2 Major Program Modifications (Significant Alterations to Existing Program Component)

Neuroscience Major

Start Session:
Summer 2017

Current Calendar Description:

New Calendar Description:

HMB: Neuroscience
Neuroscience is an interdisciplinary field aimed at understanding the brain and nervous system utilizing integration of research at the molecular, cellular, and organismal levels, and through all stages of human development. The application of neuroscience has important implications for understanding human behaviour and for promoting the development of effective strategies for diagnosing and treating nervous system disorders. The objective of the HMB: Neuroscience specialist and major programs is to provide students with a solid foundation and facilitates the integration of concepts from multiple fields to their understanding of neuroscience.

Current Admission Requirements:

New Admission Requirements:
No changes

Current Enrolment Requirements:
This is a Type 1 open enrolment program. Students are permitted to enrol in the major during the POST enrolment cycle as soon as they have earned 4.0 FCE. It is recommended students complete their first year life science requirements before entering the major.

New Enrolment Requirements:

Neuroscience Major (Science Program) 2017-2018 | 8.0 FCE

This major is a Type 2L limited enrolment program. Admissions will be based on the following criteria, however achieving the minimum grades listed does not guarantee admission to the neuroscience major in any given year.

Applying with less than 8 FCEs:

• Completion of BIO130H1 with a minimum grade of 55
• Completion of CHM135H1 and CHM136H1 or completion of CHM151Y1
  • Transfer credits will be accepted in lieu of the chemistry requirements only if they carry a direct exclusion or equivalency to a pre-approved chemistry course. Please carefully check your Transfer Credit Assessments
• Completion of 4.0 FCE

Applying with 8 or more FCEs completed:
- Completion of BIO230H1/ BIO255H1 with a minimum grade of 55
- Completion of HMB265H1/ BIO260H1
- Completion of BCH210H1
- Completion of PSL300H1

Students may apply for this major program during Round 1 and Round 2 of Type 2L Enrolment after they have earned 4.0 FCE. Students applying for admissions to the program utilizing transfer credits will be considered on a case-by-case basis. Students entering from CEGEP or from another university should contact hmb.undergrad@utoronto.ca after their transfer credit assessment has been complete for program enrolment assessment. For more information about Type 2L enrolment, visit the Faculty of Arts & Science Subject Program Enrolment Instructions website.

**Current Completion Requirements:**

**Required Courses (8.0 FCE)**

**First Year Life Science**

1. BIO120H1, BIO130H1
2. (CHM135H1, CHM136H1)/ (CHM138H1, CHM139H1)/CHM151Y1 *(transfer credits will be accepted in lieu of the chemistry requirements only if they carry a direct exclusion to a pre-approved chemistry course)*
3. MAT135H1/ PHY131H1/ PHY151H1
4. PSY100H1 *(transfer credits AP and IB Psychology are not accepted)*

**Year 2: Foundations in neuroscience**

5. HMB200H1
6. BIO230H1/BIO255H1
7. PSL300H1
8. HMB265H1/BIO260H1
9. Statistics: STA220H1/PSY201H1/HMB325H1

**Year 3: Selected topics in neuroscience with greater depth and self-directed learning**

10. HMB300H1/ HMB310H1/ HMB320H1
11. CJH332H1 *(formerly CSB332H1)*
12. BCH210H1

13. 0.5 FCE from depth courses in molecular, cellular and systems neuroscience: HMB360H1/ CSB325H1/ CSB328H1/ CSB345H1/ CSB346H1/ EEB322H1/ JLP315H1/ JLP374H1/ PCL201H1/ PCL302H1/ PSL301H1/ PSL304H1/PSL305H1/ PSL374H1/ PSY342H1/ PSY371H1/ PSY372H1/ PSY390H1/ PSY396H1/ PSY397H1

**Year 4: Advanced topics in neuroscience that emphasize primary research and critical analysis**

14. 0.5 FCE from courses with advanced fundamental and translational topics in neuroscience: HMB406H1/ HMB420H1/ HMB430H1/ HMB450H1/ HMB471H1/ HMB473H1/ CSB430H1/ CSB432H1/ CSB443H1/ CSB445H1/ EEB445H1/ JLS474H1/ JLP471H1/ NEW335H1/ NFS489H1/ LMP410H1/ PCL475Y1/ PSL432H1/ PSL440Y1/ PSL444Y1/ PSL450H1/ PSL452H1/ PSL472H1/ PSY460H1/ PSY470H1/ PSY471H1/ PSY473H1/ PSY475H1/ PSY480H1/ PSY490H1/ PSY492H1/PSY493H1/ PSY494H1/ PSY497H1

*n.b. At least 0.5 FCE must be at the 400-level; students are not permitted to be enrolled in more than one Human Biology major program*

**New Completion Requirements:**
Required Courses (8.0 FCE, including at least 0.5 FCE at the 400-level)

**Chemical and Physical Foundations of Biological Systems**

1. (CHM135H1, CHM136H1) / (CHM138H1, CHM139H1)/ CHM151Y1
   
   *Transfer credits will be accepted in lieu of the chemistry requirements only if they carry a direct exclusion or equivalency to a pre-approved chemistry course.*

2. MAT135H1/ PHY131H1/ PHY151H1/ CSC120H1/ CSC148H1

3. BCH210H1

**Biological Foundations of Living Systems**

4. BIO120H1, BIO130H1

5. BIO230H1/ BIO255H1

6. HMB265H1/ BIO260H1

7. PSL300H1

**Neuroscience Concentration Courses**

8. HMB200H1

9. HMB300H1

10. CJH332H1

11. 0.5 FCE from HMB320H1/JHA410H1/ ANA300Y1

12. 0.5 FCE from HMB360H1/ HMB420H1/ HMB430H1/ HMB440H1/ HMB450H1/ HMB471H1/ HMB473H1/ HMB496Y1*/HMB499Y1*/CSB345H1/ CSB346H1/ CSB432H1/ CSB445H1/ CSC321H1/ LMP410H1/ NEW335H1/ NFS489H1/ PCL475H1/ PSL374H1/ PSL432H1/ PSL444Y1/ PSL450H1/ PSL452H1/ PSL472H1/ PSL473H1/ PSY342H1/ PSY347H1/ PSY372H1/ PSY390H1/ PSY395H1/ PSY460H1/ PSY470H1/ PSY471H1/ PSY473H1/ PSY475Y1/ PSY480H1/ PSY490H1/ PSY492H1/ PSY493H1/ PSY494H1/ PSY496H1

**Data Analysis and Research-Based Courses**

13. 0.5 FCE in statistics: HMB325H1/ STA220H1/ STA288H1/ PSY201H1

14. 0.5 FCE from a higher-year lab course: HMB310H1/ HMB314H1/ PSY399H1

* A research project from a different unit may be accepted with prior written approval from Human Biology if the course is not counting toward a different program.

**Neuroscience Major Notes:**

1. Courses can only count toward one requirement, even if listed as options to multiple requisites of the program.

2. Not all courses listed have priority enrolment for Neuroscience majors. Students are responsible for checking priority of courses and meeting course prerequisites for courses they wish to take.

3. The Neuroscience major cannot be paired with any other Human Biology Program managed major program.

**Program Delivery:**

*Method:* In Class; Online

*Mode:* Full Time; Part Time

**Brief Description of the Proposal:**

- **Neuroscience Major (ASMAJ1472)**
  - Modification of how Calendar listing is organized, for better clarity of program requirement
  - The total number of FCE required, 8.0, has remained the same
  - Courses allowed for the program at the higher levels has been reviewed and revised to better reflect courses
0.5 FCE from a pre-approved higher-year lab course with neuro-related lab skills taught (HMB310H1/HMB314H1/PSY399H1) is now required.

Program Type change from Type 1 to Type 2L to ensure that we have space in HMB310H1 for every neuroscience major who wishes to take the course as their neuro-related lab requirement.

0.5 FCE from a course with significant neuro structure is now required (HMB320H1/JHA410H1/ANA300Y1)

HMB300H1 is now a required course instead of an alternative option in lieu of HMB310H1 (now required lab course) and HMB320H1 (now one of three course options on neuro structure)

PSY100H1 is no longer required (to accommodate for lab course HMB310H1/HMB314H1/PSY399H1)

Details of Proposed Change:

Our objectives and outcomes remain as they were with the 2015-2016 major program modifications, but now that HMB has its own lab space, increased staff support, and wishes to acknowledge the changing neuroscience landscape, the required courses have been adjusted to reflect our desired outcomes and objectives, and to offer a more consistent foundation to all students in the program.

GENERAL LEARNING OUTCOMES:

Students enter the program at the end of their first year after establishing a foundation in organic biology and chemistry as well as physical chemistry. Students will build on this foundation with foundational courses (HMB200H1, HMB265H1, BIO230H1, BCH210H1, PSL300H1) that are designed to provide a broad overview of their respective subject areas, all of which supply the foundation to the study of neuroscience. Students will also learn quantitative analysis skills in a statistics course, which will become immediately applied to a neuro-related higher-year lab course in which students will learn lab skills relevant to further studies in neuroscience and cellular molecular biology.

As students progress through their studies, they will take a series of core neuroscience concentration courses that will cover a wide range of topics relevant to studies in neuroscience including: neurobiology related to behaviour (HMB300H1), neurobiology related to the synapse (CJH332H1, formerly CSB332H1), and neuroanatomy and imaging (HMB320H1/JHA410H1/ANA300Y1). These courses all focus on particular aspects of neuroscience, but build on knowledge gained in foundational courses and work in tandem to present to students a comprehensive analysis of vertebrate and invertebrate neural systems.

Students will then have the opportunity to focus on a particular aspect within the study of nervous systems in 400-level courses, and further engage in the field of study, but also apply what they have learned. These courses all have heavy critical analysis components surrounding current primary research and feature assessments such as grant proposals and literature reviews.

SPECIFIC LEARNING OUTCOMES:

By the end of this program, students will be able to:
1. Demonstrate an understanding of the fundamental concepts in a wide range of neuroscience topics and how these concepts are applied.
2. Identify and analyze data from neuroscience research from the primary literature.
3. Acquire basic laboratory skills in the life sciences.
4. Understand and apply appropriate quantitative techniques needed to examine neuroscience data.
5. Identify and critically evaluate contemporary ethical perspectives on neuroscience research.
6. Gain research experience in neuroscience through the collection, analysis and interpretation of scientific data.
7. Write and speak effectively about neuroscience issues to both scientific and broader audiences.

PROGRAM OBJECTIVES:

1. DEPTH OF KNOWLEDGE

Introductory courses are designed to expose students to fundamental concepts in genetics (HMB265H1/BIO260H1) and neurobiology (HMB200H1) and to provide a core knowledge base in these areas from which students will build. Students are then introduced to more advanced neuroscience through courses that highlight the molecular and cellular basis of the structure-function relationship in the brain, such as neurogenomics (HMB360H1), neuroanatomy (HMB320H1/JHA410H1/ANA300Y1), and the neurobiology of behaviour (HMB300H1). Further depth in these subjects is available in courses that focus on the neurobiology of the synapse (CJH332H1), human physiology focusing on neurophysiology and endocrinology (PSL300H1). After establishing this in-depth foundation of neurosciences, students can further can further engage in specialized courses in memory and learning (PSY460H1, PSY470H1), neurogenesis (CSB430H1), cellular neurophysiology (CSB432H1), and the pathobiology of neurodegenerative disease (LMP410H1). Other advanced courses complement these specialized topics by integrating concepts from other fields, such as exercise and mental health (HMB473H1), and nutritional neurosciences (NFS489H1).
2.1 CRITICAL AND CREATIVE THINKING

Students engage in critical thinking early on in the program. For example, in HMB265H1/BIO260H1, HMB200H1, and HMB300H1 there are assignments and tests that focus on the application of course concepts and information through problem-based learning, whereas written assignments and oral presentations are based on the synthesis and critical analysis of information and techniques from both primary and review articles. As with all life science programs, the integration of primary research findings into all of our courses, but especially in 300- and 400-level courses, is a critical component of the student learning experience. Students are taught how to interpret and critically analyze research as well as develop the skills in synthesizing information from multiple sources. The program also uses creative ways to facilitate reflective thinking. For example, in HMB471H1, students engage in a semester-long self-test lab to assess the effects of stress control techniques on performance. Moreover, HMB440H1 integrates community engaged learning as a primary method for teaching students about neurobiology of dementia and its societal implications.

2.2 COMMUNICATION

Students learn effective written and oral strategies for communicating their analyses and critiques. For example, seminar courses often require students to be creative and persuasive in developing research proposals (HMB440H1) or learning to transform highly specialized and detailed research findings into an engaging and informative story that is understandable to an informed public (CSB430H1). Team-based learning and peer evaluations, either in class or online, are also integrated in several different courses (HMB300H1, CJH332H1). Seminar presentations or poster presentations are common among most advanced courses and this enables students to develop key skills in explaining, discussing, critically analyzing and synthesizing research findings in an oral presentation format. Students also have opportunities to cultivate an ability to interact and debate issues in a group setting with guest speakers that are experts in their fields, preparing them with communication skills that will be useful in a professional workplace.

2.3 INFORMATION LITERACY

In order to complete written and oral assignments, students are required to learn to use Internet based search engines (e.g. PubMed, Google Scholar, Ensembl, Allen Brain Atlas, etc.) to acquire relevant information from the primary literature, and genome and gene expression databases. Students are typically evaluated on their effective gathering and use of this information through enhanced citations, and the ability to use PowerPoint, Keynote, blogs and other presentation formats.

2.4 QUANTITATIVE REASONING

While many courses will integrate quantitative analysis and reasoning, such as genetic mapping (HMB265H1), GWAS analysis (HMB360H1), and statistically analyzing altered physical parameters due to exercise (HMB471H1), the program also requires that students take basic statistics courses (HMB325H1/ STA220H1/STA288H1/ PSY201H1) that will serve as a foundation for understanding concepts and analyzing research in other courses.

2.5 SOCIAL AND ETHICAL RESPONSIBILITY

Several courses will introduce students to some of the bioethical, social and health policy issues and controversies surrounding specific topics in neuroscience, including prenatal diagnosis (HMB360H1), mental health (HMB440H1), and neurodevelopmental disorders (HMB450H1).

3. AN INTEGRATIVE, INQUIRY-BASED ACTIVITY

Seminar courses at the 400-level provide a major opportunity for students to integrate knowledge from across a spectrum of neuroscience and other life science courses. Students in the major program are encouraged to complete a full-year research project course or a summer research project course (HMB496Y1/HMB499Y1), although this is not a requirement. Students will typically identify suitable supervisors in hospital research institutes or campus-based laboratories and research groups. Research project course oversight includes a HMB faculty advisor that facilitates the placements, guide workshops on research presentation skills or apply statistical analyses (in collaboration with Department of Statistical Sciences), as well as organize research presentation days (with research faculty to serving as assessors). Students gain invaluable first-hand experience integrating their knowledge of neuroscience and other related subjects, learn to apply their quantitative reasoning and analytical skills, practice effective communication and team-based learning, and learn about ethical standards in research.

Rationale:

The Human Biology Program completed a self-study in March 2014 that the program has been steadily working on the recommendations to enhance the overall quality of the program. Many of the recommendations have already been put into effect: our smallest program has been closed (Health Care Ethics major), we have signed a MOA giving the School of the Environment full ownership of the Environment and Health major and specialist (ASMAJ0365 and ASSPE0365) and have agreed to continue teaching and supporting the capstone requirement course for the specialist program: JEH455H1 (Topics in Environment & Health) and giving Environment and Health students enrolment priority.
One of the first acts was a revision of the Health & Disease (ASMAJ2013 & ASSPE2013), Neuroscience (ASMAJ1472 and ASSPE1472), and our then- Genes, Genetics, and Biotechnology, now Fundamental Genetics and its Applications program (ASMAJ1050 and ASSPE1050), and Human Biology (ASMAJ2035) programs to better align the programs with the teaching strengths of the unit, the resources of the unit, and the course offerings within the Faculty of Arts & Science. These modifications came into effect in 2015-2016.

This realignment of four of our five programs has benefited the program as a whole and our students greatly. Since then, we have consulted with the Dalla Lana School of Public Health on pedagogy revisions for our Global Health major and Specialist (ASMAJ25757 and ASSPE2575), and have consulted with our faculty and staff to better assess pedagogy gaps and inconsistencies in program structure and pressure points within our programs in terms of enrollment and student outcomes. Many of the gaps were due to lack of lab space, staff, support, or lack of faculty to teach core courses.

However, even in the 2015-2015 major modification proposal, it was outlined that HMB has been working closely with [the Cell Systems and Biology Department], [the Department of Ecology and Evolutionary Biology] and the [Faculty of Arts & Science] to expand and modernize lab course offerings in the planned renovations of the [Ramsay Wright] teaching labs. The HMB teaching labs will be ready for full-time use by September 2017.

Thus, many of these issues have been resolved, and as such, now that HMB has more staff support, our own teaching labs, and have been approved to hire an appointed faculty member starting in July 2017 (the search is currently ongoing), we would like to make further revisions to better meet objectives outlined in 2014.

The proposed restructuring of all of our programs is the next step in further defining improvements and innovations first initiated in 2015-2016.

**Impact that the proposal may have on students or other academic units/divisions:**

Impact on other units should be minimal as enrolment is not planned to increase. The majority of the courses required in the program are the same course requirement/requirement options as the current neuroscience major. Impact on our unit should also not increase, as enrolment will be capped, and we have increased staff support.

Estimated enrolment per academic year in this program:

- Enrolment will be capped at 310 per cohort year in the major and 40 in the specialist.
- Currently we have an average of 307 per cohort year with total enrolment of 930 students enrolled in the neuroscience major. Our two year total enrolment average is 892.
- Enrolment must be restricted in order to guarantee spots for every student enrolled in the program in the now-required lab course and neuro-structure courses. Our labs hold 72 students, and we plan to offer HMB310H1 multiple times through the year in order to accommodate the current size of the neuroscience program. (enrolment into the specialist program is already restricted at Type 3)

**Consultation:**

Director Dr. Melanie Woodin has consulted extensively with Vice-Deans Pamela Klassen and Poppy Lockwood as well as with faculty within the Human Biology program. A survey has been sent to all students enrolled in HMB310H1 (Fall 2016) requesting feedback and suggestions about the lab course, and one of our instructors will on his sabbatical re-envision the course to ensure it remains a neuro-related lab with skills taught that emerging neuroscientists need to know. After consultation with Biochemistry, we have decided to remove CHM247H1 as an alternative to BCH210H1.

**Diversity:**

The re-design of the neuroscience major program ensures all students receive a solid foundation at the 300-level, which will enable all students to be better equipped for 400-level courses. HMB works closely with Accessibility Services, and accommodations requested are met. This will not change. Further, many of our faculty work to offer a variety of assignments that better provide to a variety of learners in their courses.

**Resource Implications:**

Current laboratory, library, and staff resources are sufficient to mount these program changes. We are also launching a new course (approved December 2016) that will help ensure there is enough capacity for every student in the program to undertake a course with focus on neurostructure.

**Faculty and TA Support:**
With the hire of an approved faculty member appointment in July 2017 (search is currently ongoing) support will be adequate.

**Neuroscience Specialist**

**Start Session:**

Summer 2017

**Current Calendar Description:**

**New Calendar Description:**

**HMB: Neuroscience**

Neuroscience is an interdisciplinary field aimed at understanding the brain and nervous system utilizing integration of research at the molecular, cellular, and organismal levels, and through all stages of human development. The application of neuroscience has important implications for understanding human behaviour and for promoting the development of effective strategies for diagnosing and treating nervous system disorders. The objective of the HMB: Neuroscience specialist and major programs is to provide students with a solid foundation and facilitates the integration of concepts from multiple fields to their understanding of neuroscience.

**Current Admission Requirements:**

**New Admission Requirements:**

No changes

**Current Enrolment Requirements:**

This is a Type 3 limited enrolment program. Meeting the following minimum criteria does not guarantee admissions to the specialist program:

- BIO120H1 with a minimum mark of 60%
- BIO130H1 with a minimum mark of 60%
- CHM135H1 and CHM136H1 or CHM138H1 and CHM139H1 or CHM151Y1 with a minimum mark of 60%
- MAT135H1 or PHY131H1 or PHY151H1 with a minimum mark of 60%
- and, a composite average of at least 70% on the above 2.5 FCE.

Students may apply for this program only during Round 1 of Type 3 Enrolment. Students applying for admissions to the program utilising transfer credits or later than the end of their first year will be considered on a case-by-case basis. For more information about Type 3 enrolment, visit the Faculty of Arts & Science Program Enrolment Instructions website.

**New Enrolment Requirements:**

This specialist is a Type 3 limited enrolment program. Admissions will be based on the following criteria, however achieving the minimum marks listed does not guarantee admission to the neuroscience specialist in any given year.

**Applying with less than 8 FCEs:**

- Completion of BIO130H1 with a minimum grade of 70
- Completion of CHM135H1 and completion of CHM136H1 with a minimum grade of 55 (or CHM151Y1 with a
Transfer credits will be accepted in lieu of the chemistry requirements only if they carry a direct exclusion or equivalency to a pre-approved chemistry course. Please carefully check your Transfer Credit Assessments.

**Completion of 4.0 FCE**

**Applying with 8 or more FCEs completed:**

- Completion of BIO230H1/ BIO255H1 with a minimum grade of 70
- Completion of HMB265H1/ BIO260H1
- Completion of BCH210H1
- Completion of PSL300H1

Students may apply for this major program during Round 1 and Round 2 of Type 3 Enrolment after they have earned 4.0 FCE. Students applying for admissions to the program utilizing transfer credits will be considered on a case-by-case basis. Students entering from CEGEP or from another university should contact hmb.undergrad@utoronto.ca after their transfer credit assessment has been complete for program enrolment assessment. For more information about Type 3 enrolment, visit the [Faculty of Arts & Science Subject Program Enrolment Instructions website](#).

### Current Completion Requirements:

**Required Courses (13.5 FCE)**

Prior to entering the specialist program:

1. BIO120H1, BIO130H1
2. (CHM135H1, CHM136H1), (CHM138H1, CHM139H1)/CHM151Y1 (transfer credits will be accepted in lieu of the chemistry requirements only if they carry a direct exclusion to a pre-approved chemistry course)
3. MAT135H1/ PHY131H1/ PHY151H1
4. PSY100H1 (transfer credits from AP and IB Psychology are not accepted)

**Year 2: Foundations in neuroscience**

5. HMB200H1
6. BIO230H1/BIO255H1
7. HMB265H1/BIO260H1
8. PSL300H1
9. BCH210H1
10. Statistics: STA220H1/ PSY201H1/ HMB325H1
11. Bioethics: PHL281H1/ HMB306H1
12. 0.5 FCE from introductory courses in the field of systems neuroscience: LIN200H1/ PSY260H1/ PSY270H1/ PSY280H1

**Year 3: Selected topics in neuroscience with greater depth and self-directed learning**

13. HMB300H1
14. HMB320H1
15. CJH332H1 (formerly CSB332H1)
16. 0.5 FCE in additional courses emphasizing the molecular and cellular basis of brain structure and function: BCH311H1/ CSB349H1/ PSL350H1
17. 0.5 FCE from courses that will enable the development of skills in laboratory science: HMB310H1/ CSB330H1/ CSB350H1/ BCH370H1/ PSL372H1
18. 1.5 FCE from depth courses in molecular, cellular and systems neuroscience: HMB360H1/ CSB325H1/ CSB328H1/ CSB345H1/ CSB346H1/ EE322H1/ JLP315H1/ JLP374H1/ PCL201H1/ PCL302H1/ PSL301H1/ PSL304H1/ PSL305H1/ PSL374H1/ PSY342H1/ PSY371H1/ PSY372H1/ PSY390H1/ PSY396H1/ PSY397H1
19. 1.5 FCE from courses with advanced fundamental and translational topics in neuroscience:
HMB406H1/ HMB420H1/ HMB430H1/ HMB440H1/ HMB450H1/ HMB471H1/ HMB473H1/ CSB430H1/ CSB432H1/
CSB443H1/ CSB445H1/ EEB445H1/ JLS474H1/ JLP471H1/ NEW335H1/ NFS489H1/ LMP410H1/ PCL475Y1/
PSL432H1/ PSL440Y1/ PSL444Y1/ PSL450H1/ PSL452H1/ PSL472H1/ PSY460H1/ PSY470H1/ PSY471H1/
PSY473H1/ PSY475H1/ PSY480H1/ PSY490H1/ PSY492H1/ PSY493H1/ PSY494H1/ PSY497H1

20. HMB499Y1

n.b. At least 1.0 FCE must be at the 400-level

New Completion Requirements:

Required Courses (12.0 FCE, including at least 1.0 FCE at the 400-level)

Chemical and Physical Foundations of Biological Systems
1. (CHM135H1, CHM136H1) / (CHM138H1, CHM139H1)/ CHM151Y1
   Transfer credits will be accepted in lieu of the chemistry requirements only if they carry a direct exclusion or
   equivalency to a pre-approved chemistry course.
2. MAT135H1/ PHY131H1/ PHY151H1/ CSC120H1/ CSC148H1
3. BCH210H1

Biological Foundations of Living Systems
4. BIO120H1, BIO130H1
5. BIO230H1/ BIO255H1
6. HMB265H1/ BIO260H1
7. PSL300H1

Neuroscience Concentration Courses
8. PSY100H1 Transfer credits from AP and IB Psychology are not accepted
9. HMB200H1
10. HMB300H1
11. CJH332H1
12. HMB320H1
13. JHA410H1/ ANA300Y1
14. 2.0 FCE from HMB360H1/ HMB420H1/ HMB430H1/ HMB440H1/ HMB450H1/ HMB471H1/ HMB473H1/
    CSB345H1/ CSB346H1/ CSB430H1/ CSB432H1/ CSB445H1/ CSC321H1/ LMP410H1/ NEW335H1/ NFS489H1/
    PCL475H1/ PSL374H1/ PSL432H1/ PSL440Y1/ PSL444Y1/ PSL450H1/ PSL452H1/ PSL472H1/ PSY342H1/
    PSY371H1/ PSY372H1/ PSY390H1/ PSY395H1/ PSY460H1/ PSY470H1/ PSY471H1/ PSY473H1/ PSY475Y1/
    PSY480H1/ PSY490H1/ PSY492H1/ PSY493H1/ PSY492H1/ PSY493H1/ PSY494H1/ PSY496H1

Data Analysis and Research-Based Courses
15. 0.5 FCE in statistics: HMB325H/STA220H1/ STA288H1/ PSY201H1
16. 0.5 FCE from bioethics: HMB306H1/ HMB406H1/ PHL281H1
17. 0.5 FCE from upper-year lab course: HMB310H1/ HMB314H1/ PSY399H1
18. 1.0 FCE from research project course: HMB496Y1*/ HMB499Y1*

* A research project from a different unit may be accepted with prior written approval from Human Biology if the course
  is not counting toward a different program.

Neuroscience Specialists Notes:

1. Courses can only count toward one requirement, even if listed as options to multiple
   requisites of the program.
2. **Not all courses listed have priority enrolment for Neuroscience specialists. Students are responsible for checking priority of courses and meeting course prerequisites for courses they wish to take.**

### Program Delivery:

**Method:** In Class; Online

**Mode:** Full Time; Part Time

### Brief Description of the Proposal:

**Neuroscience Specialist (ASSPE1472)**
- Modification of how Calendar listing is organized, for better clarity of program requirements
  - The total number of FCE required has been reduced to 13.5 FCE from 12.0 FCE to make the program more manageable in four years to students enrolled in the program and to promote students enrolled in the program to undertake at least one minor program to enhance their trans-disciplinary education.
  - Courses allowed for the program at the higher levels has been reviewed and revised to better reflect courses that are directly related to the study of neuroscience.
    - 0.5 FCE from introductory courses in the field of systems neuroscience: LIN200H1/ PSY260H1/ PSY270H1/ PSY280H1 no longer required
    - 0.5 FCE in additional courses emphasizing the molecular and cellular basis of brain structure and function: BCH311H1/ CSB349H1/ PSL350H1 no longer required
    - 0.5 FCE from a course with neuroimaging content (JHA410H1) now required
  - Update of specialist enrolment criteria to better demonstrate and offer more transparency on criteria already being used for specialist enrolment.

### Details of Proposed Change:

Our objectives and outcomes remain as they were with the 2015-2016 major program modifications, but now that HMB has its own lab space, increased staff support, and wishes to acknowledge the changing neuroscience landscape, the required courses have been adjusted to reflect our desired outcomes and objectives, and to offer a more consistent foundation to all students in the program.

**GENERAL LEARNING OUTCOMES:**

Students enter the program at the end of their first year after establishing a foundation in organic biology and chemistry as well as physical chemistry. Students will build on this foundation with foundational courses (HMB200H1, HMB265H1/BIO260H1, BIO230H1/BIO255H1, BCH210H1, and PSL300H1) that are designed to provide a broad overview of their respective subject areas, all of which supply the foundation to the study of neuroscience. Students will also learn quantitative analysis skills in a statistics course, which will become immediately applied to a neuro-related higher-year lab course in which students will learn lab skills relevant to further studies in neuroscience and cellular molecular biology.

As students progress through their studies, they will take a series of core neuroscience concentration courses that will cover a wide range of topics relevant to studies in neuroscience including: neurobiology related to behaviour (HMB300H1), neurobiology related to the synapse (CJH332H1, formerly CSB332H1), and neuroanatomy and imaging (HMB320H1/ JHA410H1/ ANA300Y1). These courses all focus on particular aspects of neuroscience, but build on knowledge gained in foundational courses and work in tandem to present to students a comprehensive analysis of vertebrate and invertebrate neural systems.

Students will then have the opportunity to focus on a particular aspect within the study of nervous systems in 400-level courses, and further engage in the field of study, but also apply what they have learned. These courses all have heavy critical analysis components surrounding current primary research and feature assessments such as grant proposals and literature reviews.

**SPECIFIC LEARNING OUTCOMES:**

By the end of this program, students will be able to:
1. Demonstrate a deep understanding of the fundamental concepts in a wide range of neuroscience topics and how these concepts are applied.
2. Identify, analyze, and critically evaluate data from neuroscience research from the primary literature.
4. Understand and apply appropriate quantitative techniques needed to examine neuroscience data.
5. Identify and critically evaluate contemporary ethical perspectives on neuroscience research.
6. Gain in depth research experience in neuroscience through the collection, analysis and interpretation of scientific data.
7. Write and speak effectively about neuroscience issues to both scientific and broader audiences.

PROGRAM OBJECTIVES

1. DEPTH OF KNOWLEDGE

Introductory courses are designed to expose students to fundamental concepts in genetics (HMB265H1/BIO260H1) and neurobiology (HMB200H1) and to provide a core knowledge base in these areas from which students will build. Students are then introduced to more advanced neuroscience through courses that highlight the molecular and cellular basis of the structure-function relationship in the brain, such as neurogenomics (HMB360H1), neuroanatomy (HMB320H1/JHA410H1/ANA300Y1), and the neurobiology of behaviour (HMB300H1). Further depth in these subjects is available in courses that focus on the neurobiology of the synapse (CJH332H1), human physiology focusing on neurophysiology and endocrinology (PSL300H1). After establishing this in-depth foundation of neurosciences, students can further engage in specialized courses in memory and learning (PSY460H1, PSY470H1), neurogenesis (CSB430H1), cellular neurophysiology (CSB432H1), and the pathobiology of neurodegenerative disease (LMP410H1). Other advanced courses complement these specialized topics by integrating concepts from other fields, such as exercise and mental health (HMB473H1), and nutritional neurosciences (NFS489H1).

2. COMPETENCIES

2.1 CRITICAL AND CREATIVE THINKING

Students engage in critical thinking early on in the program. For example, in HMB265H1/BIO260H1, HMB200H1, and HMB300H1 there are assignments and tests that focus on the application of course concepts and information through problem-based learning, whereas written assignments and oral presentations are based on the synthesis and critical analysis of information and techniques from both primary and review articles. As with all life science programs, the integration of primary research findings into all of our courses, but especially in 300- and 400-level courses, is a critical component of the student learning experience. Students are taught how to interpret and critically analyze research as well as develop the skills in synthesizing information from multiple sources. The program also uses creative ways to facilitate reflective thinking. For example, in HMB471H1, students engage in a semester-long self-test lab to assess the effects of stress control techniques on performance. Moreover, HMB440H1 integrates community engaged learning as a primary method for teaching students about neurobiology of dementia and its societal implications.

2.2 COMMUNICATION

Students learn effective written and oral strategies for communicating their analyses and critiques. For example, seminar courses often require students to be creative and persuasive in developing research proposals (HMB440H1) or learning to transform highly specialized and detailed research findings into an engaging and informative story that is understandable to an informed public (CSB430H1). Team-based learning and peer evaluations, either in class or online, are also integrated in several different courses (HMB300H1, CJH332H1). Seminar presentations or poster presentations are common among most advanced courses and this enables students to develop key skills in explaining, discussing, critically analyzing and synthesizing research findings in an oral presentation format. Students also have opportunities to cultivate an ability to interact and debate issues in a group setting with guest speakers that are experts in their fields, preparing them with communication skills that will be useful in a professional workplace.

2.3 INFORMATION LITERACY

In order to complete written and oral assignments, students are required to learn to use Internet based search engines (e.g. PubMed, Google Scholar, Ensembl, Allen Brain Atlas, etc.) to acquire relevant information from the primary literature, and genome and gene expression databases. Students are typically evaluated on their effective gathering and use of this information through enhanced citations, and the ability to use PowerPoint, Keynote, blogs and other presentation formats.

2.4 QUANTITATIVE REASONING

While many courses will integrate quantitative analysis and reasoning, such as genetic mapping (HMB265H1), GWAS analysis (HMB360H1), and statistically analyzing altered physical parameters due to exercise (HMB471H1), the program also requires that students take basic statistics courses (HMB325H1/STA220H1/STA288H1/PSY201H1) that will serve as a foundation for understanding concepts and analyzing research in other courses.

2.5 SOCIAL AND ETHICAL RESPONSIBILITY

Several courses will introduce students to some of the bioethical, social and health policy issues and controversies surrounding specific topics in neuroscience, including prenatal diagnosis (HMB360H1), mental health (HMB440H1), a required ethics course in new biotechnologies (HMB306H1/HMB406H1/PHL281H1), and neurodevelopmental...
3. AN INTEGRATIVE, INQUIRY-BASED ACTIVITY

Seminar courses at the 400-level provide a major opportunity for students to integrate knowledge from across a spectrum of neuroscience and other life science courses. Students in the specialist program are required to complete a full-year research project course or a summer research project course (HMB496Y1/HMB499Y1). Students will typically identify suitable supervisors in hospital research institutes or campus-based laboratories and research groups. Research project course oversight includes a HMB faculty advisor that facilitates the placements, guide workshops on research presentation skills or apply statistical analyses (in collaboration with Department of Statistical Sciences), as well as organize research presentation days (with research faculty to serving as assessors). Students gain invaluable first-hand experience integrating their knowledge of neuroscience and other related subjects, learn to apply their quantitative reasoning and analytical skills, practice effective communication and team-based learning, and learn about ethical standards in research.

Rationale:

The Human Biology Program completed a self-study in March 2014 that the program has been steadily working on the recommendations to enhance the overall quality of the program. Many of the recommendations have already been put into effect: our smallest program has been closed (Health Care Ethics major), we have signed a MOA giving the School of the Environment full ownership of the Environment and Health major and specialist (ASMAJ0365 and ASSPE0365) and have agreed to continue teaching and supporting the capstone requirement course for the specialist program: JEH455H1 (Topics in Environment & Health) and giving Environment and Health students enrolment priority in a number of our courses.

One of the first acts was a revision of the Health & Disease (ASMAJ2013 & ASSPE2013), Neuroscience (ASMAJ1472 and ASSPE1472), and our then-Genes, Genetics, and Biotechnology, now Fundamental Genetics and its Applications program (ASMAJ1050 and ASSPE1050), and Human Biology (ASMAJ2035) programs to better align the programs with the teaching strengths of the unit, the resources of the unit, and the course offerings within the Faculty of Arts & Science. These modifications came into effect in 2015-2016.

This realignment of four of our five programs has benefited the program as a whole and our students greatly. Since then, we have consulted with the Dalla Lana School of Public Health on pedagogy revisions for our Global Health major and Specialist (ASMAJ25757 and ASSPE2575), and have consulted with our faculty and staff to better assess pedagogy gaps and inconsistencies in program structure and pressure points within our programs in terms of enrollment and student outcomes. Many of the gaps were due to lack of lab space, staff, support, or lack of faculty to teach core courses.

However, even in the 2015-2015 major modification proposal, it was outlined that HMB has been working closely with [the Cell Systems and Biology Department], [the Department of Ecology and Evolutionary Biology] and the [Faculty of Arts & Science] to expand and modernize lab course offerings in the planned renovations of the [Ramsay Wright] teaching labs. The HMB teaching labs will be ready for full-time use by September 2017. Thus, many of these issues have been resolved, and as such, now that HMB has more staff support, our own teaching labs, and have been approved to hire an appointed faculty member starting in July 2017 (the search is currently ongoing), we would like to make further revisions to better meet objectives outlined in 2014.

The proposed restructuring of all of our programs is the next step in further defining improvements and innovations first initiated in 2015-2016.

Impact that the proposal may have on students or other academic units/divisions:

Impact on other units should be minimal as enrolment is not planned to increase. The majority of the courses required in the program are the same course requirement/requirement options as the current neuroscience major. Impact on our unit should also not increase, as enrolment will be capped, and we have increased staff support.

Estimated enrolment per academic year in this program:

Total enrolment of the Neuroscience specialist is 85 with a two year average of 93. Enrolment for the specialist in neuroscience is already restricted to 44 students. This is because of the lab size of HMB310H1, but it will continue to be restricted (reduced to 40) as the cap does not fill (allowing more spots for the more popular major, which will be changed to a Type 2 program as it will also require HMB310H1 or other neuro-related lab course) and restricting the size of the specialist program allows more spots in a larger variety of courses (especially at the 400-level) to the students enrolled in the major.

We are not anticipating a large increase in enrolment (our average cohort year in the specialist is 29 per cohort year) but nevertheless, the program will remain capped at 40 students per cohort year.

Consultation:
Director Dr. Melanie Woodin has consulted extensively with Vice-Deans Pamela Klassen and Poppy Lockwood as well as with faculty within the Human Biology program. A survey has been sent to all students enrolled in HMB310H1 (Fall 2016) requesting for feedback and suggestions about the lab course, and one of our instructors will on his sabbatical re-envision the course to ensure it remains a neuro-related lab with skills taught that emerging neuroscientists need to know. After consultation with Biochemistry, we have decided to remove CHM247H1 as an alternative to BCH210H1.

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<th>Diversity:</th>
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<td>The re-design of the neuroscience major program ensures all students receive a solid foundation at the 300-level, which will enable all students to be better equipped for 400-level courses. HMB works closely with Accessibility Services, and accommodations requested are met. This will not change. Further, many of our faculty work to offer a variety of assignments that better provide to a variety of learners in their courses.</td>
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<th>Resource Implications:</th>
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<td>Current laboratory, library, and staff resources are sufficient to mount these program changes. We are also launching a new course (approved December 2016- JHA410H1) that will help ensure there is enough capacity for every student in the program to undertake a course with focus on neurostructure.</td>
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<th>Faculty and TA Support:</th>
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<td>With the hire of an approved faculty member appointment in July 2017 (search is currently ongoing) support will be adequate.</td>
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