod
Program Code	TBD-1520
Level	Graduate
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Degree	Master of Science
Title	MSc in Health Sciences

8. 11/17/16 4:03 pm
   Dan Begin (danbegin):
   Approved for SCCASP

Program Requirements

Academic Requirements

All candidates are required to obtain a grade of B or higher in each course in the program.

Admission Requirements

The normal requirement for admission into the Ph.D. program is an M.Sc. degree in a relevant field. Students who are in the Health Sciences M.Sc. program may be admitted to the Ph.D. program if they show outstanding academic performance and demonstrate significant promise for advanced research, upon recommendation of the student's Graduate Advisory Committee and approval by the Graduate Advisor.

Program Requirements

M.Sc. in Health Sciences (5.0 credits)

1. 1.0 credit in:		**1.0**
HLTH 5901 [0.0]	**Advanced Topics in Interdisciplinary Health Sciences**	
HLTH 5902 [0.0]	**Seminars in Interdisciplinary Health Sciences for MSc**	
2. Completion of:		**0.0**
HLTH 5905 [0.0]	**Final research seminar presentation for MSc**	
3. 4.0 credits in:		**4.0**
HLTH 5909 [0.0]	**MSc Thesis**	
Total Credits		5.0

Note: the final research seminar presentation must be completed within one month of the thesis defence.

New Resources Faculty

Summary	New MSc. in Health Sciences
Rationale	New resources: As presented in the Business Plan and Volume 1 of the MSc. and Ph.D. in Health Sciences
Transition/Implementation	New program

Program reviewer comments

Key: 1520

New Program Proposal

Date Submitted: 11/11/16 9:29 am

Viewing: **TBD-1521 : PhD Health Sciences**

Last edit: 11/17/16 3:31 pm

Last modified by: sandrabauer

Changes proposed by: lesliemacdonaldhicks

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. **SCCASP**
9. **SAPC**
10. **Senate**
11. CalEditor

Approval Path

1. 11/11/16 9:46 am Claire MacArthur (clairemacarthur): Approved for HLTH ChairDir GR
2. 11/11/16 10:07 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/11/16 2:53 pm Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/14/16 9:16 am Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 11:30 am Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/17/16 2:57 pm Christina Noja (christinanoja): Approved for CUCQA
7. 11/17/16 3:31 pm Sandra Bauer (sandrabauer): Approved for PRE SCCASP

Effective Date	2017-18
Workflow	majormod
Program Code	TBD-1521
Level	Graduate
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Degree	Doctor of Philosophy
Title	PhD Health Sciences

8. 11/17/16 4:02 pm Dan Begin (danbegin): Approved for SCCASP
9. 11/18/16 12:26 pm Christina Noja (christinanoja): Approved for SAPC

Program Requirements

Academic Requirements

All candidates are required to obtain a grade of B or higher in each course in the program.

Admission Requirements

The normal requirement for admission into the PhD program is an MSc degree in a relevant field.

Students who are in the Health Sciences MSc program may be admitted to the PhD program if they show outstanding academic performance and demonstrate significant promise for advanced research, upon recommendation of the student's Graduate Advisory Committee and approval by the Graduate Advisor.

Program Requirements

1. 1.5 credits in:		**1.5**
HLTH 5901 [0.0]	**Advanced Topics in Interdisciplinary Health Sciences**	
HLTH 6902 [0.0]	**Seminars in Interdisciplinary Health Sciences**	
HLTH 6903 [0.0]	**Grant Proposals and Ethics**	
2. Completion of:		**0.0**
HLTH 6904 [0.0]	**Mid-program research defence and knowledge examination for PhD**	
HLTH 6905 [0.0]	**Final research seminar presentation for PhD**	
3. 8.5 credits in:		**8.5**
HLTH 6909 [0.0]	**PhD Thesis**	
4. Twice-yearly meetings with thesis Graduate Advisory Committee, with students reaching a level of satisfaction as determined by the Committee		
Total Credits		10.0

Note: If the student fails to satisfy the requirements of HLTH 6904, he/she will be withdrawn from the program. The final research seminar presentation must be completed within one month of the thesis defence.

New Resources	Faculty
Summary	New PhD in Health Sciences
Rationale	New Resources: As presented in the Business Plan and Volume 1 MSc and PhD in Health Sciences
Transition/Implementation	New program
Program reviewer comments	

Key: 1521

New Program Proposal

Date Submitted: 11/11/16 9:30 am

Viewing: TBD-1523 : MSc in Health Sciences with Specialization in Data Science

Last edit: 11/11/16 9:30 am

Last modified by: lesliemacdonaldhicks

Changes proposed by: lesliemacdonaldhicks

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. SCCASP
9. SAPC
10. Senate
11. CalEditor

Approval Path

1. 11/11/16 9:46 am Claire MacArthur (clairemacarthur): Approved for HLTH ChairDir GR
2. 11/11/16 10:06 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/11/16 2:54 pm Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/14/16 9:16 am Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 11:30 am Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/17/16 2:56 pm Christina Noja (christinanoja): Approved for CUCQA

Effective Date	2017-18

Workflow	majormod
Program Code	TBD-1523
Level	Graduate
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Degree	Master of Science
Title	MSc in Health Sciences with Specialization in Data Science

Program Requirements

Admission Requirements

1. 1.0 credits in:		**1.0**
HLTH 5901 [0.0]	**Advanced Topics in Interdisciplinary Health Sciences**	
HLTH 5902 [0.0]	**Seminars in Interdisciplinary Health Sciences for MSc**	
2. 0.5 credits in:		**0.5**
DATA 5000 [0.5]	**Data Science Seminar**	
3. Completion of:		
HLTH 5905 [0.0]	**Final research seminar presentation for MSc**	
4. 4.0 credits in:		**4.0**
HLTH 5909 [0.0]	**MSc Thesis**	
5. Twice-yearly meetings with the thesis Graduate Adcisory Committee, with students reaching a level of satisfaction as determined by the Committee		
Total Credits		5.5

Note: The final research seminar presentation must be completed within one month of the thesis defence.

New Resources	Faculty
Summary	New MSc in Health Sciences with specialization in Data Science
Rationale	New Resources: As presented in Business Plan and Volume 1 MSc and PhD in Health Sciences.
Transition/Implementation	New program
Program reviewer comments	

Key: 1523

New Course Proposal

Date Submitted: 11/11/16 1:22 pm

Viewing: HLTH 5901 : Advanced Topics in Interdisciplinary Health Sciences

Last edit: 11/11/16 1:22 pm

Changes proposed by: anshulsingh

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. PRE SCCASP
8. SCCASP
9. SAPC
10. Senate
11. Banner

Approval Path

1. 11/11/16 1:24 pm Anshul Singh (anshulsingh): Approved for HLTH ChairDir GR
2. 11/17/16 11:43 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/17/16 11:46 am Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/17/16 3:36 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 3:46 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard

Programs referencing this course	MSc in Health Sciences PhD in Health Sciences MSc in Health Sciences with Specialization in Data Science
Effective Date	2017-18 majormod

Workflow	
New Resources	Faculty
Level	Graduate
Course Code	HLTH
Course Number	5901
Title	Advanced Topics in Interdisciplinary Health Sciences
Title (short)	Advanc Topics Interdiscip HLTH
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Credit Value	0.50
Course Description	Discussion of current health problems and exploration of innovative interdisciplinary solutions. Development of skills required to perform critical analyses of health research to evaluate the quality, interpret the findings, and assess the impact of health sciences literature across disciplines.
Prerequisite(s)	
Class Format	Seminar/lecture
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Standard Letter Grade
Schedule Type	Lecture Seminar
Summary	New course in Health Sciences MSc. and Ph.D. program.
Rationale for new course	As reported in Business Plan and Volume 1 Self-Study
Course reviewer comments	**sandrabauer (11/11/16 10:35 am):** Rollback: change workflow to major **anshulsingh (11/11/16 11:33 am):** Rollback: Re-setting the workflow to include Dean approval steps. No action required. **anshulsingh (11/11/16 1:20 pm):** Rollback: Setting the workflow to include Faculty & Grad Dean approval steps. No action required. Re-Approving for HLTH ChairDir level.

Key: 9157

New Course Proposal

Date Submitted: 11/11/16 1:23 pm

Viewing: HLTH 5902 : Seminars in Interdisciplinary Health Sciences for MSc

Last edit: 11/11/16 1:23 pm

Changes proposed by: anshulsingh

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. SCCASP
9. SAPC
10. Senate
11. Banner

Approval Path

1. 11/11/16 1:25 pm Anshul Singh (anshulsingh): Approved for HLTH ChairDir GR
2. 11/17/16 11:43 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/17/16 11:46 am Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/17/16 3:39 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 3:46 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/18/16 12:33 pm Christina Noja (christinanoja): Approved for CUCQA

Programs referencing this course	MSc in Health Sciences MSc in Health Sciences with Specialization in Data Science

Effective Date	2017-18
Workflow	majormod
New Resources	Faculty
Level	Graduate
Course Code	HLTH
Course Number	5902
Title	Seminars in Interdisciplinary Health Sciences for MSc
Title (short)	Interdisciplinary Hlth Sci
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Credit Value	0.50
Course Description	Seminar course in interdisciplinary health research. Development of scientific communication skills through attendance at interdisciplinary seminars and by the student presenting a seminar on their own thesis research. Topics have specific or broad relevance to health sciences.
Prerequisite(s)	
Class Format	Seminar
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Satisfactory/Unsatisfactory
Schedule Type	Seminar
Summary	New course for MSc. and Ph.D. Health Science program
Rationale for new course	New resources: As reported in Business Plan and Volume 1 Self-Study
Course reviewer comments	**lesliemacdonaldhicks (11/11/16 10:15 am):** Rollback: Possible CourseLeaf glitch **anshulsingh (11/11/16 11:33 am):** Rollback: Re-setting the workflow to include Dean approval steps. No action required.

anshulsingh (11/11/16 1:20 pm): Rollback: Setting the workflow to include Faculty & Grad Dean approval steps. No action required. Re-Approving for HLTH ChairDir level.

Key: 9158

New Course Proposal

Date Submitted: 11/11/16 1:23 pm

Viewing: HLTH 5905 : Final research seminar presentation for MSc

Last edit: 11/11/16 1:23 pm

Changes proposed by: anshulsingh

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. SCCASP
9. SAPC
10. Senate
11. Banner

Approval Path

1. 11/11/16 1:25 pm Anshul Singh (anshulsingh): Approved for HLTH ChairDir GR
2. 11/17/16 11:43 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/17/16 11:46 am Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/17/16 3:39 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 3:46 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/18/16 12:34 pm Christina Noja (christinanoja): Approved for CUCQA

Programs referencing this course	MSc in Health Sciences MSc in Health Sciences with Specialization in Data Science

Effective Date	2017-18
Workflow	majormod
New Resources	Faculty
Level	Graduate
Course Code	HLTH
Course Number	5905
Title	Final research seminar presentation for MSc
Title (short)	Research Seminar Presentation
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Credit Value	0.0
Course Description	Final seminar of MSc thesis research. Seminar presentation should occur within one month of the final oral thesis defence.
Prerequisite(s)	
Class Format	Preparation for thesis
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Thesis/Dissertation
Schedule Type	Other
Summary	New course for MSc. and Ph.D. Health Sciences program
Rationale for new course	As reported in Business Plan and Volume 1 Self-Study
Course reviewer comments	**lesliemacdonaldhicks (11/11/16 10:15 am):** Rollback: Possible CourseLeaf glitch **anshulsingh (11/11/16 11:33 am):** Rollback: Re-setting the workflow to include Dean approval steps. No action required. **anshulsingh (11/11/16 1:20 pm):** Rollback: Setting the workflow to include Faculty & Grad Dean approval steps. No action required. Re-Approving for HLTH ChairDir level.

Key: 9159

New Course Proposal

Date Submitted: 11/11/16 1:23 pm

Viewing: HLTH 5909 : MSc Thesis

Last edit: 11/11/16 1:23 pm

Changes proposed by: anshulsingh

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. SCCASP
9. SAPC
10. Senate
11. Banner

Approval Path

1. 11/11/16 1:25 pm Anshul Singh (anshulsingh): Approved for HLTH ChairDir GR
2. 11/17/16 11:43 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/17/16 11:46 am Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/17/16 3:39 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 3:46 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/18/16 12:34 pm Christina Noja (christinanoja): Approved for CUCQA

Programs referencing this course	MSc in Health Sciences MSc in Health Sciences with Specialization in Data Science

Effective Date	2017-18
Workflow	majormod
New Resources	Faculty
Level	Graduate
Course Code	HLTH
Course Number	5909
Title	MSc Thesis
Title (short)	MSc Thesis
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Credit Value	4.0
Course Description	MSc Thesis
Prerequisite(s)	
Class Format	Thesis
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Thesis/Dissertation
Schedule Type	Masters Thesis
Summary	MSc Thesis
Rationale for new course	New resources: As reported in Business Plan and Volume 1 Self-Study
Course reviewer comments	**lesliemacdonaldhicks (11/11/16 10:15 am):** Rollback: Possible CourseLeaf glitch **anshulsingh (11/11/16 11:33 am):** Rollback: Re-setting the workflow to include Dean approval steps. No action required. **anshulsingh (11/11/16 1:21 pm):** Rollback: Setting the workflow to include Faculty & Grad Dean approval steps. No action required. Re-Approving for HLTH ChairDir level.

Key: 9164

New Course Proposal

Date Submitted: 11/11/16 1:23 pm

Viewing: HLTH 6902 : Seminars in Interdisciplinary Health Sciences

Last edit: 11/11/16 1:23 pm

Changes proposed by: anshulsingh

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. SCCASP
9. SAPC
10. Senate
11. Banner

Approval Path

1. 11/11/16 1:25 pm Anshul Singh (anshulsingh): Approved for HLTH ChairDir GR
2. 11/17/16 11:43 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/17/16 11:46 am Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/17/16 3:39 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 3:46 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/18/16 12:34 pm Christina Noja (christinanoja): Approved for CUCQA

Programs referencing this course PhD in Health Sciences

Effective Date	2017-18
Workflow	majormod
New Resources	
Level	Graduate
Course Code	HLTH
Course Number	6902
Title	Seminars in Interdisciplinary Health Sciences
Title (short)	Interdisciplinary Hlth Sci
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Credit Value	0.50
Course Description	Seminar course in interdisciplinary health research. Development of scientific communication skills through attendance at interdisciplinary seminars and by the student presenting a seminar on their own thesis research. Topics have specific or broad relevance to health sciences.
Prerequisite(s)	
Class Format	Seminar
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Satisfactory/Unsatisfactory
Schedule Type	Seminar
Summary	New course for MSc and Ph.D. Health Sciences program.
Rationale for new course	As reported in Business Plan and Volume 1 Self-Study
Course reviewer comments	**lesliemacdonaldhicks (11/11/16 10:15 am):** Rollback: Possible CourseLeaf glitch **anshulsingh (11/11/16 11:33 am):** Rollback: Re-setting the workflow to include Dean approval steps. No action required.

anshulsingh (11/11/16 1:21 pm): Rollback: Setting the workflow to include Faculty & Grad Dean approval steps. No action required. Re-Approving for HLTH ChairDir level.

Key: 9166

New Course Proposal

Date Submitted: 11/11/16 1:23 pm

Viewing: HLTH 6903 : Grant Proposals and Ethics

Last edit: 11/11/16 1:23 pm

Changes proposed by: anshulsingh

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. SCCASP
9. SAPC
10. Senate
11. Banner

Approval Path

1. 11/11/16 1:25 pm Anshul Singh (anshulsingh): Approved for HLTH ChairDir GR
2. 11/17/16 11:43 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/17/16 11:46 am Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/18/16 9:05 am Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/18/16 9:21 am Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/18/16 12:34 pm Christina Noja (christinanoja): Approved for CUCQA

Programs referencing this course PhD in Health Sciences

Effective Date	2017-18
Workflow	majormod
New Resources	Faculty
Level	Graduate
Course Code	HLTH
Course Number	6903
Title	Grant Proposals and Ethics
Title (short)	Grant Proposals and Ethics
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Credit Value	0.50 Specify Other:
Course Description	Advanced course in writing successful grant proposals in Tri-Council (CIHR, NSERC, SSHRC)formats. Discussion of ethics associated with conducting health sciences research, including the preparation of ethics proposals for human and animal studies in health sciences research.
Prerequisite(s)	
Class Format	Seminar/Lecture
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Standard Letter Grade
Schedule Type	Lecture Seminar
Summary	New course for MSc and PH.D. Health Sciences program
Rationale for new course	New resources: As reported in Business Plan and Volume 1 Self-Study
Course reviewer comments	**lesliemacdonaldhicks (11/11/16 10:15 am):** Rollback: Possible CourseLeaf glitch **anshulsingh (11/11/16 11:34 am):** Rollback: Re-setting the workflow to include Dean approval steps. No action required.

anshulsingh (11/11/16 1:21 pm): Rollback: Setting the workflow to include Faculty & Grad Dean approval steps. No action required. Re-Approving for HLTH ChairDir level.

Key: 9161

New Course Proposal

Date Submitted: 11/11/16 1:23 pm

Viewing: HLTH 6904 : Mid-program research defence and knowledge examination for PhD

Last edit: 11/11/16 1:23 pm

Changes proposed by: anshulsingh

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. SCCASP
9. SAPC
10. Senate
11. Banner

Approval Path

1. 11/11/16 1:25 pm Anshul Singh (anshulsingh): Approved for HLTH ChairDir GR
2. 11/17/16 11:43 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/17/16 11:46 am Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/17/16 3:39 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 3:46 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/18/16 12:34 pm Christina Noja (christinanoja): Approved for CUCQA

Programs referencing this course PhD in Health Sciences

Effective Date	2017-18
Workflow	majormod
New Resources	Faculty
Level	Graduate
Course Code	HLTH
Course Number	6904
Title	Mid-program research defence and knowledge examination for PhD
Title (short)	Defence and knowledge exam
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Credit Value	0.0
Course Description	Departmental seminar and Graduate Advisory Committee meeting on PhD research including results to date and future research aims and directions, and on field-specific knowledge.
Prerequisite(s)	
Class Format	Part of thesis preparation
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Thesis/Dissertation
Schedule Type	Other
Summary	New requirement for MSc. and Ph.D. Health Sciences program
Rationale for new course	New resources: As reported in Business Plan and Volume 1 Self-Study
Course reviewer comments	**lesliemacdonaldhicks (11/11/16 10:15 am):** Rollback: Possible CourseLeaf glitch **anshulsingh (11/11/16 11:34 am):** Rollback: Re-setting the workflow to include Dean approval steps. No action required. **anshulsingh (11/11/16 1:21 pm):** Rollback: Setting the workflow to include Faculty & Grad Dean approval steps. No action required. Re-Approving for HLTH ChairDir level.

Key: 9162

New Course Proposal

Date Submitted: 11/11/16 1:24 pm

Viewing: HLTH 6905 : Final research seminar presentation for PhD

Last edit: 11/11/16 1:24 pm

Changes proposed by: anshulsingh

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. SCCASP
9. SAPC
10. Senate
11. Banner

Approval Path

1. 11/11/16 1:25 pm Anshul Singh (anshulsingh): Approved for HLTH ChairDir GR
2. 11/17/16 11:44 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/17/16 11:46 am Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/17/16 3:39 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 3:46 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/18/16 12:34 pm Christina Noja (christinanoja): Approved for CUCQA

Programs referencing this course PhD in Health Sciences

Effective Date	2017-18
Workflow	majormod
New Resources	Faculty
Level	Graduate
Course Code	HLTH
Course Number	6905
Title	Final research seminar presentation for PhD
Title (short)	Research seminar presentation
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Credit Value	0.0
Course Description	Final seminar of PhD thesis research. Seminar presentation should occur within one month of the final oral thesis defence.
Prerequisite(s)	
Class Format	Part of thesis preparation
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Thesis/Dissertation
Schedule Type	Other
Summary	New requirement for MSc and Ph.D. Health Sciences program
Rationale for new course	New resources: As reported in Business Plan and Volume 1 Self-Study
Course reviewer comments	**lesliemacdonaldhicks (11/11/16 10:15 am):** Rollback: Possible CourseLeaf glitch **anshulsingh (11/11/16 11:34 am):** Rollback: Re-setting the workflow to include Dean approval steps. No action required. **anshulsingh (11/11/16 1:21 pm):** Rollback: Setting the workflow to include Faculty & Grad Dean approval steps. No action required. Re-Approving for HLTH ChairDir level.

Key: 9163

New Course Proposal

Date Submitted: 11/11/16 1:24 pm

Viewing: HLTH 6909 : PhD Thesis

Last edit: 11/11/16 1:24 pm

Changes proposed by: anshulsingh

In Workflow

1. **HLTH ChairDir GR**
2. **SCI Dean**
3. **GRAD Dean**
4. **GRAD FCC**
5. **GRAD FBoard**
6. **CUCQA**
7. **PRE SCCASP**
8. SCCASP
9. SAPC
10. Senate
11. Banner

Approval Path

1. 11/11/16 1:25 pm Anshul Singh (anshulsingh): Approved for HLTH ChairDir GR
2. 11/17/16 11:44 am Malcolm Butler (malcolmbutler): Approved for SCI Dean
3. 11/17/16 11:46 am Adrian Chan (adrianchan): Approved for GRAD Dean
4. 11/17/16 3:39 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FCC
5. 11/17/16 3:46 pm Leslie Macdonald-Hicks (lesliemacdonaldhicks): Approved for GRAD FBoard
6. 11/18/16 12:34 pm Christina Noja (christinanoja): Approved for CUCQA

Programs referencing this course PhD in Health Sciences

Effective Date	2017-18
Workflow	majormod
New Resources	
Level	Graduate
Course Code	HLTH
Course Number	6909
Title	PhD Thesis
Title (short)	PhD Thesis
Faculty	Faculty of Science
Academic Unit	Department of Health Sciences
Credit Value	8.50
Course Description	PhD Thesis
Prerequisite(s)	
Class Format	Thesis
Precluded Courses	
Also listed as	
Piggybacked Courses	
U Ottawa Code	
Grade Mode	Thesis/Dissertation
Schedule Type	PhD Thesis
Summary	PhD thesis
Rationale for new course	New resources: As reported in Business Plan and Volume 1 Self-Study
Course reviewer comments	**lesliemacdonaldhicks (11/11/16 10:16 am):** Rollback: Possible CourseLeaf glitch **anshulsingh (11/11/16 11:34 am):** Rollback: Re-setting the workflow to include Dean approval steps. No action required. **anshulsingh (11/11/16 1:21 pm):** Rollback: Setting the workflow to include Faculty & Grad Dean approval steps. No action required. Re-Approving for HLTH ChairDir level.

Key: 9165