FOR CONFIRMATION **PUBLIC** **CLOSED SESSION**

TO: Executive Committee

SPONSOR: Susan McCahan, Vice-Provost, Academic Programs
CONTACT INFO: (416) 978-0490, vp.academicprograms@utoronto.ca

PRESENTER: See Sponsor
CONTACT INFO:

DATE: June 3, 2019 for June 10, 2019

AGENDA ITEM: 4(a)

ITEM IDENTIFICATION:

New Graduate Program Proposal: Master of Health Science in Laboratory Medicine (MHSc), Faculty of Medicine

JURISDICTIONAL INFORMATION:

The Committee on Academic Policy and Programs has the authority to recommend to the Academic Board for approval new graduate programs and degrees. *(AP&P Terms of Reference, Section 4.4.a.ii)*

GOVERNANCE PATH:

1. Committee on Academic Policy and Programs [for recommendation] (May 8, 2019)
2. Academic Board [for approval] (May 30, 2019)
3. Executive Committee [for confirmation] (June 10, 2019)

PREVIOUS ACTION TAKEN:

The proposal for the Master of Health Science in Laboratory Medicine received approval from the Faculty of Medicine Faculty Council on April 22, 2019.

HIGHLIGHTS:

This is a proposal for a professional master's degree program called Master of Health Science in Laboratory Medicine (MHSc) to be offered by the Department of Laboratory Medicine and Pathobiology in collaboration with the Department of Obstetrics and Gynecology, Faculty of Medicine. The program consists of 9.5 full-course equivalents (FCE). Students will be in one of two fields of study: Clinical Embryology (CE) and Pathologists' Assistant (PA). All students

will complete six common core courses and 1 elective (4.0 FCE). Students in the CE field will complete 8 courses in the area (4.0 FCE) and 3 practicum courses (1.5 FCE). Students in the PA will complete 3 courses in the area (1.5 FCE) and 8 practicum courses (4.0 FCE). The degree program will be offered face-to-face and is two years (6 terms) in length.

Graduates of the MHSc in Laboratory Medicine will pursue careers in one of two clinical laboratory scientist disciplines, Pathologists' Assistant (PA) or Clinical Embryology (CE). Pathologists' Assistants are involved in providing diagnostic services in anatomical pathology by applying knowledge of tissue and laboratory analysis of human specimens. PAs are currently trained in Canada on the job without a formal academic foundation. Very recently, PAs have been encouraged by the medical laboratory community to obtain a professional master's in an accredited academic program to be eligible for certification to work in highly responsible laboratory positions under the supervision of medically qualified pathologists. The proposed program is alilgned with accreditation requirements. Clinical Embryologists are responsible for all clinical and management decisions related to assisted reproductive technology (ART) in the clinical embryology laboratory and infertility research labs. Currently, the apprenticeship model is the mode of training and that approach alone, while appropriate in the early days of the field, is not sufficient for the sophisticated health care offered today. The proposed professional master's will provide laboratory and clinical-focused students with an understanding of the scientific underpinnings of their fields and a strong academic foundation to meet the dynamic complexities that are now part of today's clinical science professions.

Applicants must have an appropriate Bachelor of Science degree and must have a demonstrated interest in human biological and life sciences, preferably with a major or specialist program in the life sciences.

Consultation took place within the Faculty as well as with the Dalla Lana School of Public Health bioethics faculty, Faculty of Arts and Science, University of Toronto Mississauga and University of Toronto Scarborough and Council of Health Science Deans. Consultation has also taken place with the Canadian Association of Pathologists and the associated Canadian Certification Council of Pathologists' Assistants as well as the Canadian Fertility and Andrology Society and Canadian Chairs of Pathology and Laboratory Medicine.

The program was subject to an external appraisal on February 26, 2019 by Professors Barry Behr, Department of Obstetrics & Gynecology-Reproductive Endocrinology & Infertility, Stanford University and James R. Wright, Jr., Department of Pathology & Laboratory Medicine, University of Calgary. The external appraisers made a number of suggestions, which resulted in changes to the program as is reflected in the Dean's response to the appraisal report.

FINANCIAL IMPLICATIONS:

The new financial obligations resulting from this program will be met at the divisional level.

RECOMMENDATION:

Be It Confirmed by the Executive Committee,

THAT the proposed degree program, Master of Health Science in Laboratory Medicine (MHSc) as described in the proposal from the Faculty of Medicine dated April 12, 2019 be approved effective September 1, 2020.

DOCUMENTATION PROVIDED:

- *Proposal for a Master of Health Science in Laboratory Medicine*

UNIVERSITY OF TORONTO

University of Toronto
New Graduate Program Proposal

This template (last updated by the Office of the Vice-Provost, Academic Programs) is for all proposals for new graduate programs. It will help to ensure that all evaluation criteria established by the Quality Council are addressed in bringing forward a proposal for a new program. Separate templates have been developed for other types of proposals.

Full name of proposed program: (i.e., Master of Arts in History; Master of Science in Sustainability Management)	Master of Health Science in Laboratory Medicine
Degree name and short form: i.e., Master of Arts, M.A.; Master of Science in Sustainability Management, M.Sc.S.M.	MHSc in Laboratory Medicine
Program name: i.e., History; Sustainability Management	Laboratory Medicine
Professional program:	Yes
Unit (if applicable) offering the program: i.e., site of academic authority. Where a program is housed elsewhere (in physical terms), this should also be indicated. If a new graduate unit is contemplated, please indicate here.	Department of Laboratory Medicine & Pathobiology
Faculty/division:	Medicine / Division 4
Dean's office contact:	Allan Kaplan, Vice Dean, Graduate and Academic Affairs
Proponent:	Rita Kandel, Chair, Laboratory Medicine and Pathobiology
Version date: (please change as you edit this proposal)	April 17, 2019

Development & Approval Steps	**Date (e.g., of external appraisal site visit, final sign off, governance meeting, quality council submission, ministry submission)**
New Program Consultation Meeting	September 13, 2018
Consultation Proponents/Dean's Office/Provost's Office	
Provost's Advisory Group	December 5, 2018
Decanal signoff *In signing off I confirm that I have ensured appropriate:* • compliance with the evaluation criteria listed in UTQAP section 2.3 • consultation with the Office of the Vice-Provost, Academic Programs early in the process of proposal development • Consultation with faculty and students, other University divisions and external institutions	Allan Kaplan, Vice Dean, Graduate and Academic Affairs, designate for Trevor Young, Dean, Faculty of Medicine (Division 4) January 29, 2019
Provostial signoff *In signing off I confirm that the new program proposal:* • Is complete • Includes information on all the evaluation criteria listed in UTQAP section 2.3	Susan McCahan Vice-Provost, Academic Programs February 4, 2019
External Appraisal	February 26, 2019
Unit-level approval (if required)	[date]
Faculty/divisional governance	[date]
Submission to Provost's office	
AP&P	[date]
Academic Board (if a new degree)	[date]
Executive Committee of Governing Council (if a new degree)	[date]
The program may begin advertising as long as any material includes the clear statement that, "No offer of admissions will be made to the program pending final approval by the Quality Council and the Ministry of Training, Colleges and Universities (where the latter is required)."	
Ontario Quality Council	[date]
Submitted to the Ministry (in case of a new degree)	[date]

New Graduate Program Proposal

MHSC in Laboratory Medicine
Laboratory Medicine & Pathobiology
Division 4

Table of Contents

Instructions: Please include all sections with page numbers and a full list of appendices in the table of contents. The Table of Contents will update automatically when you right-click on it and select "Update Field" and then "Update Entire Table."

1 Executive Summary

Please provide a brief overview of the proposed program summarizing the key points from each section of the proposal. (You may wish to complete this section last.) This may need to be used on a stand-alone basis:

The Department of Laboratory Medicine and Pathobiology (LMP), with close collaboration with the Department of Obstetrics and Gynecology (OB/GYN), is proposing the creation of a two year full-time professional Master's graduate program (Master of Health Science degree) to educate clinical laboratory medicine scientists in one of two fields: Pathologists' Assistant (PA) or Clinical Embryology (CE). Enrollment is 10 students per year (5 PA and 5 CE students) who will complete 9.5 full course equivalent (FCE) courses. The name, Master of Health Science (MHSc) in Laboratory Medicine, reflects the nature of the unique program which incorporates the two fields under a Laboratory Medicine framework and is acceptable to the community of laboratory scientists and physicians. Pathologists' Assistants (PAs) are involved in providing diagnostic services in anatomical pathology by applying knowledge of tissue and laboratory analysis of human specimens. Clinical Embryologists (CEs) provide clinical management related to assisted reproductive technology in clinical embryology laboratories. The academic rationale for the program is to provide education that imparts general core knowledge in laboratory medicine and specific basic and applied principles and skills of anatomic pathology or assisted reproductive technology (ART) required to work as high quality laboratory scientists. The nature of this graduate program equips trainees to apply their knowledge to complex decision making, to serious ethical issues and to develop a strong sense of personal accountability and intellectual rigour and independence. The university graduate education imparts deep content expertise and essential practical skills to address complex clinical problems and make evidence based judgements during the course of clinical practise.

In all Faculty of Medicine programs, the instructors will include tenured, clinical and status-only faculty. The faculty teaching this program are recruited from our very best educators who are committed to the learning objectives and outcomes of this program.

Critical research skills are taught to both interpret current research and to plan original research independently. Understanding the principles of research is essential since these two disciplines are dynamic and are constantly incorporating new concepts and techniques to improve healthcare. The curriculum will include lectures, student presentations, student reviews and reports and practica at the university teaching hospitals as well as the university affiliated Forensic Pathology unit. Students will also complete laboratory research projects at the university and teaching hospitals. The emphasis on student presentations and critical analysis provides skills for life long learning. The program will be monitored annually by an education committee that will have processes to assess courses and practica, to receive feedback and self-reflections from students, and student evaluations of courses and teaching faculty. Students will have the opportunity to attend career development and wellness sessions.

The time is right to launch this program since the medical community, the professional regulators and the lay public expect that clinical practitioners be well trained in their discipline. To accomplish this, professional masters graduate programs exist in Europe and the United States that teach appropriate academic and clinical standards of practice and

graduate students who are competent to meet the modern challenges of their professional work. Furthermore, there is an education gap in Canada as clinical scientists have been historically trained on the job through random and independent apprenticeship arrangements. Such training does not focus on delivering an understanding of the scientific underpinnings of the fields and a strong academic foundation to meet the dynamic complexities that are now part of today's clinical science professions.

2 Effective Date

Anticipated date students will start the program: Fall 2020
Program will first be subject to a cyclical review in 2021-22

3 Academic Rationale

Please use the headings below:

- Identify what is being proposed and provide an academic rationale for the proposed program (what is being created and why?).
- Explain the appropriateness of the program name and degree nomenclature.
- If relevant, describe the mode of delivery (including blended or online; placement, etc.) and how it is appropriate to support students in achieving the learning outcomes of the program.
- Context
  - Discuss how the program addresses the current state of the discipline or area of study. (Identify pedagogical and other issues giving rise to the creation of this program. Where appropriate, speak to changes in the area of study or student needs that may have given rise to this development.)
  - Describe the consistency of the program with the University's mission as specified within the *Statement of Institutional Purpose* and unit/divisional academic plan and priorities.
- Distinctiveness
  - Identify any unique curriculum or program innovations or creative components

The rationale for this professional MHSc is that highly qualified clinical laboratory scientists are essential in the delivery of medical laboratory health care in Ontario and worldwide. Our review of the educational landscape in laboratory science indicates this proposal is aligned with appropriate degree nomenclature, program name and educational norms when compared to the few existing programs in United States, United Kingdom and Canada. The degree name, Master of Health Science (MHSc) in Laboratory Medicine, reflects the nature of the unique program that incorporates the two fields under a Laboratory Medicine framework and is acceptable to the community of laboratory scientists and physicians. The fields are named as such to align with what is currently used in practice.

The Department of Laboratory Medicine and Pathobiology (LMP) will be partnering with the Department of Obstetrics and Gynaecology (OB/GYN) at the University of Toronto (UofT) to deliver the MHSc program in Laboratory Medicine. Both are internationally recognized academic and clinical departments that have consistently achieved excellence in research, education and clinical practice. Hence, the faculty members in these two departments are

highly qualified to train these graduate students in professional laboratory scientist programs in two types of clinical laboratory scientist disciplines, Pathologists' Assistant (PA) and Clinical Embryology (CE), reflecting two professional fields in medical laboratory practice.

This type of program is unique to Canada and the world, and is meant to strengthen laboratory healthcare in an efficient and effective way by offering a core curriculum in laboratory sciences with overall goals followed by a stratified curriculum for PAs and CEs. Faculty in both LMP and OB/GYN strongly support the creation of this MHSc in Laboratory Medicine because it aligns with their individual departmental academic plans and strategic departmental priorities, and promotes interdepartmental teaching. The faculty, including all the Hospital Chiefs, (see Appendix H: Letters of Support) recognize the academic rationale and educational need of this combined professional program which teaches independent decision making, quality improvement and precision clinical lab practice.

Academic rationale for a professional graduate Master's program in LMP

This proposed health focussed professional graduate program is consistent with the University of Toronto's Statement of Institutional Purpose which specifies "The University of Toronto is committed to being an internationally significant research university with undergraduate, graduate, and professional programs of excellent quality." We aspire to achieve an international reputation for our MHSc in keeping with the high global rankings of UofT programs in the Faculty of Medicine.

LMP is a world-class academic department that has an excellent track record of training both laboratory physicians in anatomic pathology and doctoral graduate students in the study of pathogenesis of human disease. Our tenured, status only and clinical faculty are enthusiastic and committed to developing and actively participating in this much-needed new professional program. The department sits at the crossroads of basic science and clinical medicine, strategically placing itself in an excellent position academically to mount a high-quality graduate clinical laboratory sciences program. This is due to the presence of well-qualified dedicated faculty, excellent pathology and infertility resources at the teaching hospitals, an outstanding mix of anatomic pathology cases at the teaching hospitals, and an excellent scholarship track record of linking teaching and research in basic biomedical science and clinical laboratory science.

The MHSc in Laboratory Medicine will be offered by LMP. The department currently offers two research focused degrees: the MSc and PhD, both in this field of Laboratory Medicine. Approximately 200 doctoral stream graduate students (120 PhDs and 80 MSc) are currently enrolled in LMP. Our graduates are successfully employed with approximately 50% in post-secondary education, just under 30% in the private sector and 18% in the public sector (See U of T School of Graduate Studies 10,000 PhDs Project, 2000-2015). As well, LMP has been successfully training non-physician laboratory scientists for many years in the disciplines of clinical chemistry and clinical microbiology; both of these programs are accredited and trainees successfully sit for certification exams. Our graduates are working as laboratory professionals throughout North America. Thus, training clinical scientists aligns very well with the ongoing teaching in LMP carried out by our tenured, clinical and status-only faculty based at the university (St. George campus) and university-affiliated hospital based research institutions.

A brief history provides further rationale for this new LMP graduate program. In 1997, the Faculty of Medicine merged the clinical laboratory disciplines into one comprehensive academic department. The purpose of the merger was to facilitate strategic planning by laboratory physicians and scientists to embrace molecular and precision medicine, to enhance the culture of safe and efficient laboratory practices through quality assurance and to develop educational programs to meet the emerging requirements for delivering education through competency models with state of the art innovative programs linking education to biomedical research. LMP has since become a "full service department" within the Faculty of Medicine with successful educational and research programs that span the University of Toronto campus and the laboratory departments and research institutes of the teaching hospitals.

LMP has also been very responsive to societal and community needs by developing new educational programs within the department. When transfusion medicine training needed a home, LMP provided the faculty, staff and resources to successfully initiate and integrate the teaching and clinical training of transfusion medicine physicians since they functioned mostly as laboratory physicians. When there was an acute need for forensic pathology training in Ontario and in Canada, LMP rose to the occasion and established a very successful Royal College of Physicians and Surgeons of Canada accredited program whose certified graduates now populate forensic units in Ontario and elsewhere. Prior to this, there were no accredited forensic training programs in Canada and there was no mechanism to certify forensic pathologists. Thus, they either had to be certified in the United States or United Kingdom or learn on the job without having had formal training.

We are now at the same point in Canada with clinical laboratory scientists. Most PAs and CEs are working without formal training in accredited programs and this educational gap needs to be filled. LMP has the academic and clinical expertise to meet this need to train graduates who will be eligible for certification, at present from the American Society for Clinical Pathology (ASCP) Board of Certification. There are no similar existing programs being offered at UofT, and in Ontario, one small PA program exists at Western University.

Advances in medicine through breakthroughs in clinical medicine, in basic and translational research and in technology, require enhanced laboratory services since approximately 70% of medical decisions rely on laboratory tests and services. There is an increasing demand across Canada and worldwide for well-trained clinical laboratory scientists who function in assisted reproductive technology or, as physician extenders to oversee and manage the preparation, examination and utilization of human tissues in the setting of surgical, autopsy and forensic pathology, and in biomedical research. The degree program will include the following distinctive features:

- University of Toronto affiliated teaching hospitals are major national tertiary/quaternary health care centers with a unique case mix, including rare cases referred from across Canada. This exposure to material provides a unique and in-depth opportunity for learning. In addition, LMP and its teaching hospitals promote subspecialized pathology services including some that are limited in other provinces, such as the largest transplant service in North America, soft tissue pathology, endocrine pathology etc. Many of our pathologists are national and international consultants in diagnostic pathology and do both one-on-one and

classroom teaching. Thus, our program will offer a unique opportunity for both general and subspecialized PA training under the supervision of dedicated internationally renowned pathologists. Some of our hospitals, such as Princess Margaret Cancer Centre, Sinai Health System and SickKids handle unique complex pathology cases associated with very subspecialized services.

- A unique feature will be the ability to receive applied training in cancer, stem cell and other types of biobanking. Biobanking refers to the process by which samples of bodily fluid or tissue are collected for research use to improve our understanding of health and disease. This will involve didactic classroom teaching and applied wet laboratory protocols and/or experiments. The rationale is that cancer related biobanking is evolving nationally and internationally as a requirement for the delivery of precision medicine. Many hospitals will soon require some biobanking capability and there will be a need for PAs to extend the scope of pathologist practice in this area. Sophisticated regulations recently emerged for obtaining and maintaining tissues for research and clinical trials which require an in-depth understanding of the basic and applied science related to tissue procurement and handling. In Toronto, we have access to two of the largest and most advanced biobanking facilities in Canada, which we will access in order to train PAs in this emerging field of clinical laboratory practise. Similarly, many CEs actively participate in research, and biobanking of excess materials for research purposes is expanding in the ART field. Thus, best practice in biobanking is a topic relevant to both the CE and PA fields.

- With precision medicine beginning to appear in clinical practice, there is a strong rationale for having PAs know how to handle tissues for accurate molecular analysis. To do this effectively and efficiently, they will require an understanding of relevant cell and molecular biology. The Province of Ontario, through Cancer Centre Ontario, is a pioneer in molecular pathology, and as a result, our graduates will have the opportunity to learn firsthand state-of-the art advanced molecular pathology.

- Precision medicine will be further supported by the development of Artificial Intelligence (AI) based methods, some of which rely on big data. A unique aspect of this program will be exposing our students to excellent quantitative approaches for mining molecular and cell biology information and data. The students will learn how tissue handling, selection and preservation impact on digital pathology in which digitized histopathology slide images are easily stored, visualized, shared and utilized using computational tools. The University of Toronto is an international leader in AI and LMP will facilitate the application of AI in clinical laboratory medicine.

- Currently, the apprenticeship model of training for CEs allow individuals to gain technical skill over a protracted period of time, with little opportunity for theoretical training. This unregulated apprenticeship approach has the potential to put patients at risk. Thus, there is a rationale to train CEs in the fundamental knowledge of reproductive biology and pathobiology since it forms the underpinnings of a solid understanding of the processes involved and enables well informed trouble shooting skills and decision making, which is essential for CEs to

become valued members of the ART team. The University of Toronto has unique academic strength in reproductive biology and development, infertility, and molecular biology that will facilitate the creation of a high quality, leading-edge, robust program. New approaches and techniques in ART are continually introduced and adopted by ART clinics, and the CEs need to be prepared to assess the research supporting these advances in terms of their quality and potential impact on the field.

- Establishment of a Simulation and Skills Lab which is supported by LMP and the Department of Obstetrics and Gynecology. They will supply equipment and personnel to provide hands-on training.

4 Fields/Concentrations

- Description of fields/concentrations, if any. (Please note: graduate programs are not required to have fields/concentrations in order to highlight an area of strength or specialization within a program.)

This degree program will have two fields of study, PA and CE. The Pathologists' Assistant (PA) field prepares students in a discipline that employs highly trained clinical laboratory scientists who demonstrate highly responsible medical or biomedical laboratory based expertise and work under the supervision of medically qualified pathologists. The discipline has evolved to provide diagnostic services in anatomical pathology laboratories through the handling, preparation and utilization of human tissue and fluids for diagnostic and for research purposes.

The discipline of Pathologists' Assistant encompasses clinical scientists who are involved with the provision of diagnostic services in anatomical pathology, a discipline in which physicians specialize in the diagnosis and management of human disease by laboratory methods. The role of the PA is to develop and apply the knowledge of tissue and laboratory analysis to assist in the diagnosis and treatment of individual patients. They provide services in surgical, autopsy and forensic pathology, and in laboratory research programs in the biomedical area both in academic and non-academic (industry, pharmaceutical and biotech companies, government regulatory labs, public and private health agencies) laboratories.

Pathologists' Assistants (PAs) are members of the clinical laboratory discipline of Pathologists' Assistant and are currently trained in Canada on the job without a formal academic foundation. Very recently, PAs have been encouraged by the medical laboratory community to obtain a professional MHSc in an accredited academic program to be eligible for certification to work in highly responsible laboratory positions under the supervision of medically qualified pathologists. PAs require competencies in many areas that are best taught at the Master's level including complex problem solving, self-directed and independent learning, quality assurance, professionalism, research integrity and ethics and communication skills. Consequences of errors in their performance or judgement may lead to serious medical errors in the delivery of healthcare.

Clinical Embryology (CE) is a discipline created to provide highly trained CE healthcare professionals who are responsible for all clinical and management decisions related to assisted reproductive technology (ART) in the clinical embryology laboratory and infertility research labs. Currently, the apprenticeship model of training allows individuals to gain technical skill over a protracted period of time. The apprenticeship approach alone, while appropriate in the early days of the field, is not sufficient for the sophisticated health care offered today. Fundamental knowledge of reproductive biology, pathobiology and research are serious gaps in the current apprentice training. The knowledge forms the underpinnings of a solid understanding of the processes involved and enable evidence based trouble shooting skills and decision-making. This is essential for CEs to provide the value expected from a key team leader. The University of Toronto has academic strength in reproductive biology and development, infertility, and molecular biology that will facilitate the creation of a high quality, leading edge, robust academic graduate program for the CE field of laboratory science.

Clinical Embryologists (CEs) are trained to be responsible for all clinical and management decisions related to assisted reproductive technology (ART) in the clinical embryology laboratory. They work in conjunction with physician input. The discipline requires that the clinical embryologist employ numerous technical skills with varying degrees of complexity. Errors in performance and judgement may lead to serious consequences for those under their care who are seeking reproductive assistance.

ART was created with the first human *in vitro* fertilization conception and live birth in 1978. Since this Nobel Prize achievement by Drs. Patrick Steptoe and Robert Edwards, the discipline has developed to address infertility which is estimated to affect one in six Canadian couples. In addition to infertility patients, ART is used for the preservation of gametes to preserve fertility prior to gonadotoxic drugs for pre-pubertal and reproductive-aged oncology patients, and is accessed by members of the LGBTQ community as well as by carriers of genetic diseases. For example, here are some of the work CEs carry out:

1. handling and micromanipulation of gametes (oocytes and sperm)
2. gamete quality assessment
3. sperm cryopreservation and thawing
4. *in vitro* fertilization
5. preimplantation embryo culture and assessment
6. catheter loading for embryo transfer
7. intracellular sperm injection (ICSI)
8. sperm selection
9. laser-assisted embryo hatching
10. embryo cryopreservation and thawing
11. tissue handling for testicular and ovarian samples
12. sperm/spermatid isolation from testicular biopsy or epididymal aspirations
13. trophectoderm biopsy for preimplantation genetic testing
14. oocyte cryopreservation and thawing
15. time lapse embryo imaging and interpretation
16. laboratory workflow and sample tracking

The MHSc Laboratory Medicine program in the field of Clinical Embryology will prepare leaders in assisted reproductive technology (ART) by providing breadth and depth of

knowledge, and ensuring that students have the ability to apply and communicate it. Critical thinking and continuous quality improvement are themes that weave throughout the program. The synthesis of these with an understanding of the ethical, scientific and managerial challenges will provide the basis for a career as a clinical embryologist.

5 Need and Demand

- Provide a brief description of the need and demand for the proposed program focusing, as appropriate, on student interest, societal need, employment opportunities for prospective graduates, interest expressed by potential employers, professional associations, government agencies or policy bodies and how this has been determined.
- How is the program distinct from other programs at U of T? (Address, if relevant, how this program might affect enrolment in other related programs offered here.)
- With specific reference to the impact on need and demand, describe how the proposed program relates to (is similar to or different from) existing programs offered by other universities in North America and Internationally (with specific reference to Canadian and Ontario examples). In doing this, you may wish to append a table showing other programs.

The current state of PA and CE disciplines in Canada

There is a societal need to train clinical laboratory scientists in graduate programs to ensure excellence in academic and applied science training in accredited programs that prepare trainees to successfully achieve certification. The United States and the United Kingdom are ahead of Canada in establishing such accredited programs with opportunities for individual certification. In Canada, there are four small existing/emerging programs for PAs in Canada. These are accredited by the US based National Accreditation Agency for Clinical Laboratory Sciences (NAACLS). Although Ontario is the largest province, in terms of population and health services, there is only one PA program at the Master's level at Western University. This 2 year program trains 5 students per year and is insufficient for current and future healthcare needs. It should also be noted that the programs in other provinces include 2 year MSc programs at University of Alberta (2 students per year), University of Calgary and Manitoba, (2-3 students per year). Our program will train 5 PAs per year which is the most number of trainees in a program in Canada. A list of high calibre PA programs can be found in Appendix G.

The PA section of the Canadian Association of Pathologists (CAP) will be phasing out the current informal and apprenticeship routes that allowed for professional membership in their section. This creates new needs for formal education and the route being demanded by employers (pathology departments) is professional Masters graduate programs. The Canadian Chairs of Pathology and Laboratory Medicine are beginning to work with CAP and the Canadian Certification Council of Pathologists' Assistant (CCCPA) to establish standards of accreditation; current processes and standards need to be revised and redeveloped. By 2018, all PAs will be certified. It is expected that all new participating PAs in Canada will be graduates of an accredited Master`s degree program. Moreover, PAs are in demand for the expanding fields of biobanking, autopsy services, pathology research, forensic pathology, and the pharmaceutical and biotechnological industries. Thus, the job market for highly

qualified laboratory scientists with expertise in tissue and fluids is expanding. Currently (January 2018), there are eight advertisements for PAs in Canada.

In the United States, PAs are members of the American Association of Pathologists' Assistants (AAPA). The National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) Board of Directors voted in 1995 to accept the Essentials (now Standards) of Accredited Training Programs for the Pathologists' Assistant, establishing a process of accreditation for Pathologists' Assistant training programs. To earn certification the PA must graduate from a NAACLS accredited training program and subsequently pass the American Society for Clinical Pathology (ASCP) Board of Certification examination called the PA (ASCP). We plan to create a rigorous graduate program in Laboratory Medicine in Toronto and seek accreditation by the NAACLS. This will allow our graduates to be eligible to write the PA (ASCP) certification examination. As noted above, we will also work with Canadian bodies including the Canadian Chairs of Pathology and Laboratory Medicine to develop equivalent Canadian accreditation and certification processes that reflects best practise in clinical laboratory science.

In 2007, the Canadian Association of Pathologists (CAP) created the Section for Pathologists' Assistant to establish some informal standards of professional ethics, practical education and key competencies creating informal Canadian training guidelines for PAs. However beginning in 2016, the PA section of the Canadian Association of Pathologists (CAP) is phasing out the current informal and apprenticeship routes that allowed for professional membership by 2018.

The Ontario government Ministry of Health and Long Term Care (MOHLTC) has previously demonstrated their commitment to addressing human fertility needs by providing a seventy-million-dollar annual budget for public funding of ART, with concomitant quality oversight. This has led to a need for high quality educational programs to meet the increased demand for well-trained clinical embryologists to provide ART services in the province. Presently in Canada, CEs are trained informally using an apprenticeship model, where the laboratory director oversees and validates the training of new individuals in their own specific clinical laboratories. These trainees generally have a BSc in a biological discipline, before they begin their unregulated apprenticeship in the clinical lab, with little or no laboratory experience. Recently, the field has seen a slight rise in the employment of graduates with a thesis-based Master's degree in a biomedical field but it is typically unrelated to reproduction or clinical embryology training.

Due to the clinical responsibilities of the job, many laboratory directors do not have sufficient time, teaching skills or resources to adequately educate their staff in all techniques. The volume of clinical cases in many clinical ART centres does not allow 'downtime' needed for training. Most important, any training provided lacks rigorous teaching of reproductive physiology and the theory underlying the techniques to be mastered. ART is a continuously evolving field with new tests and approaches emerging that require critical evaluation and appropriate implementation. CEs are practitioners as they provide advice/insight that directly impacts the patient's care. Thus, best practice has evolved in Europe and the United States to have a formal graduate training program in a university setting to ensure these individuals have a solid academic foundation to better make these critical decisions and to seek out, understand and apply new information derived from research studies directly to the clinic.

There is a two-fold need for CE education in Canada. Firstly, there is a need for trained embryologists in Canada. Secondly, CE training needs to move from an apprenticeship model to a formal academic professional model.

Formal certification processes, however, do exist in the United States and the United Kingdom. The United States and United Kingdom have established graduate programs to train CEs. With this driving our educational planning, as with the PA field, the laboratory science educators at the University of Toronto are well positioned to fill the need and mount a rigorous and comprehensive CE training program.

Currently, there is an academic focused infertility clinic at Sinai Health System. Physicians from OB/GYN working in this clinic recognized the need for our graduate professional program and are heavily involved in the creation and design of our MHSc. There are also a number of other high profile clinics within the city, which are serviced by some physicians who hold university clinical appointments in the Faculty of Medicine. The academic strength of innovative teaching and research in the Division of Reproductive Endocrinology and Infertility in the Department of Obstetrics and Gynaecology will provide faculty to fill the need for CE professional graduate education.

The European Society of Human Reproduction and Embryology (ESHRE) guidelines recommend "clinics that perform up to 150 [oocyte] retrievals and/or cryopreservation cycles per year should have always a minimum of two qualified clinical embryologists." This estimate would translate to at least 300 embryologists required in Canada for approximately 30 000 IVF cycles a year. Currently, there are approximately 150 embryologist members of the Canadian Fertility and Andrology Society (CFAS). There are some clinical embryologists who are not members of CFAS since it is not necessary to be a member to be able to practice in Canada. In both 2016 and 2017, there were more than 20 nationally placed advertisements for jobs for embryologists, attesting to the need. Importantly, this number does not reflect time needed for more complex cases, such as IVF performed with spermatids isolated from testicular biopsy and ovarian tissue cryopreservation, which are increasingly being offered by the more advanced clinics. Due to the previously noted influx of MOHLTC support, the number of IVF cycles (treatments) has doubled in the last two years. In addition, the number of high acuity services such as embryo biopsy has likewise doubled. Thus, there is a need for establishing an academic program that will train CEs for the job market.

In the United Kingdom, the Human Fertilization Embryology Authority (HFEA) requires that all embryologists undergo a "recognized training scheme" and be registered with the Health Care Professional Council (HCPC) as a clinical scientist with specific expertise in clinical embryology. Likewise, the standards of Association for Clinical Embryologists of the United Kingdom state that "all embryologists should have undergone a training scheme….such as MSC training in reproductive science."

We are not seeking any existing US clinical embryology accreditation since these do not align with our academic program that focuses on both basic science and applied practice but we will meet Canadian standards. In Canada, there is currently only a voluntary embryology exam given by the CFAS. It is anticipated that more formal mandatory testing will be required in the near future, especially by the Government of Ontario. A letter in Appendix H

describes CFAS' willingness "to collaborate with (our) curriculum development committee." The University of Toronto MHSc will be positioned to prepare clinical embryology graduates for future certification that is developed by a professional body. Please refer to Appendix G for a list of comparable programs in clinical embryology (or its closest equivalent).

There is also a global need for trained embryologists particularly in emerging economies. We anticipate an interest from international students once our program is well established. This is consistent with the University of Toronto's plans to expand its international student cohorts, including in programs that train health care professions. LMP is able to meet this goal as we have an excellent track record in training international pathologists and laboratory physicians. What helps in this regard as well is the diverse nature of our clinical teaching faculty, which will result in global interest in our new training program.

6 Enrolment

- Please provide details regarding the anticipated in-take by year, reflecting the expected increases to reach steady state. Include approximate domestic/international mix. This table should reflect normal estimated program length. (Please adjust the table as necessary.)
- Please provide an explanation of the numbers shown and their relation to the Faculty/division's enrolment plan. Please be specific where this may differ from approved enrolment plans.

The program will have an intake of 10 domestic students (5 for PA, 5 for CE), with an anticipate program start date of Fall 2020. It will remain at this state for the foreseeable future (i.e. steady state by 2021-2022). As noted under the heading Need and Demand, we expect a sufficient pool of high quality applicants to admit into this program. International enrolment will be considered once the program is well established (i.e. 2021/22 or 2022/23) and will count as additional students above the planned 10 domestic students. These enrolment projections are reflected in the Faculty of Medicine's five year budget plan. The program will be starting with a small group of students and is open to expanding this program in the future.

Table 1: Graduate Enrolment Projections*

	2020 - 21	2021 –22*	2022 - 23	2023 - 24	2024 – 25
Year 1	10	10	10	10	10
Year 2	-	10	10	10	10
Total	10	20	20	20	20

*Please note when the program expects to reach steady state.

7 Admission Requirements

- Provide a formal statement of admissions requirements, as they will appear in the SGS Calendar entry.
- Explain how the program's admission requirements are appropriate for the learning outcomes established for completion of the program.
  - How will they help to ensure students are successful?
    - Provide sufficient explanation of any admissions requirements that are above or in addition to the normal minimum requirements for a graduate program at this level (including higher GPA, specific knowledge or skills – e.g., prior calculus; prior professional practice; additional language, interviews, portfolio, letters of intent, etc.) For example, are there specific undergraduate or master's programs from which students may be drawn?

Minimum Admission Requirements

- Applicants are admitted under the General Regulations of the School of Graduate Studies and must also satisfy the additional admission requirements stated below
- Admission is based on demonstrated exceptional scholarly achievement, using the following criteria:
  - one page statement summarizing how this program will contribute to the advancement of the applicants' professional goals identifying their field of preference.
  - curriculum vitae (CV)
  - 2 letters of reference, one of which should be familiar with the candidate's scholarly activities
- Applicants must have an appropriate Bachelor of Science degree (B.Sc.) from a recognized university, with an average of at least B+ in the last two years of study. The students must have a demonstrated interest in human biological and life sciences, preferably with a major or specialist program in the life sciences. These programs prepare students for the study of biomedical science, for fluency in biomedical terminology, and for critical evaluation of biomedical literature. Courses in human anatomy and physiology are desirable.
- All potential students will be interviewed prior to final acceptance into the program. The initial selection of students will be based on a combination of their academic record, individual statement and letters of reference. These students will be asked to participate in an interview with the Program Coordinator to determine their fit with the program and their education/professional goals. Specifically, the interview will look for the applicant's demonstrated ability to effectively communicate, work in a team environment, valuing diversity and meeting goals. Furthermore, the interview will provide initial direction for the Program Coordinator to identify appropriate practicum placements.
- Applicants who were educated outside Canada, whose primary language is not English, and who graduated from a university where the language of instruction was not English, must demonstrate proficiency in the English language through the successful completion of the:

- Test of English as a Foreign Language (TOEFL) with the following minimum scores: Internet-based TOEFL: 100/120 and 22/30 on the writing and speaking sections.
- Michigan English Language Assessment Battery (MELAB) Web; Required score: 95
- International English Language Testing Systems (IELTS); Required score: 8.0 (Academic) with at least 6.5 for each component
- Certificate of English Proficiency (COPE); Required score: 86 minimum total with at least 22 each component and 32 in writing.
- School of Continuing Studies, University of Toronto, "Academic English" course Required score: a final grade of B in Level 60 (Advanced)

8 Program Requirements, Learning Outcomes, Degree-Level Expectations (DLEs), and Program Structure

- In a curriculum map, or in the table below, or in another format appropriate for the discipline, state the program learning outcomes and program requirements, and show how the program learning outcomes are appropriate for the degree level expectations.
- Discuss how the design, structure, requirements and delivery of the program are appropriate for the program learning outcomes and degree-level expectations. Please include:
    - The sequencing of required courses or other learning activities, etc.
    - The mode of delivery of the program (face-to-face; blended or online; placement, etc.) and how it is appropriate to support students in achieving the learning outcomes of the program and the degree-level expectations. Whether the program will be offered on a full-time basis only or will also be offered part-time and if so, why.
    - The program length for both full-time and part-time students. Address how the program requirements can reasonably be completed within the proposed time period.
    - Describe how the specific elements of the curriculum (e.g., Internships, etc.) will be administered.
    - A clear indication of how faculty "scholarship and research is brought to bear on the achievement of Degree Level Expectations" (UTQAP 1.1)
    - For research-focused graduate programs, provide a clear indication of the nature and suitability of the major research requirements for degree completion. For professional graduate programs, how the research expectations of the degree level expectations will be met.
    - Describe how the program structure and delivery methods reflect universal design principles and/or how the potential need to provide mental or physical health accommodations has been considered in the development of this program
    - Please include the standard text which has been inserted in the box.

Whereas the Province's Quality Assurance Framework requires that students complete a minimum of two-thirds of courses at the graduate level, the University of Toronto requires graduate students to complete all of their course requirements from amongst graduate level courses. This proposed program complies with this requirement. The program is offered only as a full-time two year program since there is progressive development throughout the curriculum that students must take in lockstep so that foundational knowledge is built and forms the basis to accumulate expert knowledge in one of the two fields. Most of the courses are face-to-face, combined with student presentations of assigned peer-reviewed journal articles and class discussions on the topic of the day. Emphasis is on quality of research, identification of gaps in knowledge and importance for clinical care which is focused on in the practicum courses. The courses are presented by tenured biomedical scientists, clinician-scientists, academic clinicians and status-only scientists appointed at the University of Toronto.

Physical health or mental health accommodations are handled through Faculty of Medicine and university student support services. There is no alternate pathway through the program so accommodations will be focussed on assisting the student in completing the program which is structured with minimum flexibility. It is necessary to cover all the material presented in courses, practicums and capstone projects. Inability to do so will require repetition of the year depending on the extent of absences and thus time to degree will be extended. This information will be communicated to students during the recruitment phase and again in the introduction to the program for new students.

The timetable below (Table 2) shows the sequencing of required courses; initial core courses designed for all clinical laboratory scientists provide the foundations and the essential knowledge for both PAs and CEs working in biomedical health care environments. This is followed by discipline specific courses that build on the information in the initial core courses. These discipline courses are designed to be more interactive and prepare students for the practicum components of the program where knowledge is applied in clinical type settings. The capstone course is designed to create a research environment in which much of the knowledge in the earlier courses is applied to investigate a biomedical research problem. Thus the program is designed to link the fundamental science learning closely to the applied science learning. The design is such that repetition of technical skills occur so that the students become proficient as they move through their applied practice.

The PA and the CE faculty will collaborate to design and present a core curriculum that covers many aspects of training such as laboratory quality and management, biobanking, principles of research bioethics and research integrity, research methodology and biostatistics. The capstone project (LMP 2005Y) will be a core component of the program. Students will select topics for a research project with the assistance of the field director. Students will spend a significant amount of time conducting research, under the supervision of a faculty mentor whose research interest align with the student's interest. Students will be assessed based on their performance during the course and final written and oral reports. This capstone will significantly add to the academic nature of the program and enhance the job opportunities for our future graduates, especially at research institutions, in industry and in clinical trial settings where strong academic credentials are valued.

Description of Curriculum for the field of Pathologists' Assistant

The foundation core courses focus on providing a solid understanding of the science of molecular biology, *Cell and Molecular Biology* (LMP 2000H). The PA specific courses *Basic Principles in Human Pathobiology* and *Pathophysiology* (LMP 2200H) and *Anatomy and Pathology of Organ Systems* (LMP 2201H) utilize this molecular biology information to provide the student with an understanding of the cellular and system origins of diseases to which PAs are exposed to in their daily work. The ability to critically appraise current scientific literature and laboratory practice is emphasized and is further considered in *Biomedical Research Methods* (LMP 2001H) in the first semester and *Biostatistics* (LMP 2004H) in term three. The early introduction of *Biomedical Ethics* (LMP 2003H) sets the stage for the type and quality of discourse and professional behaviour expected of the students. Ethical considerations transcend virtually all aspects of laboratory science education including research ethics, diversity, consideration of respectful handling of human tissues, and professionalism in interactions with colleagues and patients. This course will ensure that ethics and professionalism is explicitly taught to the students (LMP 2001H).

Early on, the students are introduced to laboratory processes and standards in *Clinical Laboratory Management* (LMP 2002H) which are essential concepts for those working in a clinical laboratory setting. This learning will continue in the series of practicums.

Having solidified the cognitive skills, the student will then learn the technical skills in terms 3, 4, 5 and 6 in the series of practicum courses (LMP 2202H-2210H). The practicums are organized along organ systems and in each, the student begins at an introductory level and proceeds to intermediate and then expert level. The PAs are trained in three areas of anatomic pathology that they will likely encounter upon graduating: surgical pathology, autopsy pathology and forensic pathology.

The *Capstone Project* (LMP 2005Y), spread over the last three terms, will pull together the knowledge acquired in the fundamental sciences, *Biomedical Research Methods* (LMP 2001H), *Biostatistics* (LMP 2004H) and *Biomedical Ethics* (LMP 2003H). Students will be asked to apply their knowledge to an important question to be answered scientifically. They will first identify a gap in scientific biomedical knowledge to explore and then learn to design and analyze research protocols. The PA students will use the fundamental knowledge gained in LMP 2200H (*Basic Principles in Human Pathobiology and Pathophysiology*) and LMP 2201H (*Anatomy and Pathology of Organ Systems*) to choose an area to work on. The Capstone Project (LMP 2005Y) involves considerable communication opportunities and teaches students to be critical and defend their scientific and applied ideas in front of peers and faculty.

Description of Curriculum for the field of Clinical Embryology

The foundations of ART are molecular biology (*Cell and Molecular Biology*, LMP 2000H), and reproductive physiology (*Advanced Reproductive Physiology,* LMP 2100H). These two courses provide the student with the cellular and system origins of reproduction. To complement this is an introduction to laboratory processes and standards in *Clinical Laboratory Management* (LMP 2002H).

Ethical considerations transcend virtually all aspects of this education from research ethics, to diversity consideration to disposition of gametes, and a working knowledge of this will be provide by *Biomedical Ethics* (LMP2003H). This course will ensure that professional capacity is explicitly taught to the students.

Following these foundational courses, the student layers a deeper understanding of embryology and the genetics behind it in *Human Embryology* (LMP 2101H) and *Reproductive Genetics* (LMP 2103H). At the same time, basic clinical laboratory embryology is introduced in *Foundations in ART (LMP* 2102H) and then more sophisticated application is taught in *Applied Methods in ART* (LMP 2104H).

In term four, the students will apply their knowledge in three related courses: *Innovations in* ART (LMP 2105H), *Current Topics in Causes and Treatment of Infertility* (LMP 2106H) and *Applied ART: Laboratory Decision Making* (LMP 2107H). These courses will address controversies in the delivery of ART. This requires an appreciation of the gaps in knowledge and the ability to critically appraise current scientific literature and laboratory practice. The early introduction of research methods (Biomedical Research Methods, LMP 2001H) will set the stage for the type and quality of discourse expected of the students.

Having solidified the cognitive skills, the student will learn technical skills in terms 5 and 6. *Clinical Embryology Laboratory Simulation I* (LMP 2108H*) and Clinical Embryology Laboratory Simulation II* (LMP 2109H) will give CE students the minimum skills required to work in a clinical embryology laboratory. *ART Laboratory Rotation* (LMP 2110H) will layer the real-life element, providing exposure to interprofessional collaboration.

The capstone project (LMP2005Y) will pull together the knowledge acquired in *Foundations in ART* (LMP 2102H), *Biomedical Research Methods* (LMP 2001H), *Biostatistics* (LMP 2004H) and *Biomedical Ethics* (LMP 2003H) and ask the student to apply it to a question to be answered scientifically.

In summary, the introductory level will be standard procedures and the science behind them. (LMP 2000H, 2003H, 2100H, 2101H, and 2103H). This will be followed by innovations (LMP 2105H) which will require analysis of processes and procedures, and will ask the student to combine the content from Applied Methods in ART and Clinical Lab Management and Biomedical Research Methods and Biostatistics. Finally, the student will be asked to layer economic and management factors to efficacy factors in Applied ART Laboratory Decision Making.

Table 2. MHSc in Laboratory Medicine: Course Time Table

	TERM 1 Fall	TERM 2 Winter	TERM 3 Summer	TERM 4 Fall	TERM 5 Winter	TERM 6 Summer
CORE	Cell and Molecular Biology (LMP 2000H, 0.5 FCE)	Clinical Lab Management (LMP 2002H, 0.5 FCE)	Biostatistics (LMP 2004H, 0.5 FCE)	Capstone Research Project (LMP 2005Y, 1.0 FCE)		
	Biomedical Research Methods (LMP 2001H, 0.5 FCE)	Biomedical Ethics (LMP 2003H, 0.5 FCE)				
Clinical Embryology	Advanced Reproductive Physiology (LMP 2100H, 0.5 FCE)	Human Embryology (LMP 2101H, 0.5 FCE)	Reproductive Genetics (LMP 2103H, 0.5 FCE)	Innovation in ART (LMP 2105H, 0.5 FCE)	CE Lab Simulation I (LMP 2108H, 0.5 FCE)	ART Lab Rotations (LMP 2110H, 0.5 FCE)
		Foundations in ART (LMP 2102H, 0.5 FCE)	Applied Methods in ART (LMP 2104H, 0.5 FCE)	Current Topics in Causes and Treatment of Infertility (LMP 2106H, 0.5 FCE)	CE Lab Simulation II (LMP 2109H, 0.5 FCE)	
				Applied ART Laboratory Decision Making (LMP 2107H, 0.5 FCE)		
Pathology Assistants	Basic Principles in Human Pathobiology and Pathophysiology (LMP 2200H, 0.5 FCE)	Anatomy and Pathology of Organ Systems (LMP 2201H, 0.5 FCE)	Practicum in Surgical Pathology I (LMP 2202H, 0.5 FCE)	Practicum in Surgical Pathology III (LMP 2204H, 0.5 FCE)	Practicum in Autopsy Pathology (LMP 2206H, 0.5 FCE)	Practicum in Surgical Pathology V (LMP 2209H, 0.5 FCE)
			Practicum in Surgical Pathology II (LMP 2203H, 0.5 FCE)	Practicum in Surgical Pathology IV (LMP 2205H, 0.5 FCE)	Practicum in Forensic Pathology (LMP 2207H, 0.5 FCE)	Practicum in Surgical Pathology VI (LMP 2210H, 0.5 FCE)
					Biobanking for Research (LMP 2208H, 0.5 FCE)	
	Elective* (0.5 FCE)					

	Credits
Core	3.5
CE field	5.5
PA field	5.5
Core Elective	0.5

**Students select one elective from the graduate studies calendar. Can be taken in any of the 6 terms.*

This table provides information on how each of the Degree Level Expectations are evaluated and why these methods are appropriate.

Table 3: Evaluation of Learning Objectives

Master's DLEs (based on the Ontario Council of Academic Vice-Presidents [OCAV])	**Master's Program Learning Objectives and Outcomes**	**How the Program Design and Requirements Supports the Attainment of Student Learning Outcomes** Note: please see the curriculum map in Appendix F to support the explanation in this column.
Expectations: **This MHSc in Laboratory Medicine is awarded to students who have demonstrated:**		
1. Depth and Breadth of Knowledge A systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of the academic discipline, field of study or area of professional practice.	Depth and Breadth of Knowledge is defined in Laboratory Medicine as general and specific knowledge of a broad range of scientific and medical concepts, principles and applied practical skills that allow for use of evidence based pathology and embryology knowledge and information to assist in handling and assessing pathological tissue specimens and fertility related tissue for the diagnosis and treatment of human disease and infertility. *Core Outcomes:* • Understand the fundamental cell and molecular biology principles of pathology and reproductive technology used in the clinical laboratory. • Identify gaps in knowledge that lead to research and clinical investigations • Understand the principles of laboratory quality assurance *PA Outcomes:* • Identify and list the etiology and pathogenesis of human diseases • Recognize tissue specimen variation and decide which laboratory approaches are best suited to each type of variation	The program design and requirements that ensure these student outcomes for depth and breadth of knowledge are: *Core-specific program design*: An introduction of molecular and cell biology will be provided in LMP 2000H and applied in human embryology, LMP 2101. These principles will also be applied in the understanding of the genetic underpinnings for fertility & reproductive diagnosis in LMP 2103H. These courses will combine didactic lectures with student presentations. An understanding of molecular and cell biology will be applied for CE students in LMP 2106H as emerging literature relevant to clinical embryology is presented and critically discussed. PA students will integrate cell biology in the understanding of human pathology as types of disease categories are introduced in LMP 2200H through didactic lectures. LMP 2201H will build on some aspects of LMP 2200H and will focus on disease in certain organs and tissues. A central philosophy of the program is to question the known literature and to be self-reflective. In all courses, but particularly the later courses, instructors encourage this kind of critical and reflective thinking in students - through student presentations and discussions. Quality assurance is a critical practice for all clinical laboratories. Fundamental knowledge of quality assurance will be provided in LMP 2002H, and this knowledge will be applied in courses LMP 2104H and LMP 2105H for CE students and throughout all the practicum series for PA students [LMP 2202H to LMP 2210H].

Master's DLEs (based on the Ontario Council of Academic Vice-Presidents [OCAV])	Master's Program Learning Objectives and Outcomes	How the Program Design and Requirements Supports the Attainment of Student Learning Outcomes Note: please see the curriculum map in Appendix F to support the explanation in this column.
	CE Outcomes: • Understand reproductive physiology and the underlying pathophysiology leading to common causes of infertility • Know current ART procedures, their indications, strengths, and limitations	*PA-specific program design:* Students will be presented important context to view and classify disease conditions. LMP 2000H - general to normal cell and biology; LMP 2200H - general to disease; LMP 2201H – disease in organ systems. Practica will be organized by organ system. Students will begin learning about each organ tissue type at the introductory level and progress to intermediate and then to expert as they move through the program (as indicated by colour). *CE-specific program design:* CE students are introduced to causes of infertility in the first 3 terms, including those that result from developmental sequelae. This general information is reinforced with a deeper understanding through critical analysis of current relevant literature in LMP 2106H. The objective is ensure students have a solid foundation to understand the application of specific technologies to these populations. Students will learn the general approaches to infertility treatment in LMP 2100H. Specific aspects of each of these approaches as they pertain to the andrology and embryology laboratories will be presented in LMP 2102H and 2104H. This will be applied in LMP 2105H as students explore and discuss nascent changes in existing technologies and impact of technological advances in the near future. Students will develop decision-making skills as to the appropriate application of existing techniques in LMP 2107H.
2. Research and Scholarship A conceptual understanding and methodological competence that • Enables a working comprehension of how established techniques of research and inquiry are used to create and interpret knowledge in the discipline;	Research and Scholarship is defined in Laboratory Health Sciences as the ability to interpret and synthesize scientific information and medical findings to understand the pathobiology of human disease. Core outcomes: • Critically read and interpret research and clinical literature in the disciplines of pathology or ART • Understand the principles involved in developing a viable research proposal	The program design and requirements that ensure these student outcomes for research and scholarship are: Students are introduced to overall research approaches in LMP 2000H and LMP 2001H, which will be built upon in the Biostatistics course (LMP 2004H). These courses will provide the basic tools to critically review the relevant literature within their respective streams. For CE students, examples of key studies leading to development of laboratory procedures in the embryology lab will be presented in terms 3 and 4, with the students applying their reviewing skills in LMP2106 and 2107, and putting the skills into practice in their

Master's DLEs (based on the Ontario Council of Academic Vice-Presidents [OCAV])	Master's Program Learning Objectives and Outcomes	How the Program Design and Requirements Supports the Attainment of Student Learning Outcomes Note: please see the curriculum map in Appendix F to support the explanation in this column.
• Enables a critical evaluation of current research and advanced research and scholarship in the discipline or area of professional competence; and • Enables a treatment of complex issues and judgments based on established principles and techniques; and, on the basis of that competence, has shown at least one of the following: • The development and support of a sustained argument in written form; or • Originality in the application of knowledge.	• Critically assess technologies for their appropriate use and effectiveness	capstone project. For PA students, the introduction to research provided in the core courses will form the basis for further critical literature review and interpretation necessary for their capstone project. The students are introduced to concepts that will enable them to ultimately produce a viable and defensible research plan/proposal in LMP 2001H, and the need to obtain appropriate research ethics board approval in LMP2003. Consideration of statistical testing and how it impacts experimental design will be conveyed in LMP 2004. The student will apply this knowledge in developing their own research plan in LMP2005. For PA students this will include a clear understanding of the role and importance of the biobank in research. The ability to critically assess existing and emerging technologies and apply them appropriately is an important element in the expectations of a clinical laboratory specialist. All students are introduced to research evaluation in LMP 2001H. PA will apply this in LMP 2203H and CE will be exposed to technologies relevant to embryology in the Foundations in ART course (LMP 2102H) with a more critical view taken in LMP 2104H and LMP 2105H. In LMP 2107H, students will learn to apply this knowledge to making clinical care decisions/recommendations. The capstone project will also entail the appropriate application of experimental or clinical technology for both PA and CE students. The expectation is that the student's level of expertise in this application will advance as the capstone project progresses.
3. Application of Knowledge Competence in the research process by applying an existing body of knowledge in the critical analysis of a new question or of a specific problem or issue in a new setting.	Application of Knowledge is defined in Laboratory Health Sciences as the use of anatomic pathology and clinical embryology information and principles to guide work performance decisions. Core outcomes: • Know when and how to use statistical tests • Apply quality assurance processes in the clinical lab	The program design and requirements that ensure these student outcomes for application of knowledge are: Core-specific program design: An understanding of fundamental statistical principles is important for the critical evaluation of the literature and clinical purposes. Quality assurance is an integral part of any clinical lab. The students are introduced to quality assurance practices in the clinical lab

Master's DLEs (based on the Ontario Council of Academic Vice-Presidents [OCAV])	Master's Program Learning Objectives and Outcomes	How the Program Design and Requirements Supports the Attainment of Student Learning Outcomes Note: please see the curriculum map in Appendix F to support the explanation in this column.
	• Recommend and justify the need for follow-up evaluation and/or procedures based on initial findings and clinical context PA outcomes: • Interpret clinical pathology results with an understanding of the inherent strengths and limitations of an individual procedure • Use patient medical and hospital records to guide clinical work CE outcomes: • Assess oocytes, sperm, and embryos • Perform laboratory techniques used in ART	and their importance in core course LMP 2002H. These overall principles will be expanded upon in field-specific courses as specific aspects diverge between the pathology and embryology laboratory. For CE students, these discipline-specific practices are presented in LMP 2102H with further in-depth information presented in LMP 2104H, and in LMP 2107H, in a coordinated fashion. The CE students will gain practical skills by performing standard quality assurance testing as part of their CE simulation lab training (LMP 2108H and 2109H), where they will become proficient in monitoring key quality procedure parameters. Finally, as part of their clinical lab rotation (LMP 2110H), CE students will observe and participate in quality assurance procedural monitoring in an active operational clinical embryology laboratory. For PA students, this will also include standards for autopsy dissection and forensic examination which will be covered in LMP 2206H and LMP 220Hh. Decision making in ART is the shared purview of the two care providers: embryologist and physician. The CE student will be introduced to important concepts that form the knowledge base to meet this challenge throughout their training. How this is applied will be introduced in LMP 2102 (Foundations in ART) and LMP 2104 (Applied Methods in ART). This learning objective will be strengthened and evaluated in LMP 2107. Ultimately, these decisions are the responsibility of the attending physician, so an intermediary level of competence is the expectation of the program of the human component of the decision making compared to the cell component. In the practicum series the PA student will be taught to search for and identify areas for follow-up evaluation. This skill will build as the practicum progresses and will focus on specific organ systems. *PA-specific program design:* This learning objective addresses a task that is essential to a PA's daily routine. Students will be exposed to the basic principles in gross dissection and interpretation in LMP 2200H and 2201H. How this varies with the

Master's DLEs (based on the Ontario Council of Academic Vice-Presidents [OCAV])	Master's Program Learning Objectives and Outcomes	How the Program Design and Requirements Supports the Attainment of Student Learning Outcomes Note: please see the curriculum map in Appendix F to support the explanation in this column.
		assessment of specific tissue types and diseases will be addressed in the practicum series. This learning objective covers a skill that is essential for the PA student to acquire. The ability to critically read the patient's chart, using the clinical history and laboratory findings to guide the examination and submission of appropriate tissue specimens for microscopic examination, including any special procedures (e.g. molecular analysis). This skill will be developed in each practica as they relate to specific organ systems. As the practica series progresses, the student will become more adept at interpreting the charts and performing a clinical pathology correlation. *CE-specific program design:* The ability to assess gamete and embryo quality based on qualitative and quantitative histomorphic and behavioural (e.g. sperm motility) parameters is a fundamental task performed by all practicing clinical embryologists. CE students will be introduced to the concept of grading and the general principles of gamete and embryo assessment in LMP 2102H (Foundations in ART). The application of evaluation criteria will be discussed in detail in LMP 2104H (Applied Methods in ART) and applied in the CE simulation lab (LMP 2108H and LMP 2109H), where the student is expected to show proficiency and accuracy in these evaluations. The student will then observe and, in some cases, participate in the evaluation of gametes and/or embryos in the practicing clinical embryology lab as part of LMP 2110H. Within the CE simulation lab, we will provide students with directed practice in ART laboratory techniques. This will allow us to ensure the student develops a beginner level 'hands-on' technical skills in common procedures required by potential employers.
4. Professional Capacity/ Autonomy • The qualities and transferable skills necessary for	Professional Capacity/Autonomy is defined in Laboratory Health Sciences as the ability to apply the appropriate skills required for the interpretation and use of human	The program design and requirements that ensure these student outcomes for professional capacity/autonomy are: Core-specific program design:

Master's DLEs (based on the Ontario Council of Academic Vice-Presidents [OCAV])	Master's Program Learning Objectives and Outcomes	How the Program Design and Requirements Supports the Attainment of Student Learning Outcomes Note: please see the curriculum map in Appendix F to support the explanation in this column.
employment requiring ○ The exercise of initiative and of personal responsibility and accountability; and ○ Decision-making in complex situations • The intellectual independence required for continuing professional development; • The ethical behavior consistent with academic integrity and the use of appropriate guidelines and procedures for responsible conduct of research; and • The ability to appreciate the broader implications of applying knowledge to particular contexts.	genomic data in a laboratory setting. Core outcomes: • Know, and be able to apply ethical standards for clinical laboratory science • Know and follow the professional guidelines for communication of clinical findings • Appreciate the consequence of growing availability of cell and molecular biology information on clinical medicine CE outcomes: • Understand how the embryologist can provide patient centered care	Ethical practice and adherence is a basic tenet of professionals. Situation-specific aspects to laboratory medicine, pathology and fertility will be studied. PA: Several courses will deliver knowledge of standards including consents, scope of analysis, and use of tissue for research. CE students will study the legal framework within which the profession practices (Assisted Human Reproduction Act). The application and relevance are addressed in LMP 2104H, 2105H, and 2107H, in particular procedures and approaches. Communication of clinical findings, maintaining patient confidentiality and respect is a common element for both fields. Basic principles will be introduced in LMP 2003H as part of Biomedical Ethics course, including appropriate legal requirements. Clinical embryologists often must communicate with patients or other healthcare providers on sensitive information regarding genetic disorders. This field-specific aspect will be outlined as part of the Reproductive Genetics course, LMP 2103H, with situational testing on simulated case studies in that course as well as in. LMP 2107H, Applied ART: Laboratory Decision Making. Confidentiality of the situation and results for PAs becomes a concern for autopsy and forensic pathology and biobanking. Clinical laboratory specialists are encouraged to consider new technologies and advances in our understanding of disease and their treatment. The use of genetic information in clinical labs will increase in the foreseeable future. A fundamental understanding of cell and molecular biology, presented in LMP 2000H will provide the tools needed to appreciate what these changes entail. For CE students, these concepts will be expanded on as they apply to preimplantation genetic testing and screening (LMP 2103H) and decision-making (LMP 2107H). For PA students, emerging skills for tissue handling and processing for molecular genetic testing will be discussed within the practicum series. *CE-specific program design*:

Master's DLEs (based on the Ontario Council of Academic Vice-Presidents [OCAV])	Master's Program Learning Objectives and Outcomes	How the Program Design and Requirements Supports the Attainment of Student Learning Outcomes Note: please see the curriculum map in Appendix F to support the explanation in this column.
		Cultural awareness; sensitivity to diversity; and appreciation of health inequity as related to infertility care in general and ART in particular are essential for the clinical embryologist. Legal and ethical requirement will be taught in Biomedical Ethics (LMP 2003H) with concepts relevant to ART discussed in Foundations in ART (LMP 2102) and Applied ART: Laboratory Decision Making (LMP 2107)
5. Communications Skills The ability to communicate ideas, issues and conclusions clearly.	Communications Skills is defined in Laboratory Health Sciences as the ability to communicate anatomic pathology and clinical embryology information in a clear, easily understood fashion tailored to the level of understanding of the audience. This is reflected in students who are able to present critical reviews of appropriate scientific areas and clinical reports on applied topics as part of their clinical workload. Creating research reports on their capstone project, presenting orally and defending their research work. *Core outcomes*: • Create written and oral presentations on research topics and literature • Synthesize complex information in written and oral form to present to appropriate stakeholders	The program design and requirements provide the student opportunities to develop written and oral communication skills through class presentations and written assignments. These have been incorporated into all courses in the program. Students will develop and defend a research proposal relevant to their field as part of their capstone project. LMP 2005Y is a continuous course where students will learn how to give a strong presentation and how to write an effective proposal. These skills will be strengthened with feedback provided by preceptors and instructors, to culminate in a finished project. For CE students, written research summaries and presentation will be a fundamental component of LMP 2106H. Communication of knowledge translation will also be taught within the interactive Applied ART: Laboratory Decision Making (LMP 2107H). Students will be asked to evaluate the work of their peers, further embedding the learning of these skills. Communication with peers within the embryology lab, between various team members within the ART clinic and with patients, is essential for the delivery of safe and appropriate patient care. Simplification of complex procedures and concepts to other ART team members and/or patients is often necessary. We will work towards this in multiple courses within the program. Simplification of complex genetic testing information will be discussed in LMP 2103H and increasingly complex laboratory procedures in LMP 2104H and LMP 2105H. Communication of complex information is a focus of the capstone project and by its completion, students should demonstrate a level of expertise in this skill. This will also

Master's DLEs (based on the Ontario Council of Academic Vice-Presidents [OCAV])	Master's Program Learning Objectives and Outcomes	How the Program Design and Requirements Supports the Attainment of Student Learning Outcomes Note: please see the curriculum map in Appendix F to support the explanation in this column.
		be an important element of the evaluation of the student by their preceptor during the clinical lab rotation. For PAs, communication with the full pathology team, including other PAs, supervising pathologists, and technicians will be introduced in LMP2002H and applied in the practicum series.

9 Assessment of Learning

- Appropriateness of the proposed methods for the assessment of student achievement of the intended program learning outcomes and degree-level expectations.
- Describe plans for documenting and demonstrating the level of performance of students consistent with the DLEs. (Assessment of Teaching and Learning examples in Guide to Quality Assurance Processes)

Assessment of Learning:

In this section, we will first summarize the main kinds of assessments to provide an overview. This will be followed a detailed breakdown in Table 4. The assessment of learning in this program uses evaluations of various teaching modalities employed in the program to show the level of performance of each student with respect to DLE's.

a) Students are evaluated on the knowledge taught in the didactic lectures through quizzes and exams, which is appropriate for the DLE and LO described. These will be administered in-class and will test application of the learned material and the degree of understanding through recall of key concepts and through applying the knowledge to written scenarios and problems.
b) Student presentations to peers and faculty will evaluate several aspects of student learning. These include their ability to critically review, and in some cases select, relevant literature; their ability to assemble material from multiple sources and place it in a logical progression, their ability to take complex information and extract key information, and their ability in oral communication and developing critical and defensible arguments. These skills are important for instilling a process for lifelong self-directed learning.
c) Student discussions on topics of the day are evaluated by course instructors based on engagement, knowledge and innovative thinking. This allows instructors to evaluate student comprehension of the material in an ongoing fashion, enabling them to provide additional explanation as might be required.
d) Student essay and reports are evaluated by instructors using a marking scheme that evaluates format, background knowledge, critical assessments and innovative conclusions. Similar to the preparation for class presentations, these activities enable instructors to assess the students' ability to select and evaluate relevant literature, their ability to assemble this material into an original, informative, and focused

document, their ability to take complex information and extract key information, and their written communication skills. These skills are important for instilling a process for lifelong self-directed learning.

e) Practicums are assessed by quizzes, by competency checklists, by maintenance of student activity logs and by observations of tasks by faculty instructors. These tools are appropriate to assess practicum learning. They allow the instructor the ability to directly evaluate how well the students understand the material taught in the practicums and how well they are able to apply what they have learned and how they can problem solve based on their fundamental academic and clinical knowledge and skills. Technical skills are vital aspects for both PAs and CEs. For CEs, the simulation lab and rotations will provide them with basic skills that they can then build upon in their employment as they develop expertise.

How the program will document and demonstrate the level of performance of students' consistent with the University's DLEs

The MHSc in Laboratory Medicine will establish a Curriculum and Oversight Committee which will consist of the Program Coordinator, Field Directors, key faculty and at least one practicum site leaders. Please refer to Appendix E for the Program Organizational Chart. Its purpose will be to review student grades and student evaluation of courses to assess whether the program is meeting its objectives. This committee will meet at least twice a year to discuss the curriculum, specifically how to identify and address gaps in the curriculum, review the assessments of practicum placements, and identify program strengths and areas for improvement.

The program has been designed to allow for flexibility in curriculum design to incorporate new knowledge in pathology and advanced reproductive technology/infertility. This structured evaluation and course-planning approach will ensure that students are being provided with effective and relevant content.

The following metrics to measure the success of the program will be implemented and the data gathered will help the Program Director and necessary committees make important decisions regarding the training of these students:

1) Evaluations: Course, Capstone and Program Exit Evaluations

All students will be provided with an anonymous course evaluation form to complete at the end of the course. Their responses to this will help guide subsequent revisions to the program.

Students will also have the opportunity assess their Capstone Project experience through a written report and oral exit evaluation. The success of each capstone project will be rated on student participation, final formal oral presentation, and final written report. Potential for abstract/paper submission will be encouraged and requested, when appropriate.

Upon completion of the program, students will complete an exit survey allowing them to assess the overall quality of the program on 3 topics: content, overall teaching and student experience.

2) Review of Grades and Quality of Assignments

This committee will meet two times a year to assess whether the learning outcomes of the courses delivered have been achieved by reviewing grades and the quality of assignments

3) Tracking Success of Graduates

Graduates will be tracked annually by the department immediately after graduation and every year thereafter. Such records will include passing board certification and first employment of graduates so that short term and longitudinal data will be available for review by program and field directors.

Table 4. Assessment of Program Learning Outcomes & Degree Level Expectations

	Type of Learning Objective	Program Learning Outcomes	BOTH	PA	CE	Type of Assessment			
						Quizzes and Exams	Written reports	Oral presentations	Practical examinations
L-01	Depth and Breadth of Knowledge	Understand the fundamental cell and molecular biology principles of pathology and reproductive technology used in the clinical laboratory.	x			Students will be assessed through examinations that will determine the extent of their knowledge in all listed courses.	Students will be assessed based on the quality of review summaries in LMP 2100H, 2101H, 2103H, and 2200H. Students will also submit written reports of their presentation topics in LMP 2000H, 2106H and 2201H.	Students will be assessed on the quality and content of their in class presentations and discussions in LMP 2000H, 2102H, 2106H, and 2201H.	
L-02	Depth and Breadth of Knowledge	Identify gaps in knowledge that lead to research and clinical investigations	x			Students will be evaluated through examinations and quizzes [LMP 2001H, 2102H, 2103H, and 2106H].	All students will be assessed through written assignments in LMP 2001 and on the rationale and significance of the self-selected topic of their capstone research project [in consultation with their capstone supervisor] in LMP 2005Y. CE students will be assessed on written critical assessments of literature on laboratory approaches in clinical embryology in LMP 2105H and LMP 2106H.		
L-03	Depth and Breadth of Knowledge	Understanding the principles of laboratory quality assurance	x			Students will be evaluated based upon their understanding of topics related to laboratory management and quality assurance through set quizzes and examinations in LMP 2002H. CE students will be assessed by quizzes	PA students will be assessed for their knowledge of quality assurance compliance by viewing video case studies and providing a written analysis in their practicum series. CE students will be assessed based upon written reports of oral presentations in LMP 2104H and 2105H.	Students will be evaluated on their presentation and discussions in LMP 2104H and 2105H (for CE students) and in their practicum series courses (PA students)	

Table 4. Assessment of Program Learning Outcomes & Degree Level Expectations

	Type of Learning Objective	Program Learning Outcomes	BOTH	PA	CE	Type of Assessment			
						Quizzes and Exams	Written reports	Oral presentations	Practical examinations
						and exams in LMP 2104H and 2105H.			
L-04	Depth and Breadth of Knowledge	Identify and list the etiology and pathogenesis of human diseases		x		Students will be assessed by quizzes and examinations.		Students will be evaluated on their presentations and discussions in LMP 2000H, 2200H, and 2201H	
L-05	Depth and Breadth of Knowledge	Recognize tissue specimen variation and decide which laboratory approaches are best suited to each type of variation		x		Students will be assessed by quizzes within each course of the PA practicum series.		Students will be evaluated based on their presentation and discussions in their practicum series courses.	Students will be assessed based upon a competency checklist in the practicum series
L-06	Depth and Breadth of Knowledge	Understand reproductive physiology and the underlying pathophysiology leading to common causes of infertility			x	Students will be assessed by in-class quizzes and examinations (LMP 2100H, LMP 2101H and LMP 2103H).	Students will be assessed based on written assignments (LMP 2103H), on written summaries of topics presented by other students and an in-depth written summary of their oral presentation topics (LMP 2100H, LMP 2102H and LMP 2106).	Students will be evaluated based on their oral presentations and participation in class discussions (LMP 2100H; LMP2101H, LMP2202H, LMP2103H, and LMP2106H)	

Table 4. Assessment of Program Learning Outcomes & Degree Level Expectations

	Type of Learning Objective	Program Learning Outcomes	BOTH	PA	CE	Type of Assessment			
						Quizzes and Exams	Written reports	Oral presentations	Practical examinations
L-07	Depth and Breadth of Knowledge	Know current ART procedures, their indications, strengths, and limitations			x	Students will be assessed by in-class quizzes and examinations (LMP 2100H, LMP 2102H, LMP 2104H and LMP 2103H).	Students will be assessed based on written assignments and a written review paper (LMP 2107H), on written summaries of topics presented by other students and an in-depth written summary of their oral presentation topics (LMP 2100H, LMP 2102H, LMP 2104H and LMP 2105H)	Students will be evaluated on their oral presentations and participation in class discussions (LMP 2100H, LMP2202H, LMP2104H, and LMP2105H)	
L-08	Research and Scholarship	Critically read and interpret research and clinical literature in the disciplines of pathology or ART	x			Students will be assessed by in-class quizzes and examinations (LMP 2000H, LMP 2001H, LMP 2102H, LMP 2104H, LMP 2106H)	Students will be assessed based upon their written assessments of published literature (LMP 2000H, LMP 2001H), written assignments (LMP 2001H), written summaries of topics presented by other students and an in-depth written summary of their oral presentation topics (LMP 2102H, LMP 2104H and LMP 2105H) as well as weekly evaluations of class presentations (LMP 2106H). The students will also submit a	Students will be assessed based on the caliber of their critical analysis presented orally and within ensuing class discussions [all courses within this learning objective].	

Table 4. Assessment of Program Learning Outcomes & Degree Level Expectations

	Type of Learning Objective	Program Learning Outcomes	BOTH	PA	CE	Type of Assessment			
						Quizzes and Exams	Written reports	Oral presentations	Practical examinations
							research proposal as part of their capstone project.		
L-09	Research and Scholarship	Understand the principles involved in developing a viable research proposal	x			Students will be assessed by quizzes and examinations (LMP 2001H, LMP 2102H, LMP 2203H)	Students will be assessed based upon in-class written assignments (LMP 2001H, LMP 2003H) and the quality of their written research proposal (LMP 2005Y)	Students will be evaluated on their oral presentations and participation in class discussions (LMP 2100H, LMP2202H, LMP2104H, and LMP2105H) and the oral defense of their capstone project.	
L-10	Research and Scholarship	Critically assess technologies for their appropriate use and effectiveness	x			Students will be assessed by quizzes and examinations [LMP 2001H, LMP 2102H, LMP 2107H].	Students will be assessed based on the content and quality on their written research proposal in LMP2005Y, and by in-class written assignments (LMP 2001H, 2101H, 2102H)	Students will be evaluated on their oral presentations and participation in class discussions (LMP 2100H, LMP2202H, LMP2104H, and LMP2105H) and the oral defense of their capstone project.	Students will be assessed based upon a competency checklist in LMP 2203H
L-11	Application of Knowledge	Know when and how to use statistical tests	x			Students will be assessed by quizzes and problem-based examinations	Students will be assessed based upon in-class written assignments in LMP 2004H		
L-12	Application of Knowledge	Apply quality assurance processes in the clinical lab	x			Students will be assessed by case-based quizzes			

Table 4. Assessment of Program Learning Outcomes & Degree Level Expectations

	Type of Learning Objective	Program Learning Outcomes	BOTH	PA	CE	Type of Assessment			
						Quizzes and Exams	Written reports	Oral presentations	Practical examinations
						and examinations (LMP 2002H, 2102H, 2104H, 2107H,2108H, and 2109H)			Students will be assessed based upon an on-site clinical supervisor or preceptor evaluation in LMP 2202H, 2206H, 2207H, and 2110H.
L-13	Application of Knowledge	Recommend and justify the need for follow-up evaluation and/or procedures based on initial findings and clinical context	x			Students will be assessed by quizzes and examinations in LMP 2102H, 2104H (for CE students) and by quizzes in the PA practicum series.	Students will be assessed based upon problem-based learning assignments in LMP 2104H and 2107H (for CE students).	Students will be evaluated on their oral presentations and participation in class discussions (LMP 2107H)	PA students will be assessed based upon a competency checklist applied in each of the PA practicum series
L-14	Application of Knowledge	Interpret clinical pathology results with an understanding of the inherent strengths and limitations of an individual procedure		x		Students will be assessed by quizzes and examinations in LMP 2200H, 2201H, and in all PA practicum courses.			Students will be assessed based upon a competency checklist applied in each of the PA practicum series
L-15	Application of Knowledge	Use patient medical and hospital records to guide clinical work		x		Students will be evaluated through on-site quizzes performed within each course of the PA practicum series.	PA students will be assessed by viewing video case studies and providing a written analysis in all courses of the PA practicum series.		
L-16	Application of Knowledge	Be able to assess oocytes, sperm, and embryos			x	Students' knowledge in assessing gametes and embryos will be assessed			Student technical ability to assess gametes and embryos

Table 4. Assessment of Program Learning Outcomes & Degree Level Expectations

	Type of Learning Objective	Program Learning Outcomes	BOTH	PA	CE	Type of Assessment			
						Quizzes and Exams	Written reports	Oral presentations	Practical examinations
						by quizzes and exams in the foundation courses, LMP 2102H and 2104H.			will be assessed in a competency checklist and in practical exams conducted in the CE simulation courses, 1 and 2109. Students will also be assessed by preceptors during the clinical lab rotations (LMP 2110).
L-17	Application of Knowledge	Perform laboratory techniques used in ART			x				Students will be examined in 4 practical examinations in each of the CE simulation courses and will be evaluated for participation. Practical examinations will consist of both a written and performance component.
L-18	Professional Capacity/ Autonomy	Know, and be able to apply ethical standards for clinical laboratory science	x			Students will be assessed by examinations (LMP 2003H, 2104H, and 2107H) and in-class quizzes (LMP 2206H, 2207H, and 2208H).	Students will submit written assignments in LMP 2003H, 2104H, 2105H, and 2107H.		Students in LMP 2206H, 2207H, and 2208H will be tested using a competency checklist.
L-19	Professional Capacity/	Know and follow the professional guidelines for	x			Students will be assessed by examinations (LMP	CE students will be assessed through written report		PA students will be evaluated through

Table 4. Assessment of Program Learning Outcomes & Degree Level Expectations

	Type of Learning Objective	Program Learning Outcomes	BOTH	PA	CE	Type of Assessment			
						Quizzes and Exams	Written reports	Oral presentations	Practical examinations
	Autonomy	communication of clinical findings				2003H, 2103H, 2107H), and within all courses in the PA practicum series.	submitted in LMP 2103H and 2107H.		situational testing by practicum supervisors for adherence and application of communication guidelines.
L-20	Professional Capacity/ Autonomy	Appreciate the consequence of growing availability of cell and molecular biology information on clinical medicine	x			Students will be assessed by quizzes and examinations in LMP 2000H, 2103H, and in all PA practicum courses.	Students will be assessed based on the quality of review summaries in LMP 2103H. Students will also submit written reports of their presentation topics in LMP 2000H.	Students will be assessed based on the caliber of their critical analysis presented orally and within ensuing class discussions [LMP 2000H].	
L-21	Professional Capacity/ Autonomy	Understand how the embryologist can provide patient centered care			x	Students will be assessed by quizzes and examinations in LMP 2103H, 2104H and 2107H.	Students will be assessed based on the quality of written assignments in LMP 2003H. Student will also submit written reports of their presentation topics in LMP 2104H and 2107H.	Students will be assessed based on the caliber of their critical analysis presented orally and within ensuing class discussions (LMP 2104H and 2107H).	
L-22	Com. Skills	Create written and oral presentations on research topics and literature	x				Students will be assessed based on the content and quality on their written research proposal in LMP2005Y, and by in-class written assignments (LMP 2106H and 2107H)	Students will be evaluated based upon their communication skill exhibited during the oral defense of their capstone project (LMP 2005Y) and in literature reviews and summaries presented	

Table 4. Assessment of Program Learning Outcomes & Degree Level Expectations

	Type of Learning Objective	Program Learning Outcomes	BOTH	PA	CE	Type of Assessment			
						Quizzes and Exams	Written reports	Oral presentations	Practical examinations
								in LMP 2106H and 2107H.	
L-23	Com. Skills	Synthesize complex information in written and oral form to present to appropriate stakeholders	x				CE students will be assessed based on written assignments (LMP 2103H), on written summaries of topics presented by other students and an in-depth written summary of their oral presentation topics (LMP 2104H, LMP 2105H). PA students will submit written reports within each of the courses of the PA practicum series. Students will be assessed based on the content and quality on their written research proposal in LMP2005Y.	Students will be assessed on the quality and content of their in class presentations and discussions in LMP 2103H, 2104H, and 2205H. Students will be evaluated based upon their communication skill exhibited during the oral defense of their capstone project (LMP 2005Y)	

10 Program Description & Calendar Copy

- Provide a description of the program (audiences: prospective and current students, staff, and employers) that can be used for external and internal posting that includes the following information:
  - Program's purpose (who is it for, what are the outcomes)
  - Nature of learning environment (including mode of delivery)
  - Approaches to teaching/learning/assessment
- Provide, as an appendix, a clear and full calendar copy including:
  - The program description; the program requirements including all required courses and recommended electives and their prerequisites, including for any fields/concentrations.
- Provide as an appendix:
  - A full list of the all courses included in the program including course numbers, titles, and descriptions.
    - Please indicate clearly whether they are new/existing. (Please note that all new courses should be proposed and approved independently in line with established academic change procedures. Where possible, append full course proposals as an appendix).

The Master of Health Science in Laboratory Medicine is a full-time two-year professional master's degree program offered by the Department of Laboratory Medicine and Pathobiology assisted by Obstetrics and Gynecology, Faculty of Medicine. It consists of 9.5 full course equivalents, including a capstone practicum in the last sessions of the degree program. The program will be offered on a full-time basis. The length of the program is two years (6 terms, starting in Fall) which includes the core and field-specific courses and practica.

There are two fields in Laboratory Medicine to choose from, Pathologists' Assistant (PA) and Clinical Embryology (CE). Pathologists' Assistants (PAs) are involved in providing diagnostic services in anatomical pathology through applying knowledge of tissue and laboratory analysis of human specimens. Clinical Embryologists (CEs) provide clinical management related to assisted reproductive technology in clinical embryology laboratories.

The professional MHSc is the best way to respond to education gaps in basic science, applied technology and core laboratory functions in both fields as advances are outpacing the ability to incorporate them into the current non-university, non-academic apprenticeship models of training PAs and CEs.

This new professional degree program will provide both laboratory and clinical-focussed students with the theory and practical knowledge necessary to function as PAs or CEs. The current independent apprenticeship education is no longer adequate to train PAs and CEs and is being abandoned and redeveloped into a professional graduate MHSc.
Potential applicants will be graduates from life science and biomedical programs. The curriculum will consist of lecture, discussion, presentations, practicums, and project-based courses across 6 sessions, with the intent to teach a core foundation of basic sciences, followed by field based academic and applied training to function as a clinical scientist.

There will also be a capstone project focussing on the development and demonstration of research skills.

Please see Appendix A for a full list of the course numbers and titles, indicating clearly whether they are new/existing.

Please see Appendix B for proposed calendar copy.

11 Consultation

- Describe the expected impact of what is being proposed on the nature and quality of other programs delivered by the unit/division.
- Describe the expected impact of what is being proposed on programs being offered by other units/divisions.
- Describe any consultation with the Deans of Faculties/divisions that will be implicated or affected by the creation of the proposed program as per UTQAP 2.4.2 "The Dean ensures that appropriate consultation is conducted with faculty and students, other university divisions and external institutions."

- There is no expected impact of this program on other programs presented by LMP as these programs for doctoral and [academic content] focused. The professional master's will not likely draw students from other graduate programs

- The administrators of the Surgical Skills Lab at Mount Sinai Hospital have been consulted for advice on simulation laboratory operations. Heather Shapiro, faculty in this program is participating in the University of Toronto, Faculty of Medicine external review (2018) of simulation education in the faculty

- The Canadian Fertility and Andrology Society has been consulted and has provided a letter of support (Appendix H)

- The Canadian Chairs of Pathology and Laboratory Medicine have been consulted and support the creation of the Professional MHSc in Laboratory Medicine

- The Canadian Association of Pathologists (CAP) and its associated PA section, Canadian Certification Council of Pathologists' Assistants, are supportive of our program and offered to provide any assistance. CAP includes academic and community pathologists and promotes both the academic and clinical mission of pathologists in Canada.

- The departments of Pathology of the five medical schools in Ontario have been consulted

- Faculty teaching bioethics at the Dalla Lana of Public Health have been consulted

- Cognate departments such as Medicine, Surgery and Institute of Medical Science have been consulted.

- The proposal was presented to the Council of Health Deans on January 9, 2019

- The undergraduate Vice-Deans at the University of Toronto from the Faculty of Arts and Sciences, UTSC and UTM have been provided with a copy of the proposal.

12 Resources

12.1 Faculty

- Complete Table 3 below
- Brief commentary to provide:
  - Evidence of the participation of a sufficient number and quality of faculty who will actively participate in the delivery of (teach and/or supervise) the program
  - Evidence of and planning for adequate numbers and quality of faculty and staff to achieve the goals of the program
  - That faculty have the recent research or professional/clinical expertise needed to sustain the program, promote innovation and foster an appropriate intellectual climate
  - of how supervisory loads will be distributed, and the qualifications and appointment status of faculty who will provide instruction and supervision
  - Planned/anticipated class sizes (connect this to delivery method, Section 8 and assessment methods, Section 9)
  - If relevant, plans and commitment to provide additional faculty resources to support the program.
  - The role of any adjunct or contractual (e.g., stipendiary) faculty.
- Provide the CVs of all faculty who appear in Table 3, as evidence substantiating the above. The appendix should form a separate document with a table of contents and all CVs in alphabetical order. CVs should be submitted in a consistent format

There is sufficient faculty in LMP and OB/GYN who have committed themselves to actively participate in the delivery of the courses, practicums and research projects in the program. The organizational structure of the program is described in Appendix E. Table 5 notes the responsibility of each faculty. Appendix A identifies course directors for the courses.

Each course will have a course director. The faculty with specific expertise will prepare and deliver each session (lecture), lead discussions and assess student presentations, participate in student discussions, and evaluate quizzes, exams, oral and written reports. By Fall 2020, all faculty listed in Table 5 will have associate or full appointments to the School of Graduate Studies. All instructors will be assessed by course directors and students through formal course evaluations annually to ensure the quality of teaching is maintained meets the highest standards.

These assessments will be reviewed by the Curriculum and Oversight Committee. It will have access to all course evaluations and student assessments, such as final marks, student performance and engagement and performance on quizzes, exams, written reports, practicum assessments. It will monitor the program to ensure a sufficient and appropriate faculty to student ratio and that the progression of teaching and learning remains appropriate.

As a professional graduate program in the Faculty of Medicine, the program faculty includes tenured, clinical and status-only faculty. Some faculty will be appointed as adjunct faculty to provide expertise in teaching techniques for simulation and skills laboratory courses and the PA practicums and will be overseen by the field directors. The tenured and clinical faculty will provide leadership in the program and will provide most of the basic science teaching for PAs and CEs. The clinical faculty are experienced teachers in the clinical sphere and have the motivation, interest, and expertise to train PAs and CEs. LMP has considerable experience in clinical and status-only faculty with a large clinical faculty who have School of Graduate Studies' memberships and participate as research supervisors, members of student advisory committees, course instructors and lecturers in our graduate programs. LMP has a large successful doctoral stream program and an undergraduate Specialist Program that rely on teaching by clinical and status-only faculty.

The practicums for PAs will be taught by clinical faculty at the Ontario Forensic Pathology Service and at the teaching hospitals. Each site will have a designated clinical liaison (i.e. an existing resource) who is employed at the site and coordinates the clinical experiences for the students. These hospitals are Sinai Health System (formally Mount Sinai Hospital), St. Michael's Hospital – Unity Health Toronto, University Health Network and SickKids (formally the Hospital for Sick Children), Michael Garron Hospital - Toronto East Health Network (formally known as Toronto East General), Sunnybrook Health Sciences Centre and Credit Valley Hospital - Trillium Health Partners. In addition, the practicum for Forensic Pathology takes place at the Coroner's Office where we already train our fellows in the Royal College Program in Forensic Pathology. The faculty there have proven to be excellent teachers over several years and they are eager to provide training to our PA graduate students.

Table 5 Faculty Complement (please list alphabetically)

Name (Field)	**Unit of Primary Budgetary Appt & % of dept appointment pending**	**University Rank**	**Graduate Faculty Membership** (e.g. Associate/Full privledges) *appointment pending for Associate, restricted membership	**Commitment to other programs** (please list other program in which the person routinely teaches/supervises)	**Nature of contribution to this program** (Field director [FD], program coordinator [PC], course coordinator [CC], course instructor [CI], capstone instructor [CapI], clinical or practice supervisor [C/PS])
Tenure Stream:					
Michelle Bendeck (PA)	LMP	Professor	Full	MSc & PhD LMP; Undergraduate LMP	CI
Brian Cox (CE)	Physiology	Associate	Full	MSc & PhD Physiology; OB/GYN	CI
Harry Elsholtz (PA)	LMP	Associate	Full	MSc & PhD LMP; Undergraduate LMP	CI
Avrum I. Gotlieb (PA, CE)	LMP	Professor	Full	MSc & PhD LMP; Undergraduate LMP Dentistry	CI, PC, CC
David Irwin (PA, CE)	LMP	Professor	Full	MSc & PhD LMP; Undergraduate	CI, CC
Jennifer Mitchell (CE)	CSB	Associate	Full	CSB	CI
Michal Jozef Opas (PA)	LMP	Professor	Full	Undergrad	CI
Teaching Stream:					
Danielle Bentley (CE)	Anatomy (TS)	Assistant	Associate	Anatomy	CI, CC
Others (please specify, i.e., adjunct (CA), teaching stream (TS) status only (SO), clinical faculty (CF), visiting or other as per U of T definitions):					
Rebecca Arthur (CE)	OB/GYN (CF)	Assistant	Associate*	Post MD Education	CI
Kerry Bowman (CE,PA)	DCFM, IM (SO)	Assistant	Full	Bioethics	CI, CC
Theodore Brown (CE)	OB/GYN (SO)	Professor	Full	MSc & PhD Physiol; Undergrad Physiol; IMS; LMP	CI, CC
Jagdish Butany (PA)	LMP (CF)	Professor	Associate	Post MD Education, Undergraduate LMP	CI
Isabella Caniggia (CE)	OB/GYN (SO)	Professor	Full	Physiol/IMS	CI

Dianne Chadwick (PA)	LMP (CF)	To be determined	Associate*	TBD	CC
Crystal Chan (CE)	OB/GYN (CF)	Assistant	Associate*	TBD	CI, CC
Pat Chronis-Brown (CE)	OB/GYN* (CA)	To be determined	Associate*	TBD	CI, C/PS
Myron Cybulsky (PA)	LMP (CF)	Professor	Full	Graduate LMP	CI
Hala Faragalla (PA)	LMP (CF)	Assistant	Associate*		CI, CC, C/PS
Ellen Greenblatt (CE)	OB/GYN (CF)	Professor	Associate*		CI, CC
G. Scot Hamilton (CE)	OB/GYN (CA)	Adjunct	Associate*		CI, CC, C/PS
Carlo Vincent Hojilla(PA)	LMP (CF)	Assistant	Associate*	Post MD Education, LMP	CI, CC, C/PS
Nadia Ismiil (PA)	LMP (CF)	Assistant	Associate*	Post MD Education, LMP	CI, CC, C/PS
Michael James (PA)	LMP (CF)	Assistant	Associate		
Keith Jarvi (CE)	Surgery (CF)	Professor	Full	Grad/IMS	CI
Claire Jones (CE)	OB/GYN (CF)	To be determined	Associate*		CI, CC
Andrea Jurisicova (CE)	OB/GYN (SO)	Associate	Full	Physiol	CI
Rita Kandel (PA)	LMP (CF)	Professor	Full	Graduate LMP	CI
John Kingdom (CE)	OB/GYN (CF)	Professor	Full	LMP, Physiol, IMS	CI
Elena Kolomietz (CE)	LMP (SO)	Associate	Associate*		CI, CC
Clifford Librach (CE)	OB/GYN (CF)	Professor	Full	Physiol, IMS	CI
Kimberly Ellen Liu (CE)	OB/GYN (CF)	Assistant	Associate*		CI
Svetlana Madjunkova (CE)	OB/GYN* (CA)	To be determined	Associate*		CI
James Meriano (CE)	OB/GYN* (CA)	To be determined	Associate*		CI
Adam Millar (CE)	Medicine (CF)	Assistant	Associate*		CI
Lorna Mirham (PA)	LMP* (CF)	To be determined	Associate*		CI
Sergey Moskovtsev (CE)	OB/GYN (SO)	To be determined	Associate*		CI
John Brendan Maurice Mullen (PA)	LMP (CF)	Associate	Associate*	Post MD Education, LMP	CI
Abdul Noor (CE)	LMP (SO)	Assistant	Associate*		CI
Michael Pickup (PA)	LMP(CF)	To be determined	Associate*	Post MD Education, LMP	CI, CC, C/PS
Simon Jonathan Raphael (PA)	LMP (CF)	Associate	Associate*	Post MD Education, LMP	CI, CC, C/PS
Ian Rogers (CE)	OB/GYN (SO)	Associate	Full	Physiol	CI
Heather Shapiro (CE, PA)	OB/GYN (CF)	Associate	Associate	Grad/Undergrad, Physiol; IHPME. Grad LMP	CI, FD, CC, CaPI
Sony Sierra (CE)	OB/GYN (CF)	Assistant	Associate*		CI
John Snelgrove (CE)	OB/GYN (CF)	To be determined	Associate*		CI
Douglas Mills Templeton (PA)	LMP (PA)	Professor	Full		CI
Alicia Ann Tone (CE)	OB/GYN* (CA)	To be determined	Associate*		CI

Ilan Weinreb (PA)	LMP (CF)	Assistant	Associate*		CI, CC, C/PS
Rosanna Weksburg (CE)	Mol Gen (CF)	Professor	Full	Molecular Genetics	CI
George Yousef (PA)	LMP (CF)	Professor	Full	Graduate	CI, FD, CC, CaPI
Rhonda Zwingerman (CE)	OB/GYN (CF)	To be determined	Associate*		CI

For clinical faculty (CF) the unit of budgetary appointment is the hospital that pays them and the academic unit in the Faculty of Medicine is the unit of appointment.

12.2 Learning Resources

- Evidence that there are adequate resources to sustain the quality of scholarship and research activities of undergraduate and graduate students, including library support

Please see the following appendices:

Appendix C: Library statement confirming the adequacy of library holdings and support for student learning

Appendix D: Standard statement concerning student support services

12.3 Financial Support for Graduate Students

- Where appropriate to the program, evidence that financial assistance for students will be sufficient to ensure adequate quality and numbers of students.

As is the usual practice for professional master's programs at the University of Toronto, students are not eligible for stipendiary support. Students will be eligible for scholarships, loans and line of credit which is typically available to Professional Master's degree-based graduate students.

12.4 Space/Infrastructure

- Evidence that there are adequate resources to sustain the quality of scholarship and research activities of undergraduate and graduate students, including information technology support and laboratory access; address any unique requirements including renovations to existing space, new space, equipment, etc.
- Note: The requirements for physical facilities should be identified by providing information on the change in the number of people to be accommodated by type (i.e., faculty, students, administrative staff, etc.) as well as information on changes in equipment and activities requiring accommodation. The division/Faculty should state whether it plans to bring forward proposals for additional space; the renovation of existing space; or whether the current space allocation to the academic program will accommodate the new initiative.

- Capstones and research projects may be done within LMP and OB/GYN research labs, in the FOM affiliated hospitals and Research Institutes or at other approved university affiliated sites.

- The existing administrative staff in LMP have the capacity to handle the additional students of this new program. The Program Coordinator, Dr. Avrum Gotlieb, will oversee the program as a whole and work with the Field Directors, Dr. Heather Shapiro (CE) and Dr. George Yousef (PA). Please refer to Appendix E for the Program Organizational Structure.

- **Space for a Simulation and Skills Laboratory** at the Medical Science Building has been identified on the 6th floor of the Medical Sciences Building, Rm. 6302. A renovation budget has been approved by the Dean, Faculty of Medicine and will be completed by September 2019. The purpose of the Laboratory is to establish an environment to provide appropriate equipment and resources to enable the training of basic and advanced laboratory skills for CEs, mimicking real life situations without having to compromise active clinical care while learning. This center will be used to provide exposure and hands-on experience, allowing the students to gain the technical and functional skills required to be a qualified clinical laboratory professional.

- Any deficits in the annual operating budget will be supported by LMP and OB/GYN (Appendix H). Donations for some equipment have been secured by the Office of Advancement. Since CE trainees will need to maintain technical competencies and learn new technologies, we plan once our program is established (within the first 3-4 years) to provide training in advanced ART laboratory skills to currently practicing clinical embryologists using the Simulation and Skills Laboratory as a continuing professional education site. This will not interfere with MHSc program.

12.5 Other Resource Implications

- For example,
  - Is a new graduate unit contemplated that would require a separate graduate chair appointed under the PAAA?
  - Are there interdivisional teaching implications?
  - Will the new program affect any existing agreements with other institutions, or require the creation of a new agreement to facilitate the new program (e.g., Memorandum of Understanding, Memorandum of Agreement, etc.). (Existing joint programs are offered with Centennial, Sheridan and Michener.)
- Please consult with the Provost's office (vp.academicprograms@utoronto.ca) early regarding any resource implications described in this section.

The practicums will take place in the Department of Pathology of the teaching hospitals that train our postgraduate medical residents and fellows and will not affect any existing agreements. The Chiefs of each of the Departments (Appendix H) at Sinai Health System, St. Michael's Hospital – Unity Health Toronto, University Health Network, Sunnybrook Health Sciences Centre, SickKids, Michael Garron - Toronto East Health Network and Credit Valley Hospital - Trillium Health Partners have accepted the responsibility to provide space for the practicum activities at their institutions and provide faculty to teach.

13 Quality and Other Indicators

- Please describe the appropriateness of the faculty's collective expertise and how it contributes substantively to the proposed program. Define and use indicators to provide evidence of the quality of the faculty (e.g., qualifications, research, innovation and scholarly record)
- Please explain how the program structure and faculty research will ensure the intellectual quality of the student experience.
- Please describe any elements that enhance the program's diversity.

As elaborated in Section 3, Academic Rationale, the faculty have much experience and expertise in educating basic science and clinical trainees. They have supervised graduate students and trained medical students and residents in laboratory medicine and pathology, and in obstetrics and gynecology.

The intellectual quality of the student experience will be enhanced by seminars presented by invited speakers and local U of T faculty. This will broaden the students' perspectives and provide intellectual rigour to research and problem solving.

The students will have access to a large academic faculty to provide advice on research experiments including design and analysis of investigations. All students will have a student advisory committee for their capstone project to provide them the quality of expertise and mentorship necessary for a successful research experience.

Preparing for a career in clinical laboratory sciences and biomedical research is a daunting task which requires comprehensive and accurate information on what to expect, how to plan, how to avoid pitfalls and how to be resilient and enjoy the journey to success. Our faculty have experience in mentorship and supervision of student research projects which will guide the students in this complex world of health care and biomedical research. One of our faculty has published a practical guide to academic and non-academic career development in biomedical sciences and is available to guide a comprehensive mentorship program for the students. The objective is to provide students with a competitive advantage by presenting useful information, insights and tips to guide our students in career planning as they achieve milestones and competencies in their clinical science training.

Appendix A: Courses

MHSc in Laboratory Medicine

Core Courses:

Course Code	FCE	Course Title
LMP 2000H	0.5	Cell and Molecular Biology
LMP 2001H	0.5	Biomedical Research Methods
LMP 2002H	0.5	Clinical Laboratory Management
LMP 2003H	0.5	Biomedical Ethics
LMP 2004H	0.5	Biostatistics
LMP 2005Y	1.0	Capstone Project (continuous)
	0.5	Elective
Total Core Courses	**4.0**	

Clinical Embryology (CE) Courses:

Course Code	FCE	Course Title
LMP 2100H	0.5	Advanced Reproductive Physiology
LMP 2101H	0.5	Human Embryology
LMP 2102H	0.5	Foundations in ART
LMP 2103H	0.5	Reproductive Genetics
LMP 2104H	0.5	Applied Methods in ART
LMP 2105H	0.5	Innovations in ART
LMP 2106H	0.5	Current Topics in Causes and Treatment of Infertility
LMP 2107H	0.5	Applied ART Laboratory Decision Making
LMP 2108H	0.5	CE Lab Simulation I
LMP 2109H	0.5	CE Lab Simulation II
LMP 2110H	0.5	ART Lab Rotations
Total CE Courses	**5.5**	

Pathologists' Assistant (PA) Courses:

Course Code	FCE	Course Title
LMP 2200H	0.5	Basic Principles in Human Pathobiology and Pathophysiology
LMP 2201H	0.5	Anatomy and Pathology of Organ Systems
LMP 2202H	0.5	Practicum in Surgical Pathology I
LMP 2203H	0.5	Practicum in Surgical Pathology II
LMP 2204H	0.5	Practicum in Surgical Pathology III
LMP 2205H	0.5	Practicum in Surgical Pathology IV
LMP 2206H	0.5	Practicum in Autopsy Pathology
LMP 2207H	0.5	Practicum in Forensic Pathology
LMP 2208H	0.5	Biobanking for Research
LMP 2209H	0.5	Practicum in Surgical Pathology V

LMP 2210H	0.5	Practicum in Surgical Pathology VI
Total PA Courses	**5.5**	

Detailed Course Descriptions

With the exception of Biomedical Ethics (LMP 2003H) and Biostatistics (LMP 2004H), the courses listed below will be new. Currently, LMP is in consultation with DLSPH for the Biomedical Ethics course and the Institute of Medical Science for the Biostatistics course, with the potential of using existing courses in the corresponding graduate department. The content that currently appears under these course codes reflect what the MHSc in Laboratory Medicine wishes to cover. This proposal will be updated once these consultations are finalized.

LMP 2000H: Cell and Molecular Biology
Course Co-ordinator: David Irwin

Course Objectives

- Students will learn fundamental principles of cell and molecular biology
- Students will learn about areas in cell and molecular biology actively being investigated
- Students will learn about experimental approaches to ask questions in this field
- Students will learn to critically appraise the literature in this field

Description

This course is designed to fill gaps in the fundamental knowledge of cell and molecular biology for new students enrolled in the Master of Health Sciences in Laboratory Medicine and to provide a solid foundation for other courses in this program. Emphasis will be on fundamental principles that are relevant to PAs and CEs.

Format

The first lecture will introduce the course and students will be assigned papers for class discussions. Through 10 topic-specific lectures, students will be provided with fundamental knowledge in diverse areas of cell and molecular biology. Each topic will be briefly introduced through a one-hour lecture by faculty, which would then be followed by a student-led discussions on two current papers (30 minutes each) addressing questions being addressed in the field. Lectures will be augmented by assigning readings from the current literature and online resources.

Week	Topics
1	Introduction to Cell and Molecular Biology
2	Genetics
3	Epigenetics
4	Transcription and Translation
5	Proteins: Structures to Proteomics
6	Metabolism and Energy
7	Mid-term Exam
8	Cell Structure
9	Membrane Cell Surface
10	Cell Signaling

11	Cell Division and Differentiation
12	Cell Death
13	Final Exam

Evaluation

Attendance is mandatory for all lectures. Each student will be assigned research papers, which they will be responsible for leading the discussion on. They will also write a short critique of these papers and summarize the class discussion of them. The other students will be expected to have read the papers and be ready to add to the discussions. Fundamental knowledge will be assessed through mid-term and final written exams. Enrolment is expected to be 10 students, with 2 students assigned papers each week – thus with 10 weeks covering different topics each of the students will lead the discussion of 2 papers.

Assessment

- 20% for presentations of (2) papers where they lead the discussion
- 10% for written assessment of the (2) presented papers and the discussion of them
- 10% for participation in the discussion of other (18) presented papers
- 30% midterm exam
- 30% final exam

LMP 2001H: Biomedical Research Methods
Course Co-ordinators: Heather Shapiro & Theodore Brown

Course Objectives

- Students will learn the types of research methodologies and when to use them.
- Students will learn to critically appraise the literature in their field.
- Students will be able to write a research proposal
- Students will acquire medical terminology through an online activity

Description:

Week	**Topics**
1	Types of Research Studies
2	Searching the Literature
3	Analysing the Literature
4	Translational Research
5	Seminar/ Worksheet
6	Asking a Question: Pop'n
7	Picking an Intervention
8	Determining Outcome
9	Medical Terminology Competency
10	Writing a Proposal
11	IRB
12	Science Research and Society

Evaluation

There will be three in class written assignments (70% total) and two quizzes (30% total) of which one will cover medical terminology.

LMP 2002H: Clinical Laboratory Management
Course Co-ordinator: George Yousef/ Scott Hamilton

Course Objectives

- The students will learn details of processes required for management of a clinical laboratory. The students will learn how to assess outcomes of laboratory management.
- The students will learn essentials of laboratory safety in clinical laboratories.

Description:

Week	Topics
1	Equipment
2	Maintenance
3	Certification Levels
4	Ergonomics
5	Safety Reporting
6	HCP Safety
7	Infection Control
8	KPIs
9	How to Write SOP
10	Auditing Processes
11	Building a Lab – Materials and VOCs
12	Understanding Acronyms GMP VOC HEPA
13	PHIPa/Privacy

Evaluation: TBD

LMP2003H: Biomedical Ethics
Course Co-ordinators: Heather Shapiro/Kerry Bowman

Course Objectives
The students will learn the description, assessment implementations of bioethics in a clinical laboratory. The students will learn bioethical considerations in the practice of PA and CE.

Description
This course may be offered through the Joint Centre for Bioethics (DLSPH).

Topics will include

- informed consent futility
- stem cell ethics, end of life
- reporting ethics
- tissue ownership
- communication skills
- Reproduction issues
- resource allocation

- ethical consideration of human research
- IRB/REB
- Clinical Trials/COI
- Legal/malpractice issues
- problem solving /decision making framework

LMP 2004H: Biostatistics
Course Co-ordinator: Heather Shapiro

Course Objectives:

- To develop basic statistical analysis skills used in health care research.
- To be able to critically appraise basic statistical analysis used in health care research.
- To acquire practice in communicating those skills through presenting the results of statistical analysis and interpreting them both orally and in written work.

Description
Consulting with Institute of Medical Science create or utilize existing course in this department.

LMP 2005Y: Capstone Project
Course Co-ordinator: Heather Shapiro and George Yousef

Course Objectives

- To train students to identify research problems and design a project to investigate the problem.
- To learn how to manage a research project and learn problem solving skills in biomedical science research.
- To learn to write a scholarly scientific report and to develop oral communication skills in research.

Description
A 1.0 FCE course extending over three terms to provide PAs and CEs an opportunity to explore a specific gap in knowledge and design a research proposal that investigates the topic. Topics are selected with the assistance of the field directors and the students are then matched to appropriate faculty. Each project has a student advisory committee that meets regularly with the student to provide guidance and assistance. The students will receive guidance from their supervisor who will monitor their progress and ensure that milestones are met. The outcome is an oral presentation of their work and a written report.

LMP 2100H: Advanced Reproductive Physiology
Course Co-ordinator: Theodore Brown

Course Objectives

- To expose students to the developmental and functional aspects of the male and female reproductive systems

- To provide students with a strong applied understanding of the hormonal communication fundamental to the regulation of the hypothalamic-pituitary-gonadal axis
- To provide students with an understanding of the male and female reproductive systems that can form the basis for further understanding of infertility and its treatment.

Description
This is a foundational course that will provide the key content required for an embryologist and focused on development and regulation of the reproductive system.

Week	Topic
1	Course Introduction and review of the hypothalamic-pituitary-gonadal axis
2	Steroid hormone biosynthesis, metabolism, and mechanism of action as control points in the regulation of steroid hormone activity
3	Sex determination and sexual differentiation
4	Spermatogenesis
5	Hormonal regulation of male reproductive function
6	**Term test**
7	The female reproductive system: the ovarian cycle, intraovarian regulatory mechanisms; follicle development and ovulation
8	Hormonal regulation of the female reproductive cycle
9	Regulation of GnRH
10	Oocyte development and fertilization
11	Early embryo development and stem cell allocation
12	Infertility and an overview of assisted reproductive technology

Evaluation
The course mark will be based upon two exams, one covering the first 5 lectures and a final exam covering the remainder of the course, and an in-depth 10-15 page review of specific topic related to ART, upon consultation with the course director. Both exams consist of essay-type questions. In the first exam, students are asked to answer 3 questions. In the final exam, students answer 5 questions. Each question is designed to take approximately 25 minutes to answer and involve application of principles learned during lectures. 35% of the final course mark will be derived from the first exam, and 40% will be derived from the final exam. 25% of the mark is based upon the review paper.

LMP 2101H: Human Embryology
Division of Anatomy, Department of Surgery, University of Toronto
Course Coordinator: Dr. Danielle Bentley, PhD

Course Objectives
The course is organized as two weekly lectures. Activities will be provided to the students outside of class time to reinforce course concepts and aid in understanding.

Description
Human embryology from fertilization to the end of the fetal period. Current concepts in mammalian morphogenesis applied to the development of the various organ systems; etiologies and pathogenesis of some of the more common human congenital abnormalities.

Week	Topic
1	Language of Anatomy
2	Gametogenesis
3	Fertilization and the First Two Weeks
4	Weeks Three and Four of Development
5	Folding and Placentation
6	Infertility
7	Congenital Malformations
8	Development of the Cardiovascular System
9	Development of the Limbs
10	Development of the Back
11	Development of the Nervous System
12	Stem Cells
13	Development of the Urogenital System I
14	Development of the Face and Branchial Apparatus
15	Development of the Endocrine System

Assessments
Student assessment will be based on the following

Course Tests:
There will be three term tests throughout the course. Each term test has been weighted according to the number of lectures covered, with each lecture accounting for 4.5%.
Test three will also include cumulative content from throughout the entire course, with each lecture accounting for 0.5%. As such, Test One will contribute 36% towards the final course grade, Test Two will contribute 40.5% towards the final course grade, and Test Three will contribute 18.5% towards the final course grade.

All tests will be written during class time. Location of tests is to be determined.
In-class TopHat Participation: TopHat student response system will be used in lecture. Your TopHat participation will contribute 5% towards the final course grade.

LMP 2102H: Foundations in ART
Course Co-ordinator: Scott Hamilton

Course Objectives
At the completion of this course the student will be familiar with the seminal research that laid the foundation for ART; able to identify knowledge gaps in ART science; able to analyse research and communicate this to an audience

Description

Week	Topics
1	The History of IVF
2	What is a good egg?
3	Semen Analysis vs Sperm Function
4	What makes an embryo stick? Part I
5	What makes an embryo stick? Part II
6	What do fertility drugs do to egg quality?
7	What does culture do to embryo quality?
8	The role of the incubator in embryo development
9	Presentation skills overview/outline
10	Presentations 1 and 2 and 3
11	Presentations 4 and 5 and 6
12	Presentations 7 and 8 and 9

Evaluation

This is a seminar based graduate only course. The first half of the course will be seminars led by leaders in the field. Each student will be responsible for summarizing one seminar and providing notes for the other students. These notes will be marked for content and clarity. The notes will include "unanswered questions" or topics for further conversation. Each student will then prepare a seminar in the second half of the course that will address these questions.

Assessments

Participation	10%
Summary Notes of Speaker (2 pages)	25%
Presentation	40%
Written Summary of Presentation	25%

LMP 2103H: Reproductive Genetics
Course Co-ordinator: Elena Kolomietz

Course Objectives

At the completion of this course, the student will know the human genome structure and function; know the mechanisms of inheritances of genetic conditions; can apply the principles of genetic testing to IVF treatment; be familiar with potential treatments for genetic diseases

Description

Week	Topic
1	Basic Genetics and Cytogenetics
2	Human Genome Structure and Function
3	Meiosis and Aneuploidy
4	Single gene defects
5	How to analyse a gene part 1
6	How to analyse a gene part2
7	Epigenetics and Imprinting Disorders
8	Genetic Testing in Infertility
9	ART as a treatment for genetic conditions

10	Preconception Carrier Screening –Practical and Ethical Considerations
11	Germline Genome Editing- Practical and Ethical Considerations
12	The nucleus and the mitochondria

Evaluation

- Class Participation 10%
- Midterm Test 15%
- Assignments, 2 at 25% each
- Final Exam 25%

LMP 2104H: Applied Methods in ART
Course Co-ordinator: Scot Hamilton

Course Objectives
This is a "preparatory" course, for the Simulation Lab courses, and the Innovations in ART course. It will provide the cognitive background required for technical skills learned in the simulation lab and it will act as a foundational course on which the Innovations course will build. This course will meld the theoretical and practical aspects of ART

Description
This course will be broadly divided into two areas: physiology and engineering. At the completion of the course, the student will understand the origins and the rationale for the use of common techniques

Week	Topics
1	Andrology Media
2	Sperm Function vs Sperm Tests
3	Why we need ICSI
4	Surgically Retrieved Sperm
5	Infections and Contaminations in the Lab
6	The Cell Membrane: implications in ART micromanipulation
7	The Cell Membrane: implications in ART Cryopreservation
8	The Cell Membrane: implications in ART – implantation
9	Pipettes and Catheters
10	Cell Fixation
11	Anything I can do, AI can do better

LMP 2105H: Innovation in ART
Course Co-ordinator: Crystal Chan

Course Objectives
At the completion of the course, the student will be familiar with the current controversies in ART; able to identify challenges in performing ART research; able to analyse current publications, and communicate this to an audience

Week	Topic
1	The Future of IVF
2	IVF and 'omics
3	Epigenetics and IVF
4	Mitochondria and IVF
5	Assisted Hatching
6	How to improve PGT
7	IVF and the Next Generation
8	Critical Appraisal Review
9	Presentation skills overview/outline
10	Presentations 1 and 2 and 3
11	Presentations 4 and 5 and 6
12	Presentations 7 and 8 and 9

Evaluation
This is a seminar based graduate only course. The first half of the course will be seminars led by leaders in the field. Each student will be responsible for summarizing one seminar and providing notes for the other students. These notes will be marked for content and clarity. The notes will include "unanswered questions" or topics for further conversation. Each student will then prepare a seminar in the second half of the course that will address these questions.

Assessments

Participation	10%
Summary Notes of Speaker (2 pages)	25%
Presentation	40%
Written Summary of Presentation	25%

LMP 2106H: Current Topics in Causes and Treatment of Infertility
Course Coordinator: Ellen Greenblatt

Course Objectives
To expose students to emerging concepts in reproduction and ART; To convey to students how to critically evaluate research articles; To instill a process for life-long learning in students by having them search the literature and select articles for discussion.

Description
This 0.5 FCE graduate student-only seminar-style course open to students in the CE stream will provide participants with an in-depth knowledge of physiology related to major clinically-relevant pathologies and topics in the cause and treatment of infertility. The course will consist of discussion of emerging topics in the causes and treatment of infertility. A key focus of the course will be the critical evaluation of current literature around the listed subject areas. The course will consist of 12 two-hour meetings, which will include student presentations and discussion of recent impactful research articles, with oversight provided by the faculty leader of each session.

Week	Topic
1	Overview of infertility and its causes
2	Physiology of Male Factor Infertility
3	Sperm function and semen analysis
4	Hormonal influences in infertility
5	Endometriosis
6	Over Response: Polycystic Ovarian Syndrome
7	Under Response : Ovarian Insufficiency
8	Germ cell generation from somatic cells
9	IVF – The Pharmacology of Oogenesis
10	The Macro Environment and Embryogenesis
11	The Micro Environment and Embryogenesis
12	Recurrent Implantation Failure

Evaluation
Each student will be asked to select an appropriate recent research paper on the subject area for each session. These will be approved (or may be assigned) by the session leader. Students will provide a 15-minute presentation of the research paper and will provide a written evaluation of the strengths and limitations of the work.

Weekly presentations	40%
Weekly evaluations	35%
Weekly Quizzes	15%
Participation	10%

LMP 2107H: Applied ART Laboratory Decision Making
Course Co-ordinator: Heather Shapiro

Course Objectives
- To present critical concepts relevant to operating an efficient ART Laboratory
- To present issues to consider when contemplating safe staffing levels
- To present the process for selecting, testing, and implementing new devices or technologies into the ART laboratory.

Description
Workplace Decision Making: Applying Bioethics, Management and Critical Appraisal in the Lab. The course will serve to integrate concepts taught in Bioethics and Critical appraisal along with management to develop decision making skills

Assignments:
1) Identify a new technology or equipment.
2) Review the current standards in this domain.
3) Metrics to consider: effectiveness, capital costs/operational costs, human resource needs, relative importance of the problem compared to the lab operation as a whole.
4) Complete a literature review on the scientific merits or claims of the device.
5) Prepare a presentation to the business office as to why this should be incorporated into the lab.

Week	Topic
1	Introduction; assignment of groups
2	Critical Appraisal Review: asking the question PICO
3	Assignment of groups/ brainstorming ideas
4	How to do a literature search
5	Research in Progress- presentation of topic choice
6	Introduction to Cost Effectiveness
7	What does a scientist need to know about a business plan
8	Understanding work flow implications of proposal
9	mid term test
10	Presentation skills/lit review
11	Final product presentation
12	Final product presentation
13	Judge evaluation of presenter

Evaluation
Research in Progress Presentation – 10%
Midterm Test– 25%
Final Product Presentation – 35%
Presenter, Written Report – 25%
Judge Written Report – 10%

LMP 2108H: Clinical Embryology Laboratory Simulation I
LMP 2109H: Clinical Embryology Laboratory Simulation II
Course Co-ordinator: Theodore Brown and Scot Hamilton
Instructional staff will include Laboratory Directors and Managers from IVF clinics in the GTA

Course Objectives
To provide CE stream students with a practical overview of equipment within a clinical embryology laboratory.
To provide CE stream students with practical hands-on experience with fundamental and advanced gamete and embryo handling procedures, assessment techniques, fertilization and sperm injection, cryopreservation and storage, and workflow.

Description
The purpose of this course is to expose CE stream students to a simulated clinical embryology laboratory environment where they can safely learn and practice technical skills that will be essential to their clinical career. Instructors recruited from IVF andrology and embryology clinical laboratories within the greater Toronto area, who have extensive expertise in these specific techniques will provide hands on instruction. In addition to training, we will provide the opportunity for the student to practice techniques to gain a minimal level of proficiency, understanding that many of these skills take considerable time to develop true expertise.

Term 1 – CE Lab Sim I	Topic
Week 1	Biosafety Training
Week 2	Introduction to the lab
Week 3	Semen handling, analysis, and interpretation
Week 4	Semen analysis, and interpretation-II
Week 5	Sperm cryopreservation, storage, and inventory management
Week 6	Sperm selection for ICSI
Week 7	Practical Examination
Week 8	Oocyte retrieval, handling, and fertilization culture medium
Week 9	Fertilization and assessment
Week 10	Oocyte denuding and ICSI
Week 11	ICSI
Week 12	Practical Examination
Term 2 – CE Lab Sim II	
Week 1	Embryo Assessment
Week 2	Embryo Transfer Preparation
Week 3	Trophectoderm biopsy
Week 4	Trophectoderm biopsy, handling for PGD/PGS analysis
Week 5	embryo freezing
Week 6	Oocyte cryopreservation
Week 7	Practical Examination
Week 8	Air quality in the IVF lab: VOCs monitoring
Week 9	Culture system control; temperature, pH, osmolality, Quality control and assurance procedures and adherence
Week 10	Laboratory Design and Construction
Week 11	Troubleshooting Lab Issues
Week 12	Practical Examination

Evaluation

Students will be assessed in practical examination held twice during each term and marked for participation during each of the sections. Practical examinations will consist of both a written component and a practical component where a student's understanding and performance of tasks covered in the prior weeks will be evaluated. Each of the 4 practical exams will be weighted equally (20% each). The remaining 10% will be assigned based on contribution during the sessions.

LMP 2110H: ART Laboratory Rotations
Course Directors: H. Shapiro and T. Brown

Course Objectives
To provide students with the opportunity to experience the workflow of an operating ART Laboratory

Description
Students will be placed in a partnering IVF laboratory and will function as a laboratory assistant for a period of 5 weeks. The student will be under the supervision of the laboratory director and/or a senior *embryologist* who will provide an assessment of the student's abilities. The student will observe and participate as appropriate in quality control measurements and verification, record keeping, stocking, semen processing, sperm manipulation and evaluation. Due to necessary restrictions, we do not expect students to handle oocytes or embryos; however, the student is expected to observe all procedures.

Evaluation
A rubric provided to the lab preceptor will provide guidance for the expectations of the student's activities during the rotation and for providing feedback to the course directors. Ten percent of the course mark will be based on this feedback, which will include attendance, punctuality, and professionalism. The student is also to submit a log of their activities to the course director (40%). The student will prepare a reflection of their experiences and present this to the group (25% for the written submission; 25% for presentation and discussion).

LMP 2200H: Basic Principles in Human Pathobiology and Pathophysiology
Course Co-ordinator: Avrum I. Gotlieb

Course Objectives
1. Students will describe the fundamental tissue and cellular processes that are present in common human disease conditions.
2. Students will understand and be able to discuss the cell and molecular regulation of these basic pathology processes.
3. Students will be able to describe and critique important research carried out to advance knowledge in these fundamental pathobiologic processes.

Description
This is a 0.5 FCE lecture/ seminar course with student presentations. Fundamental cellular and tissue processes will be presented in each lecture, most being common to many human diseases (to be explored in a subsequent course), that regulate normal human biology and pathobiology (often referred to as "General Pathobiology"). The material will focus on histopathology changes and the cell and molecular events that initiate and regulate these changes including genetic regulation; cell signalling pathways; cell-matrix interactions;

Week	Topics
1	Cell Adaptation, Injury and Toxicology
2	Cell Ischemia, Death and Aging
3	Acute and Chronic Inflammatory Processes

4	Immunological Processes: Innate and Acquired
5	Quiz I
6	Repair, Regeneration, Fibrosis and Remodelling
7	Thrombosis and Hemodynamic Processes
8	Basic Concepts in Neoplasia
9	Basic Conception Infection
10	Basic Concepts in Genetic Disease
11	Quiz II

Evaluation

Class discussions (10%) Student presentations (20%)
Quizzes (2) – conceptual and knowledge evaluation (15% - 2)
Final Essay, Review of a specific process in basic human pathology identifying importance of topic, background knowledge, gaps in current knowledge, general research approach to fill in the gaps through cell and molecular research. Essay is eight pages excluding references and figures and illustrations (40%).

LMP 2201H: Anatomy and Pathology of Organ Systems
Course Coordinator: Avrum I. Gotlieb

Course Objectives

1. Student will be able to describe gross and microscopic changes present in diseased organs.
2. Student will be able to understand and discuss the pathogenesis of organ and systemic disease based on the embryology, anatomy and pathology of the organ.
3. Student will be able to describe and critique important research studies of diseased organs.

Description

This is a 0.5 FCE lecture/ seminar course with student presentations. The content focuses on embryology, anatomy, pathobiology and the cell and molecular alterations in organs that occur in specific human diseases. Student presentations will focus on pathogenesis through critique of critical journal articles. The course “Research Methods” provides fundamental knowledge to aid in assessing and evaluating research. Since many diseases are systemic in nature, the pathogenesis in both organs and systems will be addressed. The students will use the knowledge gained in “Basic Principles in Human Pathobiology and Pathophysiology” and in “Cell and Molecular Biology” as foundation knowledge for this course.

Week	Topics
1	Atherosclerosis
2	Heart Disease, Ischemic Heart Disease, Myocarditis, Cardiomyopathy
3	Respiratory Disease
4	Gastrointestinal Tract Disease
5	Quiz I
6	Liver, Biliary System, Pancreas Diseases
7	Kidney and Urinary Track Disease
8	Male and Female Reproductive Track Disease
9	Breast and Skin Disease

10	Bone, Joints and Soft Tissue Disease
11	Brain and Nervous System Diseases
12	Quiz II

Evaluation
Quiz I, II – Evaluation of Concepts and basic knowledge (15% - 2)
Student Presentations (15%, 2-per student)

This will be based upon an assessment of each of the student presentations and their active participation in the discussions surrounding the topics presented in class.
Final Essay, in-depth critical review paper (8 pages) on a relevant disease condition approved by course director. Essay should identify current knowledge gaps and general approaches to investigate these gaps (40%).

LMP 2202H: Practicum in Surgical Pathology I
Course Co-ordinator: Hala Faragalla/Nadia Ismiil

Course Objectives
- Develop understanding of the overall process of surgical pathology gross examination and dissection and the special precautions for certain circumstances
- Understand and be able to troubleshoot major issues related to surgical pathology
- Learn safety precautions needed for the pathology lab grossing station
- Quality assurance measures in surgical pathology labs

Description
This is a 0.5 FCE practical hands-on training course. Candidates will be rotating between St. Michael's Hospital and Sunnybrook Health Sciences Centre. Candidates will spend 2 full days a week (6 hours per day) at one of these two participating university hospitals. They will be shadowing certified PAs at a specimen dissection workstation throughout the day. They will also have the opportunity to handle surgical specimens under supervision. This course includes an introduction to orientation, cutting, handling, macroscopic description and processing of surgical pathology specimens. It also includes reading assignments through manuals of surgical pathology grossing (e.g. Lester's manual and Ackerman surgical pathology). Candidates will also learn safety precautions including universal precautions and other common background techniques that are needed for gross pathology assessment and safety.

Week	Topics
1	Specimen handling for pathologic evaluation
2	Specimen processing: From gross specimens to tissue cassettes
3	The histology laboratory: From tissue cassette to glass slides
4	Safety precautions for the grossing station
5	Photography and X-raying specimens
6	Quality assurance and avoiding errors in the grossing lab
7	Handling small biopsies
8	Handling of cytology specimens
9	How to handle specimens for lymphoma protocol
10	How to handle specimens for molecular testing

11	Specimen handling for other studies as immunofluorescence and cytogenetics
12	Handling of cytology specimens

Evaluation:

- Quizzes (2)
- An evaluation form will be filled by the site director/pathology attendant
- Candidates will go through a simulated grossing pathology quiz addressing the appropriate anatomic landmarks, section submission, safety precautions and major drawbacks of the gross pathology examination
- A competency check list of organs grossed
- Attendance log sheet

LMP 2203H: Practicum in Surgical Pathology II
Course Co-ordinator: Hala Faragalla

Course Objectives

- Develop competency in gross examination and dissection of breast, bone, and gastrointestinal organs.
- Develop expertise in identifying a spectrum of benign and malignant lesions
- Provide accurate macroscopic description of lesions of clinical significance
- Gain expertise and be able to submit appropriate sections for different entities to guide microscopic diagnosis and provide information for a generation of a complete pathology report for appropriate patient care.

Description

This is a 0.5 FCE practical hands-on training course. Candidates will spend 2 full days a week (6 hours per day) at one of the participating university hospitals. They will be shadowing certified PAs at a grossing workstation throughout the day. They will also have the opportunity to handle surgical specimens under supervision. The course includes specimen orientation, identifying anatomical landmarks, inking, cutting, handling, macroscopic description and processing guidelines for large resections including breast and GI specimens. In this course the candidates will learn the specific techniques needed to examine, dissect and sample bone lesions, in addition they will be introduced to grossing breast specimens and gastrointestinal organs including a spectrum of benign and malignant lesions.

Week	Topics
1	General grossing guidelines for resections
2	Amputations and large resections
3	Lymph nodes and Extranodal lymphoma
4	Spleen
5	Breast specimens grossing guidelines #1 (Handling benign specimens).
6	Breast specimens grossing guidelines #2. (Handling malignant specimens and DCIS).
7	Sentinel lymph node biopsy and axillary dissection grossing guidelines in breast cancer.

8	Gastrointestinal tract specimens #1.Esophageal resections
9	Gastrointestinal tract specimens #2.Stomach
10	Gastrointestinal tract specimens #3. Small bowel
11	Gastrointestinal tract specimens #4.Colon
12	Gastrointestinal tract specimens #5. Appendix and Meckel diverticulum

Evaluation

- Quizzes (2)
- An evaluation form filled by the site director/pathology attendant
- Candidates will go through a simulated grossing pathology quiz addressing the appropriate anatomic landmarks, section submission and major drawbacks of the gross pathology examination
- A competency check list of organs grossed
- Attendance log sheet

LMP 2204H: Practicum in Surgical Pathology III
Course Co-ordinator: Simon Raphael, Lorna Mirham

Course Objectives

- Develop competency in gross examination of gastrointestinal tract, genitourinary, and gynecologic specimens
- Develop expertise in identifying a spectrum of benign and malignant lesions
- Provide accurate macroscopic description of findings of clinical relevance
- Develop expertise to discuss and submit appropriate sections to guide microscopic diagnosis

Description

This is a 0.5 FCE practical hands-on training course. Candidates will spend 2 full days a week (6 hours per day) at one of the participating university hospitals. They will be shadowing certified PAs at a workstation throughout the day. They will also have the opportunity to handle surgical specimens under supervision. The course includes an approach to inking, cutting, handling, macroscopic description and processing of GI and genitourinary organs. Candidates will learn the specific requirements of handling different pathologic entities in each of these organs. They will also gain expertise on the appropriate sections to be submitted accordingly.

Week	Topics
1	Gastrointestinal tract specimens #6. Hepatobiliary tract (liver resections)
2	Gastrointestinal tract specimens #7. Gallbladder resections
3	Gastrointestinal tract specimens #8.Pancreas
4	Genitourinary specimens #1. Kidney
5	Genitourinary specimens #2. Ureter
6	Genitourinary specimens #3. Urinary bladder
7	Genitourinary specimens #4. Prostate
8	Genitourinary specimens #5.Testis
9	Genitourinary specimens #6. Penis

10	Gynecologic specimens #1.Uterus
11	Gynecologic specimens #2.Cervix
12	Gynecologic specimens #3.Ovary

Evaluation

- Quizzes (2)
- An evaluation form filled by the site director/pathology attendant
- Candidates will go through a simulated grossing pathology quiz addressing the appropriate anatomic landmarks, section submission and major drawbacks of the gross pathology examination
- A competency check list of organs grossed
- Attendance log sheet

LMP 2205H: Practicum in Surgical Pathology IV
Course Co-ordinator: Nadia Ismiil

Course Objectives

- Develop competency in gross examination of gynecologic , head and neck , and lung resections
- Develop expertise in identifying a spectrum of benign and malignant lesions
- Provide accurate macroscopic description of findings of clinical relevance
- Describe, understand and be able to develop expertise to discuss and submit the appropriate sections to guide microscopic diagnosis

Description

This is a 0.5 FCE practical hands-on training course. Candidates will spend 2 full days a week (6 hours per day) at one of the participating university hospitals. They will be shadowing PAs at a grossing workstation throughout the day. They will also have the opportunity to handle surgical specimens under supervision. The content focuses on obtaining practical experience in inking, cutting, handling, macroscopic description and processing for gynecological, lung, and head and neck specimens.
In this course, candidates will learn the specific requirements of handling different pathologic entities in each of these organs. They will also gain expertise on the appropriate number of sections to be submitted accordingly.

Week	Topics
1	Gynecologic specimens #4.Fallopian tube
2	Gynecologic specimens #5. Vagina
3	Gynecologic specimens # 6. Vulva
4	Head and neck specimens #1. Sinus and nasal polyps
5	Head and neck specimens #2.oral cavity resections
6	Head and neck specimens #3. Tongue resections
7	Head and neck specimens #4.Salivary gland resections
8	Head and neck specimens #5. Mucosal biopsies, adenoids and tonsils
9	Laryngeal resections
10	Lung resections

11	Pleural resections
12	Radical neck dissections

Evaluation

- Quizzes (2)
- An evaluation form filled by the site director/pathology attendant
- Candidates will go through a simulated grossing pathology quiz addressing the appropriate anatomic landmarks, section submission and major drawbacks of the gross pathology examination
- A competency check list of organs grossed
- Attendance log sheet

LMP 2206H: Practicum in Autopsy Pathology
Course Co-ordinator: Jagdish Butany

Course Objectives

- Gain competency in performing medical autopsies in a hospital setting
- Describe and be familiar with basic definitions and procedures in autopsy
- Understand and appreciate ethical and confidentiality issues related to autopsy

Description

In this course students will learn the fundamentals of autopsy pathology as well as the post autopsy hands on training. Students will work on real cases under supervision and will be exposed to a variety of scenarios.

Outline of Topics

1. Fundamentals of Human Anatomy and Histology:

a) Anatomy of the Brain, circulation and major Cranial Nerves; Spinal cord, and structure of the Spinal column
b) Anatomy of the Head and Neck
c) Anatomy of the Chest
d) Anatomy of the Abdomen--wall and contents
e) Anatomy of the Pelvic organs
f) Anatomy of the limbs, emphasis on the circulation

2. Fundamentals of Autopsy Pathology– Classroom/seminar based teaching

a) Definition: What is an Autopsy? Reasons to request an Autopsy?
b) Who can request an Autopsy?
c) Hospital vs. Forensic (Coroners) cases (differences and similarities)
d) Coroner's Act
e) Different causes of death
f) External & internal examination – what to look for and make note of Post mortem changes – timeline & sequence of events
g) Types of injuries/wounds incisions, contusions, abrasions etc…
h) Wounds: accidental/ Homicidal/Bullet wounds

i) hat body tissues/fluids to save; How and why
j) Normal organ weights
k) Autopsy techniques (Virchow vs Rokitansky vs Letulle methods)
l) Restricted autopsies (e.g. brain only, chest only etc.) & special dissections (ex. Spinal cord, leg dissections for thrombus etc.)
m) Photography, Basics and the Importance of photography & how to take a good photograph
n) The autopsy table, requirements
o) The service try(s): what should it contain-tools, instruments etc.
p) Maintaining the autopsy tray, table and the room
q) Maintaining the Autopsy room.

3. Pre-Autopsy Preparation - Hands on training

a) Check List: Valid consent & paperwork
b) Identify the body
c) External examination
   - Weight, height, previous surgical scars, tattoos, eye & hair colour, any surface abnormality etc…
   - Rigor & Livor
   - Pre vs Post mortem injuries

4. Preforming Autopsy – Hands on training: Discussion with resident/pathologist before starting.

a) Y incision
b) Internal examination of organs in situ - check for fluid in cavities, organs in proper places, Sub diaphragmatic region etc.
c) Collection of forensic material (ex. Femoral blood, heart blood, urine, vitreous etc.)
d) Removal of block after careful examination & important anatomical landmarks
e) Dissection of block
   - Where to start, what vessels to probe for patency
   - How to properly slice organs
   - How to open the heart & measurements to take
   - Handling foreign bodies and medical devices
f) Brain removal
g) Pre and Post Check List

5. Post Autopsy – Hands on training:

a) The Morgue. Maintaining a Log of morgue activities
b) Daily activities morning
c) Returning tissue to body & closing
d) Releasing body to security/funeral home
e) Taking sections – How many and what to section and what to save for possible future reference
f) Quality
g) Decontamination

Evaluation

- Student keeps a log of all cases performed
- Performance evaluation by site director and faculty attendant

LMP 2207H: Practicum in Forensic Pathology
Course Co-ordinator: Michael Pickup

Course Objectives

- Gain competency in forensic pathology in a hospital setting including pre, basic, and special dissections
- Describe and be familiar with basic definitions and procedures in forensics
- Understand and appreciate ethical and confidentiality issues related to forensics

Description

In this course students will learn the fundamentals of forensic pathology as well as the hands-on training. Students will work on real cases under supervision and will be exposed to a variety of scenarios.

Week	Topics
1-2	TBD
3	PRE-DISSECTION 1 Continuity and Identification Body Handling External Examination Autopsy Observation
4	PRE-DISSECTION 2 Exhibit Continuity and Documentation Samples from the autopsy (vitreous humour, blood, urine, microbiology, etc.) Photography skills Autopsy Observation
5	BASIC DISSECTION & AUTOPSY SKILLS I Head & Neck
6	BASIC DISSECTION & AUTOPSY SKILLS II Basic Evisceration
7	BASIC DISSECTION & AUTOPSY SKILLS III Basic Evisceration
8	BASIC DISSECTION & AUTOPSY SKILLS IV Basic Evisceration
9	SPECIAL DISSECTION TECHNIQUES I Layered dissection of the anterior torso Layered dissection of the posterior torso
10	SPECIAL DISSECTION TECHNIQUES II Layered dissection of the anterior neck and face in an avascular field Removal of the spinal cord
11	SPECIAL DISSECTION TECHNIQUES III Layered dissection of the anterior torso Layered dissection of the posterior torso

	Layered dissection of the anterior neck and face in an avascular field Removal of the spinal cord
12	TRANSITION TO PRACTICE Function as a fully trained Pathologists' Assistant OBSERVED AUTOPSY DATE TO BE CONFIRMED ORAL EXAM DATE TO BE CONFIRMED

Evaluation

- Quizzes (2)
- An evaluation form filled by the site director/pathology attendant
- Candidates will go through a simulated grossing pathology quiz addressing the appropriate section submission and major drawbacks of the gross pathology examination
- A competency check list of organs grossed
- Attendance log sheet

LMP 2208H: Biobanking for Research
Course Co-ordinator: Dianne Chadwick

Description

This is a 0.5 FCE lecture/seminar course with student presentations. The content focuses on principles and methodology of Biobanking patient samples for research. There will be an overview of types of biobanks and biospecimens, biobank methodology with particular emphasis on surgical tissue, and use of banked samples and molecular derivatives in research.

Week	Topics
1	Introduction to Biobanking
2	The Science of biobanking
3	The Practice of Biobanking
4	Biobanking Methodology I - Surgical specimens
5	Biobanking Methodology II - Non-Surgical Specimens
6	Quiz / Week 11 Research Paper Distribution
7	Biobanking Workflow (on-site)
8	Research Applications using Biospecimens
9	Ethics, Privacy, Informed Consent, Governance
10	Research Tools in Biospecimen Sciences
11	Small Group Research Paper Presentations
12	Quiz

Evaluation

- Small Group Research Paper Presentations and class discussion (60%)
- Quizzes (2) – conceptual and knowledge evaluation (20% - 2)

LMP2209H: Practicum in Surgical Pathology V
Course Co-ordinator: Ilan Weinreb

Course Objectives

- Develop competency in the surgical dissection of skin, cardiovascular, endocrine organs and neuropathology resections specimens.
- Develop expertise in identifying a spectrum of benign and malignant lesions
- Provide accurate macroscopic description of findings of clinical relevance
- Describe, understand and be able to discuss the appropriate sectioning to guide microscopic diagnosis

Description

This is a 0.5 FCE practical hands-on training course. Candidates will spend 2 full days a week (6 hours per day) at one of the participating university hospitals. They will be shadowing certified PAs at a workstation throughout the day. They will also have the opportunity to handle surgical specimens under supervision. This course includes orientation, inking cutting, handling, macroscopic description and processing for skin, lymph nodes, endocrine organs and neuropathology.

Week	Topics
1	Macroscopic examination of cardiovascular system organs
2	Dermatopathology #1 (skin resections for carcinoma and Melanoma)
3	Dermatopathology #2 sentinel lymph node biopsy protocol in Melanoma
4	Thyroid
5	Parathyroid
6	Adrenal gland
7	Mediastinum resections (thymus)
8	Neuropathology specimens #1.Brain and dura biopsies
9	Neuropathology specimens #2.Brain resections
10	Neuropathology specimens #3. Eyes and lens
11	Neuropathology specimens #4.Nerve and muscle handling, grossing and processing
12	Neuropathology specimens #5. Subdural and subarachnoid hematoma evacuation

Evaluation

- Quizzes (2)
- An evaluation form filled by the site director/pathology attendant
- Candidates will go through a simulated grossing pathology quiz addressing the appropriate anatomic landmarks, section submission and major drawbacks of the gross pathology examination
- A competency check list of organs grossed
- Attendance log sheet

LMP 2210H: Practicum in Surgical Pathology VI
Course Co-ordinator: Carlo Hojilla

Course Objectives

- Develop competency in gross examination and of soft tissue specimens, lymph nodes, spleen and perinatal specimens
- Develop expertise in identifying a spectrum of benign and malignant lesions
- Provide accurate macroscopic description of specimens that is of clinical relevance
- Develop expertise to discuss and submit the appropriate sections to guide microscopic diagnosis

Description

This is a 0.5 FCE practical hands-on training course. Candidates will spend 2 full days a week (6 hours per day) at one of the participating university hospitals. They will be shadowing certified PAs at a workstation throughout the day. They will also have the opportunity to handle surgical specimens under supervision. Candidates will spend half of the rotation at Mount Sinai Hospital and the second half at the hospital for Sick Children. This course offers an approach to orientation, inking, cutting, handling, macroscopic description and processing of pediatric lung, liver, kidney, adrenal, small and large bowel (resections and biopsies [including wedges and needle cores]), pediatric and adult soft tissue specimens, lymph nodes, spleen and perinatal pathology. The pediatric component of this course would also include autopsies, particularly how to modify standard postmortem procedures to demonstrate congenital malformations. An introduction of what tissue should be obtained to assess for cytogenetic and metabolic diseases. Pediatric/fetal/infant organ removal including brain. This includes an introduction to perinatal and pediatric anatomy in addition to proper orientation and dissection of different type of lesions. This course will provide an emphasis on the importance of gross examination and section submission and how this provides the pathologist with important information pertinent to generate a complete pathology report that will subsequently affect the management plan.

Week	Topics
1	Soft tissue tumors #1
2	Soft tissue tumors #2
3	Bone Lesions
4	Neonatal autopsy
5	Perinatal surgical specimens
6	Perinatal pathology specimens - Placenta and POC
7	Pediatric abdominal tumours (kidney, liver, adrenal etc.) (SickKids)
8	Pediatric IBD resections (ileocolic, subtotal colectomy) (SickKids)
9	Pediatric heart explants, congenital cardiac anomalies and pediatric autopsy (SickKids)
10	Pediatric lung resections (tumours and non-tumours) (SickKids)
11	Pediatric liver resections for medical liver disease (biliary atresia, Kasai procedure etc.) including metabolic disease tissue handling (SickKids)

12	Pediatric brain and muscle biopsies (handling and processing) (SickKids)

Evaluation

- Quizzes (2)
- An evaluation form filled by the site director/pathology attendant
- Candidates will go through a simulated grossing pathology quiz addressing the appropriate anatomic landmarks, section submission and major drawbacks of the gross pathology examination
- A competency check list of organs grossed
- Attendance log sheet

Elective

Student will take one 0.5FTE graduate course offered in LMP or in any other department, with the approval of the Field Director. The course description and objectives are those of the course and the purpose of the course is to broaden the education of the students or to provide more in depth knowledge on a particular subject of interest to the student.

Appendix B: Graduate Calendar Copy

Laboratory Medicine and Pathobiology

LMP: Introduction
Faculty Affiliation: Medicine

Degree Programs

Laboratory Medicine and Pathobiology
MSc
PhD

Laboratory Medicine
MHSc

Program Description
The Master of Health Science in Laboratory Medicine is a two year professional (course work and practicum) Master's degree designed to educate and train highly skilled health laboratory scientists in one of two fields: Pathologists' Assistant (PA) or Clinical Embryology (CE). The program imparts general core knowledge and skills and the specific basic and applied principles of anatomic pathology or of assisted reproductive technology (ART) required to work as laboratory scientists. These principles are the foundation upon which PAs or CEs develop fundamental applied and practical knowledge and skills to function as competent, high quality clinical scientists. The nature of this graduate program equips trainees to apply their knowledge to complex decision making, to serious ethical issues and to develop a strong sense of personal accountability and intellectual rigour and independence.

Minimum Admission Requirements

- Applicants are admitted under the General Regulations of the School of Graduate Studies and must also satisfy the additional admission requirements stated below
- Admission is based on demonstrated exceptional scholarly achievement, using the following criteria:
  - one page statement summarizing how this program will contribute to the advancement of the applicants' professional goals identifying their field of preference.
  - curriculum vitae (CV)
  - 2 letters of reference, one of which should be familiar with the candidate's scholarly activities
- Applicants must have an appropriate Bachelor of Science degree (B.Sc.) from a recognized university, with an average of at least B+ in the last two years of study. The students must have a demonstrated interest in human biological and life sciences, preferably with a major or specialist program in the life sciences. These programs prepare students for the study of biomedical science, for fluency in biomedical terminology, and for critical evaluation of biomedical literature. Courses in human anatomy and physiology are desirable.
  - All potential students will be interviewed prior to final acceptance into the program. The initial selection of students will be based on a combination of their academic

record, individual statement and letters of reference. These students will be asked to participate in an interview with the Program Coordinator to determine the fit with the program and student's goals.

- Applicants who were educated outside Canada, whose primary language is not English, and who graduated from a university where the language of instruction was not English, must demonstrate proficiency in the English language through the successful completion of the:
    - Test of English as a Foreign Language (TOEFL) with the following minimum scores: Internet-based TOEFL: 100/120 and 22/30 on the writing and speaking sections.
    - Michigan English Language Assessment Battery (MELAB) Web; Required score: 95
    - International English Language Testing Systems (IELTS); Required score: 8.0 (Academic) with at least 6.5 for each component
    - Certificate of English Proficiency (COPE); Required score: 86 minimum total with at least 22 each component and 32 in writing
    - School of Continuing Studies, University of Toronto, "Academic English" course Required score: a final grade of B in Level 60 (Advanced)

Program Requirements

- **Coursework:** All students in both fields will be required to complete the following 4.0 FCE core courses
    - LMP 2000H, Cell and Molecular Biology (0.5 FCE)
    - LMP 2001H, Biomedical Research Methods (0.5 FCE)
    - LMP 2002H, Clinical Laboratory Management (0.5 FCE)
    - LMP 2003H, Biomedical Ethics (0.5 FCE)
    - LMP 2004H, Biostatistics (0.5 FCE)
    - LMP 2005Y, Capstone Project (1.0 FCE, continuous course)
    - 0.5 FCE elective
- Upon completion of these core courses, students will then pursue their field of choice and complete an additional courses
    - Clinical Embryology (4.0 FCE): LMP 2100H, LMP 2101H, LMP 2102H, LMP 2103H, LMP 2104H, LMP 2105H, LMP 2106H, LMP 2107H
    - Pathologists' Assistant (1.5 FCE): LMP 2202H, LMP 2201H, LMP 2208H
- To finish their training, students will be required to complete the following practicum courses
    - Clinical Embryology (1.5 FCE): LMP 2108H, LMP 2109H, LMP 2110H
    - Pathologists' Assistant (4.0 FCE): LMP 2202H, LMP 2203H, LMP 2004H, LMP 2205H, LMP 2206H, LMP 2207H, LMP 2209H, LMP 2210H

For students who fail a course, they will be offered remediation in the form of additional readings and assignments by the Course Director. If a student fails two courses or the offered remediation, they will be required to repeat the year.

Program Length
6 sessions full-time (typical registration sequence: F/W/S/F/W/S)

Time Limit
3 years full-time

Appendix C: Library Statement

UNIVERSITY OF TORONTO LIBRARIES

University of Toronto Libraries Report for

Master of Health Sciences in Laboratory Medicine, Department of Laboratory Medicine and Pathobiology, Faculty of Medicine, October 2018

Context: The University of Toronto Library (UTL) system is the largest academic library in Canada and is currently ranked 6th among academic research libraries in North America.[1] The UTL has an annual acquisition budget of $31 million. Its research and special collections comprise over 12 million print volumes, 5.6 million microforms, over 17,000 journal subscriptions, and rich collections of manuscripts, films, and cartographic materials. The system provides access to more than 1.9 million electronic books, journals, and primary source materials.[2] Numerous, wide-ranging collections, facilities and staff expertise reflect the breadth of research and instructional programs at the University, and attract unique donations of books and manuscripts from around the world, which in turn draw scholars for research and graduate work.

Major North American Research Libraries[3]					
	2011-2012	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**
ARL RANK	**UNIVERSITY**	**UNIVERSITY**	**UNIVERSITY**	**UNIVERSITY**	**UNIVERSITY**
1	Harvard	Harvard	Harvard	Harvard	Harvard
2	Yale	Yale	Yale	Yale	Yale
3	**Toronto (3rd)**	**Toronto (3rd)**	**Toronto (3rd)**	Columbia	Michigan
4	Columbia	Columbia	Columbia	**Toronto (4th)**	Columbia
5	Michigan	Michigan	Michigan	Michigan	New York
6					**Toronto (6th)**

[1] Chronicle of Higher Education (2017). Spending by University Libraries, 2015-16. *Almanac of Higher Education 2017 – 2018*, LXIII (43), 64.

[2] Figures as of 2015 taken from UTL's 2016 Annual Report. http://www.library.utoronto.ca/library/aboutlibraries/annualreport/2016/AnnualReportUTL2016.pdf

[3] Chronicle of Higher Education (2017). Spending by University Libraries, 2015-16. *Almanac of Higher Education 2017 – 2018*, LXIII (43), 64.

Top 5 Canadian Universities in the ARL Ranking of Major North American Research Libraries				
2011-2012	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**
RANK/UNIVERSITY	**RANK/UNIVERSITY**	**RANK/UNIVERSITY**	**RANK/UNIVERSITY**	**RANK/UNIVERSITY**
3/Toronto	**3/Toronto**	**3/Toronto**	**4/Toronto**	**6/Toronto**
10/British Columbia	18/Alberta	22/British Columbia	27/Alberta	31/Alberta
15/Alberta	24/British Columbia	26/Alberta	31/British Columbia	35/British Columbia
18/McGill	30/McGill	35/McGill	43/McGill	42/McGill
32/Montreal	35/Montreal	36/Montreal	49/Calgary	63/Calgary

Space and Access Services: The UTL's 44 libraries are divided into four administrative groups: Central, Departmental/local, Campus (UTM & UTSC) and Federated and Affiliated College Libraries. The UTL provides a variety of individual and group study spaces for students. Study space and computer facilities are available twenty four hours, five days per week at one location, Robarts Library, with additional extended hours during study and exam periods at both UTSC and UTM. Web-based services and electronic materials are accessible at all times from campus or remote locations.

Teaching, Learning & Research Support: Libraries play an important role in the linking of teaching and research in the University. To this end, information literacy instruction is offered to assist in meeting Master of Health Sciences in Laboratory Medicine degree level expectations in the ability to gather, evaluate and interpret information. Librarians collaborate with instructors on assignment design, provide student research consultations, and offer just-in-time student research help in person, by phone, or through online chat. Librarians are also available to support curriculum mapping initiatives. Special initiatives, such as an annual forum for student journal editors, extend information literacy beyond the classroom. These services align with the Association of College and Research Libraries (ACRL) *Framework for Information Literacy for Higher Education*.[4]

Program Specific Instructional Support: Instruction occurs at a variety of levels for science and health sciences students and is provided by faculty liaison librarians. The Gerstein Science Information Centre facilitates formal instruction integrated into the class schedule and hands-on tutorials related to course assignments. The Library, through its liaison librarians, customizes online research guides of library resources which can be linked in Quercus course pages. For example: *Searching the Literature: A guide to comprehensive searching in the health sciences* at https://guides.library.utoronto.ca/comprehensivesearching and *Systematic & Scoping Reviews: Methodology behind the search strategies* at https://guides.library.utoronto.ca/systematicreviews. Gerstein Librarians offer teaching and research support for students and faculty conducting systematic reviews and scoping reviews for coursework, thesis/dissertation requirements, or other research purposes.

[4] Association of College & Research Libraries. Framework for Information Literacy for Higher Education. ACRL, 2016. http://www.ala.org/acrl/sites/ala.org.acrl/files/content/issues/infolit/Framework_ILHE.pdf

Collections: Many college and campus libraries collect materials in support of Master of Health Sciences in Laboratory Medicine; the largest collection of materials is centrally located at the Gerstein Science Information Centre. Collections are purchased in all formats to meet the variety of preferences and styles of our current students and faculty. The University of Toronto Library is committed to collecting both print and electronic materials in support of Master of Health Sciences in Laboratory Medicine at the University of Toronto.

Journals: The Library subscribes to all of the top 25 journals listed in *Journal Citation Reports* (JCR) in subject area Medical Laboratory Technology, all 25 in Pathology, 24 of the top 25 in subject area Obstetrics and Gynaecology, and all of the top 25 in subject area Reproductive Biology[5]. Of these titles, 96 are available electronically to staff and students of the University. We prioritize acquisition of online journals where possible.

Monographs: The UTL maintains comprehensive book approval plans with 51 book vendors worldwide. These plans ensure that the Library receives academic monographs from publishers all over the world in an efficient manner. In support of Master of Health Sciences in Laboratory Medicine, monographs are purchased in electronic form where possible, and the Library currently receives all current e-books directly from the following publishers: Springer, Elsevier, Wiley, LWW (Books@Ovid), Cambridge, and Karger.

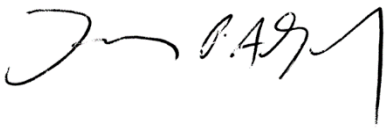
Preservation, Digitization, and Open Access: The UTL supports open access to scholarly communication and research information through its institutional research repository (known as T-Space), its Downsview print repository, its open journal services, subscriptions to open access publications, and support for preservation of research materials in all formats. In addition to acquiring materials in support of Master of Health Sciences in Laboratory Medicine, the Library has digitized its monograph holdings published before 1923. These books are available without charge to any Internet user.

Key Databases: *Medline, Embase, Scopus*

Special Collection Highlight: All students have access to the key evidence-based clinical care tools, including *DynaMed Plus* and *UpToDat*e as well as the drug and natural products information tools: *RxTx* from the Canadian Pharmacists Association; *Lexicomp Online*; *Micromedex*; and *Natural Medicines*.

Other Library-departmental engagement: Gerstein librarians participate in systematic, scoping and other knowledge syntheses in two capacities: consultants regarding comprehensive searching, relevant methodology, or citation management; or as collaborators and coauthors on the research team. This is part of the formal Systematic & Scoping Review Service which has the objective to increase research transparency and reproducibility.

Prepared by: Mikaela Gray, Liaison & Education Librarian, October 11th, 2018
Submitted by: Larry Alford, Chief Librarian, University of Toronto Libraries, February 19, 2019



[5] 2017 Journal Citation Reports® (Thomson Reuters, 2018)

Appendix D: Student Support Services

Student service information for Quality Assurance Framework

All University of Toronto undergraduate and graduate students have access to student services on all three campuses, Mississauga, St. George (downtown Toronto), and Scarborough, regardless of their 'home campus'. The services and co-curricular educational opportunities provide a complement to the formal curriculum by engaging and challenging students to reach their full potential as learners, leaders and citizens. At the University of Toronto (St. George Campus) these services are organized by Student Life Programs and Services, the academic division registrar offices, and the School of Graduate Studies. All these services combine to support the success of our students from the time they are admitted through degree completion and beyond.

Students have access to comprehensive **physical and mental health care** on campus, including a medical clinic, travel medicine services, immunization, contraception and sexual health education. Counselling and treatment options for psychological and emotional concerns include psychotherapy, group therapy and pharmacotherapy, as well as specialized assault counselling services provided both by the health and wellness centre and the Sexual Violence Prevention and Support Centre. In addition, a large number of wellness programs are provided, such as mindful meditation, workshops on coping skills and stress management.

Housing needs, including off-campus housing listings and resources for students living independently, are met through the Student Housing Service.

Coaching and education in the development of key **learning skills** – from time management to overcoming exam anxiety – is provided through the Academic Success Centre. The ASC also partners with faculty to integrate success strategies and support into the curriculum. Students' career exploration and employment services are provided through a **Career Centre** offering resume and interview coaching, workshops, career resources, on and off-campus employment and volunteer listings, job shadowing, and career counseling.

Specialized services are provided for **international students** (orientation, advising, cross-cultural counselling), students with **disabilities** (academic accommodations, advising), students with **children or other family responsibilities** (advising, resources, subsidized child care), **Indigenous students** (academic support, financial counselling) and **lesbian, gay, bisexual and transgender** students (counselling, referrals, equity outreach and engagement).

Participation in **campus life** and **experiential learning** are facilitated through Hart House (clubs, committees, events), the Centre for Community Partnerships (service learning and volunteer opportunities in community settings), the Multifaith Centre (interfaith dialogue, events), and the Student and Campus Development (leadership development, orientation, recognition and support for student groups, activities.) **Sport and recreational facilities and programs** are provided to all students through both Hart House and the Faculty of Kinesiology and Physical Education.

In the Office of the Vice Dean, Graduate and Academic Affairs in the Faculty of Medicine, is the Director of Mentorship, Professor Nana Lee, who works with students (with particular focus on

professional master students) to advise them on their professional and career development prior to graduation.

School of Graduate Studies, Student Services [all campuses]

In addition to the above services available to all students, graduate student have access to registrarial services and co-curricular programs at the School of Graduate Studies that assist students in meeting their academic goals.

Administrative staff at the School of Graduate Studies (SGS) provide **registrarial** services to graduate students including but not limited to recruitment, admission, orientation, registration, fees, program progress, awards/financial assistance and graduation. Fully equipped meeting rooms, which can be booked by student groups when not used for Final Oral Examinations, are distributed across two locations, the newly renovated 63 St. George Street (home of SGS Student Services) and 65 St. George Street. Financial advising and wellness counselling services are also available at 63 St. George.

The **Grad Room** is an accessible space on the St. George campus which provides University of Toronto graduate students with a lounge area and a multi-purpose space for academic, social and professional graduate student programming. An additional lounge area for graduate students is now available at 63 St. George.

Grad Room is home to the **Graduate Professional Skills Program** (GPS). GPS is a non-academic program presented by SGS consisting of a variety of offerings that provide doctoral stream students a range of opportunities for professional skills development. The program focuses on skills beyond those conventionally learned within a disciplinary program, skills that may be critical to success in the wide range of careers that graduates enter, both within and outside academe. GPS aims to help students communicate effectively, plan and manage their time, be entrepreneurial, understand and apply ethical practices, and work effectively in teams and as leaders.

The **Conflict Resolution Centre for Graduate Students** offers support to the University of Toronto graduate community in taking steps to prevent or resolve conflict.
It is a peer-led services that welcomes graduate students to connect confidentially with one of our trained G2G Peer Advisors to talk about options and strategies for addressing a concern and available university supports and resources.

The Office of **English Language and Writing Support** (ELWS) provides graduate students with advanced training in academic writing and speaking. By emphasizing professional development rather than remediation, ELWS helps students cultivate the ability to diagnose and address the weaknesses in their oral and written work. ELWS offers four types of instruction designed to target the needs of both native and non-native speakers of English: non-credit courses, single-session workshops, individual writing consultations, and website resources.

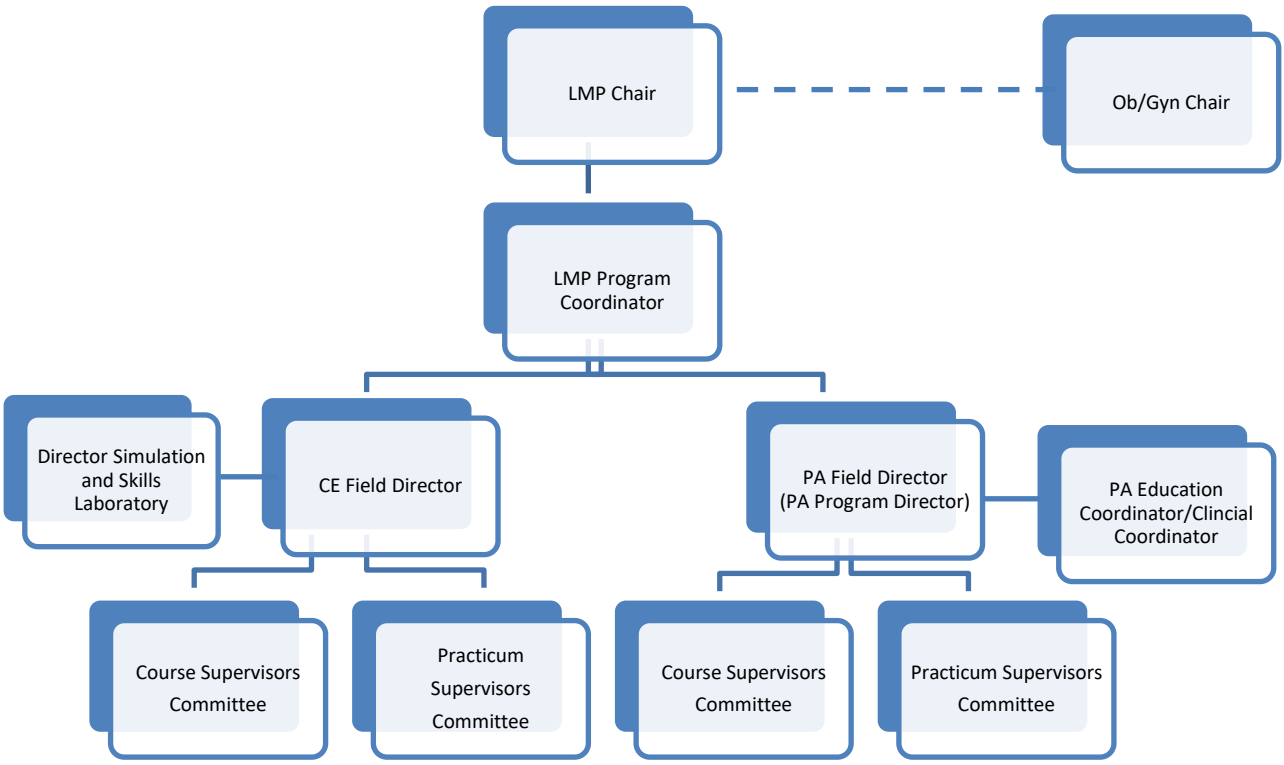
Faculty of Medicine

Starting September 2018, graduate students registered in any graduate program in the Faculty of Medicine will be able to access counselling services based in the Medical Sciences Building and at 500 University Ave.

Furthermore, any students wishing to explore career options are encouraged to make an appointment with the Director of Mentorship and Graduate Professional Development in Graduate Life & Science Education, Dr. Nana Lee.

Appendix E: Program Organizational Structure

A. Reporting Structure



B. Executive Committee

Program Coordinator (Chair), Avrum I. Gotlieb
CE Field Director, Heather Shapiro
PA Field Director, George Yousef

C. Curriculum and Oversight Committee

Program Coordinator (Chair)
CE Field Director
PA Field Director
PA Education Coordinator/Clinical Coordinator
Course Supervisors (2)
Practicum Supervisors (2)
Director, Simulation and Skills Laboratory
PA Representative (1)
CE Representative (1)
PA Field Student Representative (1)
CE Field Student Representative (1)

D. LMP Departmental Committees

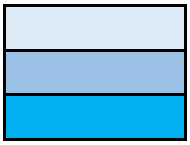
Professional Graduate Curriculum Education Committee
Professional Graduate Appeals Committee

E. Admissions Committee

F. Advisory Committee

Individuals from the community of interest who have knowledge of clinical laboratory science education.

Appendix F: DLEs, Program Learning Outcomes & Requirements



Introductory
Intermediate
Expert

Number	Type of Learning Objective	Details	BOTH	PA	CE	Fall YR 1	Winter YR 1	Summer YR 1	Fall YR 2	Winter YR 2	Summer YR 2
L-01	Depth and Breadth of Knowledge	Understand the fundamental cell and molecular biology principles of pathology and reproductive technology used in the clinical laboratory.	x			LMP 2100H LMP 2000H LMP 2200H	LMP 2101H LMP 2201H	LMP2103	LMP 2106H		
L-02	Depth and Breadth of Knowledge	Identify gaps in knowledge that lead to research and clinical investigations	x			LMP 2001H	LMP 2102H	LMP 2103H	LMP 2005Y LMP 2105H LMP 2106H	LMP 2005Y	LMP 2005Y
L-03	Depth and Breadth of Knowledge	Understanding the principles of laboratory quality assurance	x				LMP 2002H	LMP 2104H LMP 2202H LMP 2203H	LMP 2105H LMP 2204H LMP 2205H	LMP 2206H LMP 2207H LMP 2208H	LMP 2209H LMP 2210H
L-04	Depth and Breadth of Knowledge	Identify and list the etiology and pathogenesis of human diseases		x		LMP 2000H LMP 2200H	LMP 2201H				
L-05	Depth and Breadth of Knowledge	Recognize tissue specimen variation and decide which laboratory approaches are best suited to each type of variation		x				LMP 2202H LMP 2203H	LMP 2204H LMP 2205H	LMP2206 LMP 2207H LMP 2208H	LMP 2209H LMP 2210H
L-06	Depth and Breadth of Knowledge	Understand reproductive physiology and the underlying pathophysiology leading to common causes of infertility			x	LMP 2100H	LMP 2101H LMP 2102H	LMP 2103H	LMP 2106H		
L-07	Depth and Breadth of Knowledge	Know current ART procedures, their indications, strenghs, and limitations			x	LMP 2100H	LMP 2102H	LMP 2104H	LMP 2105H LMP 2107H		
L-08	Research and Scholarship	Critically read and interpret research and clinical literature in the disciplines of pathology or ART	x			LMP2000H LMP 2001H	LMP 2102H	LMP 2004H	LMP 2105H LMP 2106H LMP2005Y	LMP 2005Y	LMP2005Y
L-09	Research and Scholarship	Understand the principles involved in developing a viable research proposal	x			LMP 2001H	LMP2003	LMP 2004H	LMP 2005Y	LMP 2005Y LMP 2208H	LMP 2005Y

L-10	Research and Scholarship	Critically assess technologies for their appropriate use and effectiveness	x			LMP 2001H	LMP 2102H	LMP 2203H	LMP 2005Y LMP 2105H LMP2107	LMP 2005Y	LMP 2005Y
L-11	Application of Knowledge	Know when and how to use statistical tests	x			LMP 2001H		LMP 2004H			
L-12	Application of Knowledge	Apply quality assurance processes in the clinical lab	x				LMP 2002H LMP 2102H	LMP 2104H	LMP 2107H	LMP 2108H LMP 2109H LMP 2206H LMP 2207H	LPM2110
L-13	Application of Knowledge	Recommend and justify the need for follow-up evaluation and/or procedures based on initial findings and clinical context	x				LMP 2102H	LMP 2104H LMP 2202H LMP 2203H	LMP 2107H LMP 2204H LMP 2205H	LMP 2206H LMP 2207H	LMP 2209H LMP 2210H
L-14	Application of Knowledge	Interpret clinical pathology results with an understanding of the inherent strengths and limitations of an individual procedure		x		LMP 2200H	LMP 2201H	LMP 2202H LMP 2203H	LMP 2204H LMP 2205H	LMP 2206H LMP 2207H	LMP 2209H LMP 2210H
L-15	Application of Knowledge	Use patient medical and hospital records to guide clinical work		x				LMP 2202H LMP 2203H	LMP 2204H LMP 2205H	LMP 2206H LMP 2207H	LMP 2209H LMP 2210H
L-16	Application of Knowledge	Be able to assess oocytes, sperm, and embryos			x			LMP 2102H LMP 2104H		LMP 2108H LMP 2109H	LMP 2110H
L-17	Application of Knowledge	Perform simulation laboratory techniques used in ART			x					LMP 2108H LMP 2109H	
L-18	Professional Capacity/ Autonomy	Know, and be able to apply ethical standards for clinical laboratory science	x				LMP 2003H	LMP 2104H LMP 2202H	LMP 2105H LMP 2107H	LMP2206 LMP 2207H LMP2208H	
L-19	Professional Capacity/ Autonomy	Know and follow the professional guidelines for communication of clinical findings	x				LMP 2003H	LMP 2103H LMP 2203H	LMP 2107H LMP 2204H LMP2205H	LMP 2206H LMP 2207H LMP2208H	LMP 2209H LMP 2210H
L-20	Professional Capacity/ Autonomy	Appreciate the consequence of growing availability of cell and molecular biology information on clinical medicine	x			LMP 2000H		LMP 2103H LMP 2203H	LMP 2107H LMP 2204H LMP 2205H	LMP 2206H LMP 2207H LMP 2208H	LMP 2209H LMP 2210H
L-21	Professional Capacity/ Autonomy	Understand how the embryologist can provide patient centered care			x		LMP 2003H	LMP 2104H	LMP 2107H		
L-22	Communication Skills	Create written and oral presentations on research topics and literature	x						LMP 2106H LMP 2005Y LMP 2107H	LMP 2005Y	LMP 2005Y
L-23	Communication Skills	Synthesize complex information in written and oral form to present to appropriate stakeholders	x					LMP 2103H LMP 2104H LMP 2002H LMP 2203H	LMP 2005Y LMP 2105H LMP 2204H LMP 2205H	LMP 2005Y LMP 2206H LMP 2207H LMP 2208H	LMP 2005Y LMP 2110H LMP 2209H LMP 2210H

Appendix G: Comparable PA & CE Programs

Current PA Graduate Programs in Canada[1]

Institution	Program	Length	Number of students per year	Other Details
University of Alberta	Master of Pathologists' Assistant (MScPA)	2 years	2	National Accrediting Agency for Clinical Laboratory Sciences (NAACLS). Eligible for CCCPA certification.
University of Calgary	Master of Pathologists' Assistant (MDPA)	2 years	4-5	National Accrediting Agency for Clinical Laboratory Sciences (NAACLS). Eligible for CCCPA certification.
University of Western Ontario	Masters of Clinical Sciences-Pathologists' Assistant (MSISc)	2 years	5	National Accrediting Agency for Clinical Laboratory Sciences (NAACLS).
University of Manitoba	Masters of Science-Pathologists' Assistant (MSc-PA)	2 years	2 students every second year	Not accredited

Current PA Graduate Programs in the United States of America[1]

Institution	Program	Length	Number of Students per year	Other Details
University of Maryland School of Medicine (Baltimore, MD)	Master of Science	22 consecutive months	10	Accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) Eligible to take the American Society of Clinical Pathology (ASCP) certification examination.
Drexel University (Philadelphia, PA)	Master of Science in Pathologists' Assistant (PathA)	2 years	12	Accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS)
Duke University (Durham, NC)	Master of Health Science	2 years	6-8	In addition to the accreditation of Duke University School of Medicine, The Pathologists' Assistant Program is individually Accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS). This program certifies graduates to sit for the ASCP Board of Certification examination
West Virginia University (Morgantown, WV)	Master of Health Science	2 years	Up to 16	Accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS). Eligible to sit for the ASCP (American Society of Clinical Pathologists) exam.

Current CE Graduate Programs[2]

Institution	Degree	Duration
University of Oxford, England	MSc in Clinical Embryology	12 months, full-time
University of Dundee, Scotland	MSc Human Clinical Embryology and Assisted Conception	12 months, full-time
University of Leeds, England	MSc Clinical Embryology	24 months Distance learning
University of Valencia, Spain	Master Degree in the Biotechnology of Human Assisted Reproduction and Embryology	12 months Virtual classroom
Monash University, Australia	Intensive Master of Clinical Embryology	12 months, full-time 24 months, part-time
University of Nottingham, England	Master in Medical Science (MMedSci) Assisted Reproductive Technology	12 months, full-time
Eastern Virginia Medical School, Virginia, USA	M.S. in Reproductive Clinical Science	2 years
Northwestern University, Chicago, USA	MS in Reproductive Science and Medicine	12 months for non-thesis, full-time

Notes

[1] All programs listed are full-time. To our knowledge there are no Pathologists' Assistant graduate programs (or equivalent) that are part-time.

[2] To our knowledge there are no Clinical Embryology graduate programs (or equivalent) that exist in Canada.

Appendix H: Letters of Support

October 9, 2018

We were very excited to hear about the new Masters in Health Science, which has as one of its goals to train and educate Pathologist's Assistants. In the hospital pathology departments, these individuals are pathologist extenders and are critical for an efficiently functioning department. They are highly trained individuals, who under the supervision of the pathologist, make critical medical decisions. For this reason, it is very important that they be highly trained at a Master's level. In support of their importance, there are very few pathology laboratories that do not have such individuals and usually several of them.

There is a growing need for Pathologist's Assistants as the specimens in hospitals become increasingly complex. Additionally, there is demand for these individuals in sites outside of Pathology labs such as Forensics, research labs, and biobanks to mention just some other positions they hold in the healthcare system. For this reason, there are always hospital labs that are searching for Pathologist's Assistants. It is not unusual to see multiple advertisements for jobs. This is not surprising the few Pathologist's Assistants programs that current exist across Canada.

Thus, the program that Laboratory Medicine and Pathobiology is developing in conjunction with Obstetrics and Gynaecology is filling a great need that will have societal impact. We, the undersigned, are very enthusiastically supportive of this initiative. We also gladly commit to training these learners in our departments. As a group, given our diversity, we will be able to offer training in all the areas that they will need in their practicums. The students will not have to travel out of the city as we are able to provide a rich and stimulating environment that will promote excellence and exposure to a superb training experience. If we can help you in anyway, please let us know.

Sincerely,

Victor Tron, Chief
St. Michael's Hospital

David Hwang, Chief
Sunnybrook Health Sciences Centre

Michael Pollanen, Chief Forensic Pathologist
Ontario Forensic Pathology Service Forensic Services

Susan Richardson, Interim Chief
The Hospital for Sick Children

Simon Raphael, Chief
North York General Hospital

Matthew Cesari, Chief
Trillium Health Partners

Sebastian Karavattathayyil
Toronto East General Hospital

Rita Kandel, Professor & Chair
Laboratory Medicine & Pathobiology, UofT

Runjan Chetty, Medical Director
Toronto General Hospital

CANADIAN FERTILITY AND ANDROLOGY SOCIETY
SOCIÉTÉ CANADIENNE DE FERTILITÉ ET D'ANDROLOGIE

January 12, 2018,

Professor Trevor Young,
Dean, Faculty of Medicine
University of Toronto

Dear Professor Young,

I am writing this letter in support of the application for the new degree course, Masters of Laboratory Health Science, ART Stream at the University of Toronto.

The societal need for a Masters level education in this area is undeniable. Canada is the only developed country that does not offer formal education in Embryology. The CFAS is committed to ensuring safe and effective treatment fertility treatment, and standardized education and certification of embryologists is vital to achieving this goal.

The CFAS has worked with the University of Toronto for continuing professional development courses in the past and many of its faculty have contributed a great deal to the field of assisted reproduction in the areas of public policy, science, medicine, law, mental health, and ethics. Therefore, the CFAS believes that the University of Toronto, among all the universities in Canada, is best prepared to provide the degree program in embryology. We are aware of the extensive physical and human resources available and we welcome the opportunity to work with the university and respective department in future educational endeavours.

Of note, the CFAS has created a voluntary competency exam for practising embryologists and andrologists using the same testing development methodology as is used to qualify foreign physicians in Canada. The first cohort scheduled to take exams in April 2018. We would be very happy to collaborate with your curriculum development committee to ensure the relevant content is provided.

We commend the University of Toronto for advancing this initiative to strengthen the field and practice of embryology in Canada - an effort that will further establish Canada as a leading place for the provision of safe, effective, and advanced assisted reproductive care.

Sincerely,

Jason Min MD
President, CFAS

Mark Evans
Executive Director, CFAS

Cc: Board of Directors

1719 rue Grand Trunk • Suite 301 • Montreal • Quebec • H3K 1M1 • Canada
Tel. 514.524.9009 • Fax 514.524.2163 • info@cfas.ca • www.cfas.ca

Appendix I: Acronyms and Abbreviations

AAPA	American Association of Pathologists' Assistants
ACRL	Association of College and Research Libraries
ART	Assisted Reproductive Technology
ASCP	American Society for Clinical Pathology
C/PSI	Clinical or Practice Supervisor
CA	Clinical Adjunct
CAP	Canadian Association of Pathologists
CapI	Capstone Instructor
CCCPA	Canadian Certification Council of Pathologists' Assistants
CC	Course Coordinator
CE	Clinical Embryologist
CF	Clinical Faculty
CI	Course Instructor
CSB	Cell and Systems Biology
ELWS	English Language and Writing Support
FCE	Full Course Equivalent
FD	Field Director
HCPC	Health Care Professional Council
HFEA	Human Fertilization Embryology Authority
IHPME	Institute of Health Policy, Management and Evaluation
IMS	Institute of Medical Science
LMP	Laboratory Medicine and Pathobiology
MHSc	Master of Health Science
MOHLTC	Ministry of Health and Long Term Care
NAACLS	National Accreditation Agency for Clinical Laboratory Services
OB/GYN	Obstetrics and Gynecology
PA	Pathologists' Assistant
PC	Program Coordinator
SGS	School of Graduate Studies
SO	Status Only
TS	Teaching Stream
UofT	University of Toronto
UME	Undergraduate Medical Education
UTL	University of Toronto Library
UTM	University of Toronto Mississauga
UTQAP	University of Toronto Quality Assurance Process
UTSC	University of Toronto Scarborough

Appendix J: External Appraisal Report

UNIVERSITY OF TORONTO
FACULTY OF MEDICINE

APPRAISAL REPORT FORM | New Program Proposal

The external reviewers are asked to evaluate the standards and quality of the proposed program undergoing external review, commenting on the points below and including the associated faculty and material resources. This interactive form is based on the terms of reference and highlights the critical elements that must be considered. Reviewers are invited to acknowledge any clearly innovative aspects of the proposed program. Please make note of any recommendations on any essential or desirable modifications.

Proposed Program	Laboratory Medicine, MHSc – Dept. of Laboratory Medicine & Pathobiology
Commissioning Officer	Prof. Trevor Young, Dean
External Reviewers	Prof. Barry Behr, Dept. of Obstetrics & Gynecology-Reproductive Endocrinology & Infertility, Stanford University Prof. James R. Wright, Jr., Dept. of Pathology & Laboratory Medicine, University of Calgary
Date of Appraisal Visit	February 26, 2019

1. OBJECTIVES

- **consistency of the program with the University's mission, and Faculty's and Department's/EDU's academic plan**
- **clarity and appropriateness of the program's requirements and associated learning outcomes in addressing the academic division's graduate Degree-Level Expectations**
- **appropriateness of the degree or diploma nomenclature**

The proposed Laboratory Medicine MHSc degree, a partnership between the Department of Laboratory Medicine and Pathobiology (LMP) and the Department of Obstetrics and Gynaecology (OB/GYN), is to our knowledge unique. While other Pathologists' Assistant (PA) training programs exist in Canada and the United States, this one is unique in that it is designed to provide PAs to work in an academic, research-intensive environment, as well as in non-academic and industry environments. The training program in Clinical Embryology (CE) is simply unique, as there is no other training program for this discipline in Canada and probably nothing entirely equivalent in the United States.

This professional graduate program is clearly consistent with the University of Toronto's Statement of Institutional Purpose which specifies "The University of Toronto is committed to being an internationally significant research university with undergraduate, graduate, and professional programs of excellent quality."

The PA and CE program objectives are clear and appropriate. All courses for both programs are graduate level courses. The degree of MHSc is appropriate; all North American PA training programs are delivered as Master's level programs and several of these programs award their graduates a MHSc degree. While the CE training has few North American comparators, its clinical importance and level of rigor make it very similar to the PA degree and hence the MHSc degree is appropriate.

2. ADMISSION REQUIREMENTS

- **appropriateness of the program's admission requirements to the learning outcomes established for the completion of the program**
- **appropriateness of any alternative requirements for admission into the program such as minimum grade point average or additional languages or portfolios, along with how the program recognizes prior work or learning experience**

Admission requirements are appropriate for both PA and CE programs. Applicants will be admitted under the General Regulations of the School of Graduate Studies and must also satisfy the additional admission requirements including a minimum grade point average, two reference letters, a track record documenting interest in their chosen discipline, a one page statement summarizing how the program will contribute to the advancement of the applicants' professional goals, an interview, and documentation of English proficiency. The later is especially critical for the PA profession as communication is an essential function; dictation and transcription of gross pathology and autopsy findings will be routine daily functions. Written English language skills can be assessed via the one page statement and verbal skills during the interview. For the CE profession, communication is too important with similar requirements to the PA, although less requirements for dictation and transcription. Admission to both programs will be highly competitive (i.e., there will likely be five to ten-fold qualified applicants for each spot) and so it is anticipated that the successful applicants will far exceed the minimum requirements and will be outstanding.

3. STRUCTURE

- **appropriateness of the program's structure and regulations to meet specified program learning outcomes and Degree-Level Expectations**
- **rationale for program length in order to ensure that the program requirements can be reasonably completed within the proposed time period**
- **the extent to which the program structure and delivery methods reflect universal design principles and/or how the potential need to provide mental or physical health accommodations has been considered in the development of this program**

The North American standard for PA training programs is that they are accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS). During our site visit, the leadership and faculty for the proposed PA training program assured us that the PA training program will meet and exceed the requirements for NAACLS-accreditation. In fact, the Program Coordinator, Dr. Gotlieb, came to our meeting with a printout of the NAACLS standards which he called the "NAACLS bible." As we discussed in detail at the meeting, certain aspects of the proposal (version dated January 29, 2019) will need to be tweaked but these changes can be easily accomplished and will result in an outstanding program. Graduates of an NAACLS-accredited PA Masters degree training program are eligible to write the American Society for Clinical Pathology (ASCP) Board of Certification exam in the US and the Canadian Certifying Council for Pathologists' Assistant exam in Canada. Graduates with dual certification can work in either country. Currently, only two other Canadian programs can offer graduates the opportunity to write both board exams.

There are currently no North American standards for CE training programs; this is simply because of the paucity of CE training programs. The UofT program will immediately become a leading North American program and will help develop the standards for the CE profession. It is anticipated that they could play an important role in developing an accreditation process for training programs and a board certification exam for graduates. It will be important to engage with the American Board of Bioanalysis (ABB) to ensure the structure meets the Board requirements to sit for their entry level certification exams, ELS and ALS. It would also be advisable to allow students to identify mentors and pick a Capstone project early in the program and provide a path to a higher degree should it be desired. We do not expect this to be a popular option but should be outlined in advance of commencing.

For the PA program, all NAACLS-accredited programs are 2 year Masters degrees; this is a North American standard. While the CE training has few North American comparators, its clinical importance and level of rigor make it very similar to the PA degree and hence a two year duration is appropriate.

Mental and physical health accommodations are, in general, dealt with according to UofT policies. However, it should be noted that, because of the nature of the PA and CE training programs, there is no possibility of completing the programs on a part-time basis. The designs of both curricula require students to complete the program in the sequence as designed. NAACLS-accredited PA training programs must also comply with Standard V in the NAACLS Guide to Accreditation and Approval. This standard outlines "essential functions" related to: observation, communication, sensory-motor coordination, intellectual-conceptual-integrative-quantitative abilities, and behavioral-social attributes required for training in and practicing the PA profession. Part of the accreditation process requires a method of communication of "essential functions" to applicants and accepted students. Because of the nature of the work, admission to an accredited training program is dependent upon the ability to perform these essential functions.

4. PROGRAM CONTENT

- **ways in which the curriculum addresses the current state of the discipline or area of study**
- **identification of any unique curriculum or program innovations or creative components and their appropriateness**
- **for research-focused graduate programs: clarity of the nature and suitability of the major research requirements for degree completion**
- **evidence that each graduate student in the program is required to take all of the course requirements from among graduate level courses**

As we discussed at the face-to-face exit interviews, certain aspects of the proposal (version dated January 29, 2019) will need to be tweaked but these changes can be easily accomplished and will result in an outstanding program. Because of the nature of the training programs (i.e., they are essentially graduate professional degrees), some of the topics covered should take a survey course approach rather than an in depth approach that might be used in a purely research-intensive thesis-based graduate degree. Since all but two of the proposed courses are going to be specifically designed for these students, you will have the ability to tailor the courses to provide optimal theoretical training in the first year to compliment the practical training in the second year. To meet the requirements for NAACLS accreditation of the PA portion of the program, there will need to be specific training in human anatomy, human embryology, and human physiology. Perhaps, the latter two subjects could be part of the core curriculum shared between the two programs. The CE program then could delve into greater detail with subsequent courses. To meet NAACLS accreditation standards, the PA students will need a Clinical Rotations course providing some exposure to Clinical Pathology laboratories such as medical microbiology, clinical

chemistry, hematology, etc. The exposure is simply needed so that the students know how to collect and send specimens to these laboratories.

For the CE program, essentially the entire program and curriculum are unique as such degrees do not exist in North America. For the PA training, other Canadian and American training programs exist, but most are directed at turning out PAs to work in non-research intensive environments. The design of the proposed program is radically different in that graduates will be well-suited for working at research-intensive academic centres. The training in bio-banking is likely unique in North America.

These programs are not thesis-based but provide research training, ethics training, and significant clinical experiences through clinical rotations, the shadowing program and the simulation labs. Again, it is key to ensure that the time spent on the various topics/modules is sufficient to meet the ABB requirements as well as liaising with Canadian officials to ensure curriculum is in line with the potential future certification requirements. It would be advisable to add content on fertility preservation and legal/malpractice content for the CE program as these are real life issues that all CE's will encounter to some degree at some point early in their careers. It may also be helpful to articulate the integration of this program into the workforce with a limited apprenticeship.

All of the core courses, PA-specific courses, and the CE-specific courses are graduate courses. Training in Medical Terminology is a requirement for PA students in a NAACLS-accredited training program; since this is not a graduate level course, students will be expected to receive this training on their own using a designated online vendor and simply present a certificate of completion at the time they begin first year classes.

5. MODE OF DELIVERY

- **appropriateness of the proposed mode(s) of delivery—distance learning, compressed part-time, online, mixed-mode or non-standard forms of delivery, flex-time options—to meet the intended program learning outcomes and Degree-Level Expectations**

The mode of delivery is appropriate. The first year is didactic providing the background required to complete the second year of practical training. Because of the need for training to occur in a particular sequence, flex-time options are not possible.

It may be valuable to specifically state that the course will run continuously and that the only time off is University holidays. Please also add information on how parental leave would be addressed.

6. ASSESSMENT OF TEACHING AND LEARNING

- **appropriateness of the proposed methods for the assessment of student achievement of the intended program learning outcomes and Degree-Level Expectations**
- **completeness of plans for documenting and demonstrating the level of performance of students, consistent with the academic division's statement of its Degree-Level Expectations**

The assessment of teaching and learning are standard in this program and are satisfactory. However, they may be enhanced by adding some assessment post completion of the program. For example, evaluation of the Board pass rates of students completing the program. Hiring rates of graduates, soundness of the Capstone project and potential for abstract or paper publication.

7. RESOURCES

- **adequacy of the administrative unit's planned utilization of existing human, physical and financial resources, and any institutional commitment to supplement those resources to support the program**
- **participation of a sufficient number and quality of faculty who are competent to teach and/or supervise in the program**
- **adequacy of resources to sustain the quality of scholarship and research activities of graduate students, including library support, information technology support, and laboratory access**
- **recent research or professional/clinical expertise of faculty to sustain the program, promote innovation and foster an appropriate intellectual climate**
- **sufficiency of financial assistance for students to ensure adequate quality and numbers of students**
- **supervisory load distribution and the qualifications and appointment status of faculty who will provide instruction and supervision**

The UofT have a tremendous faculty with diverse interests and backgrounds with the ability to teach, supervise or mentor a diverse group of students that may enter the program. Their expertise allows for a wide range of projects that could be meaningful in the clinical world. The unique opportunity to shadow professionals in the real word and have a simulation lab (CE program) are unique opportunities for these students to prepare for the job market. The University and specifically the dept of LMP, have both the physical and intellectual resources to support a robust MSc program.

8. QUALITY AND OTHER INDICATORS

- **quality of the faculty (e.g., qualifications, research, innovation and scholarly record; appropriateness of collective faculty expertise to contribute substantively to the proposed program)**
- **program structure and faculty research that will ensure the intellectual quality of the student experience**
- **the extent to which the program has integrated any elements that enhance the diversity of its curriculum, students, or teaching staff**

In addition to the quality indicators identified in the proposal, for the PA program, the passing rate for the ASCP and CCCPA board certification exams should be tabulated. Achieving NAACLS accreditation of the program is also a quality indicator as it means the program design and training meet an accepted international standard.

It would be essential for the program to receive accreditation through the ABB (or a Canadian equivalent when it exists). As for the PA program and NAACLS, the ability for graduates to launch from an accredited program would not only be appropriate, but allow students to be bonified to enter the job marked with less barriers to entry.

ANY ADDITIONAL COMMENTS

In addition to the University and provincial approval timelines, accreditation of the PA program by NAACLS has a parallel timeline which should be confirmed with them. Generally speaking, there is a letter of intent followed by submission of an application of initial accreditation/approval and payment of an application fee that begins the process. Next, there is an Official Approval Form for the proposed Program Director. The Program Director can be either an ASCP-board certified PA or a pathologist; if the latter, there must be a ASCP-board certified PA appointed as "educational coordinator." Once approved by NAACLS, a Preliminary Report (a general overview of the program addressing NAACLS Standards I-VIII)) must be submitted by the approved Program Director. Once this is approved, the first class of students can be enrolled. A complete Self-Study Report must be submitted allowing the program to achieve "serious applicant" status. After this, there is a site visit prior to full accreditation. Please communicate directly with NAACLS so that both the provincial approval process and the NAACLS accreditation process proceed in a synchronized manner.

The same general format should be followed for the CE track once and accrediting body is identified.

This is a robust Master's program that is desperately needed in North America. Congratulations on putting together the makings of a terrific, novel and well needed graduate degree.

It would also be useful to add a list of abbreviations to the proposal document, as this will be reviewed by many people who may not know all of these.

Suggested Appendix - list of interviews

EXTERNAL REVIEWERS	SIGNATURES
Prof. Barry Behr	
Prof. James Wright, Jr.	

Appendix K: Dean's Response to External Appraisal Report

UNIVERSITY OF TORONTO
FACULTY OF MEDICINE

L. Trevor Young, MD PhD FRCPC

Dean
Vice-Provost, Relations with Health Care Institutions

April 12, 2019
Dr. Susan McCahan
Vice Provost, Academic Programs
University of Toronto

Dear Professor McCahan,

RE: External Appraisal of MHSc in Laboratory Medicine - February 26, 2019

On behalf of the Faculty of Medicine, University of Toronto, I would like to thank Professor Barry Behr, Dept. of Obstetrics and Gynecology at Stanford University and Professor James Wright, Dept. of Pathology & Laboratory Medicine at the University of Calgary, for their thorough expert in-depth analysis of the proposal and for their excellent report. I would also like to thank the Faculty Leads, Professors Avrum Gotlieb and Rita Kandel from the Dept. of Laboratory Medicine & Pathobiology and Professors John Kingdom, Heather Shapiro and Ted Brown from the Department of Obstetrics & Gynaecology, as well the administrative staff of both departments and all those who contributed to the preparation of the comprehensive new program proposal. I also extend many thanks to all the faculty members and students who met with the external appraisers. Their input was invaluable for this review.

The Faculty of Medicine and the Vice Dean, Graduate and Academic Affairs fully support the proposal for a new Professional Master's degree in Laboratory Medicine. We are very pleased to see that the two external appraisers are also highly supportive of this new program. They state in their review, "This is a robust Master's program that is desperately needed in North America. Congratulations on putting together the makings of a terrific, novel and well needed graduate degree". The appraisers also state that the program is consistent with the University's Statement of Institutional Purpose: *The University of Toronto is committed to being an internationally significant research university with undergraduate, graduate, and professional programs of excellent quality.*

The following highlight the key findings of the appraisers and our response to issues raised:

1. Issues involving Accreditation/Certification

a) Aligning Clinical Embryology Curriculum with Accreditation Standards

Currently, there is no accreditation body for Clinical Embryology in Canada. The appraisers recommended engaging with the American Board of Bioanalysis (ABB) regarding its certifications, but we note that they do not align well with the graduate professional program that LMP is proposing so alignment with ABB certification requirements is not appropriate. Our program is highly academic in nature, in addition to the applied practical knowledge that students will need. The appraisers were aware of the ground-breaking nature of our CE program in Canada and were supportive of our early communications with the Canadian Fertility and Andrology Society (CFAS) to pursue future certification for practice in CE (see Appendix H). The CFAS is supportive of our new program and is "committed to ensuring safe and effective treatment and standardized education and certification of embryologists is vital to achieving this goal." At present, CFAS "has created a voluntary competency exam for practicing embryologists and andrologists." CFAS "would be very happy to collaborate with (our) curriculum development committee to ensure relevant content is provided."

b) Ensuring a method of communication to applicants and accepted students about all admission criteria, based on Standard V in the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) Guide to Accreditation and Approval.

Standard V states that admission to an accredited training program is dependent upon the ability to perform these essential functions as defined as observation, communication, sensory-motor coordination, intellectual-conceptual-integrative-quantitative abilities, and behavioral-social attributes required for training in and practicing the PA profession.

These essential function requirements will be communicated to prospective students via the LMP website as well as at recruitment fairs and recruitment interviews so prospective students will be aware of them prior to applying to the degree program.

Applicants will be screened by reviewing their statement of purpose, CV and 2 letters of reference. Appropriate candidates will then be short listed for an interview, at which time they will be further assessed on critical thinking, effective communication, observation techniques and comprehension. We will also assess demonstrated ability of behavioural social attributes such as being a team player and valuing diversity and meeting goals. This has been elaborated in the admission criteria in the proposal (Section 7).

c) Seeking Accreditation with the National Accrediting Agency for Clinical Laboratory Sciences.

In developing the MHSc in Laboratory Medicine program, the proponents ensured that the curriculum, both core and PA-field specific, followed the current NAACLS standards. We will seek accreditation as soon as possible following approval of the program.

2. Issues with Curriculum

a) In response to the appraisers' feedback, regarding "*some of the topics covered should take a survey course approach rather than an in depth approach that might be used in a purely research-intensive thesis-based graduate degree,"* the following core courses will be presented using a survey course approach, providing breadth: LMP2000H (Cell and Molecular Biology), LMP2001H (Biomedical Research Methods), LMP 2002H (Clinical Laboratory Management), LMP 2003H (Biomedical Ethics) and LMP2004H (Biostatistics). Field specific courses will be presented in depth to establish competency in applied education required for practice in the professional field (i.e. Clinical Embryology: LMP2107H - Applied ART: Laboratory Decision Making, LMP2108H – CE Lab Simulation I, LMP2109H – CE Lab Simulation II; LMP2110H – ART Lab Rotations; Pathologists' Assistant: LMP2203H – Practicum in Surgical Pathology II, LMP2204H – Practicum in Surgical Pathology III, LMP2205H – Practicum in Surgical Pathology IV, LMP2206H – Practicum in Autopsy Pathology, LMP2007H – Practicum in Forensic Pathology, LMP2209H – Practicum in Surgical Pathology V, LMP2210H – Practicum in Surgical Pathology VI).

b) In response to the appraisers' feedback regarding ensuring the PA field includes "specific training in human anatomy, human embryology, and human physiology as part of the NAALCS accreditation standards", this material will be part of LMP2201H – Anatomy and Pathology of Organ Systems. The embryology, anatomy and pathology will be taught for each organ and disease conditions.

c) In response to the appraisers' feedback that PA field students will need "exposure to Clinical Pathology laboratories such as medical microbiology, clinical chemistry, hematology" as part of the PA field's alignment with NAACLS accreditation standards, I confirm that students in this field will have clinical exposure via LMP2002H – Clinical Laboratory Management and reinforced in PA practicums: LMP2202H (Practicum in Surgical Pathology I), LMP2206H (Practicum in Autopsy Pathology I) and LMP2207H (Practicum in Forensic Pathology).

d) In response to the appraisers' feedback regarding "fertility preservation and legal/malpractice content for the CE program." The former material is covered in LMP2104H (Applied Methods in ART), LMP 2108H (CE Lab Simulation I), LMP2109H (CE Lab Simulation II) and the latter in LMP2003H (Biomedical Ethics).

e) In response to the appraisers' feedback regarding "reference to a medical terminology course," this will be an eLearning activity to be completed in the first term of the program, with an exam to establish competency. It will be linked to LMP2001H – Biomedical Research Methods. Development of this eLearning activity aligns with the Faculty of Medicine and Vice Dean of Graduate and Academic Affairs priority to create more hybrid course offerings/activities.

3. Mode of Delivery

The appraisers wanted LMP to be explicit to prospective applicants about the sequential nature of this program and to add information on how parental leave would be addressed. Existing U of T School of Graduate Studies regulations cover provisions for parental leave or

leave for health or personal reasons. In the event that students require a leave of absence (e.g. parental leave, health leave), the program will make all the necessary accommodations for this and for transition back into the program. Similar protocols exist with other professional programs in the Rehabilitation Sector (i.e. MScPT, MScOT, MHSc in Speech-Language Pathology) in which student move as a cohort through a sequential curriculum. Students in the MHSc in Laboratory Medicine program will be advised on the sequential nature of the program and on this protocol at their interview and at their orientation. This information will also be described in the program syllabus.

4. Assessment of Teaching and Learning

In response to the appraisers' feedback regarding "adding some assessment post completion of the program", we have added the following to the assessment section of the proposal. Graduates will be tracked annually by the department immediately after graduation and every year thereafter. Such records will include passing board certification and first and continued employment of graduates so that short term and longitudinal data will be available for review by program and field directors. Upon completion of the program, students will complete an exit survey allowing them to assess the overall quality of the program on 3 topics: content, overall teaching and student experience. They will compose a reflection of their learning experience in the program and discuss this at an exit interview with Program Director and/or Field Director.

The Capstone project will also be assessed through written and oral evaluations of the students. The success of each capstone project will be rated on student participation, final formal oral presentation, and final written report. Potential for abstract/paper submission will be encouraged and requested, when appropriate. This is further outlined in Section 9 of the program proposal.

5. Choosing a Mentor and Capstone Project

Starting at admission interviews and reinforced at orientation, capstone projects will be discussed with the students. The intent of the MHSc in Laboratory Medicine is designed to produce highly skilled ready to work graduates in the field of Pathologists' Assistant and CE. Finally, the appraisers suggested including a list of abbreviations in the proposal. The proposal now includes a list of acronyms and abbreviations in Appendix I.

Thank you again for the opportunity to address these very helpful comments of the reviewers as we move to have this exciting and innovative program added to the offerings for our students.

L. Trevor Young
Dean

Appendix L: Vice Provost, Academic Programs, Response to External Appraisal Report

UNIVERSITY OF TORONTO

OFFICE OF THE VICE-PROVOST,
ACADEMIC PROGRAMS

April 17, 2019

Trevor Young,
Dean, Faculty of Medicine and
Vice-Provost, Relations with Health Care Institutions University of Toronto

Re: Appraisal Report, Proposed Master of Health Science in Laboratory Medicine

Dear Trevor,

I am very pleased to receive the appraisal of the proposed Master of Health Science in Laboratory Medicine. Your administrative response to the appraisal nicely summarizes the report and highlights the specific suggestions made by the appraisers for consideration.

As you note, the appraisers were highly supportive of what they indicated was a desperately needed program. The appraisers made several suggestions in order to ensure that the Pathologists' Assistant field curriculum would be aligned with the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) standards. In response you confirmed the field's curriculum has been developed in line with the agency's standards and that the program will seek accreditation with the NAACLS after it is initiated. Currently there is no formal accreditation in the area of Clinical Embryology in North America. The appraisal report recommended that the program ensure that potential applicants are made aware of the essential functions students must be able to perform to successfully complete the program, and that the program's design is sequential with limited pathway flexibility. Your letter confirms that the program will communicate these details to potential applicants. You agree with the appraisers' comments that it would be helpful to have post-completion assessment of the program, and the proposal now reflects additional ways the program will assess teaching and learning. The appraisers recommended that students be allowed to identify a mentor and pick a capstone project early in the program, and your letter indicates this will be done. You also indicate that the professional master's will not be a pathway to a higher-level degree. Finally, the appraisers suggested including a list of abbreviations in the proposal, and this has been done.

I will be very pleased to recommend this new professional master's program to governance for approval, following approval at the Divisional level.

Sincerely,

Susan McCahan
Vice-Provost, Academic Programs

cc:

Amy Lee, Executive Assistant to the Dean, Faculty of Medicine
Allan S. Kaplan, Vice Dean, Graduate and Academic Affairs, Faculty of Medicine
Joshua Barker, Dean of Graduate Studies and Vice-Provost, Graduate and Research Education
Gretchen Kerr, Vice-Dean, Programs and Innovation, School of Graduate Studies
Brian Desrosiers-Tam, Director, Office of the Vice-Provost, Graduate Research and Education
Daniella Mallinick, Director, Academic Programs, Planning and Quality Assurance, Office of the Vice-Provost, Academic Programs
Jennifer Francisco, Coordinator, Academic Change, Office of the Vice-Provost, Academic Programs