New program proposal: Neuroscience and Mental Health

- B.Sc. Honours in Neuroscience and Mental Health
- B.Sc. Major in Neuroscience and Mental Health
- B.Sc. General in Neuroscience and Mental Health
- Minor in Neuroscience and Mental Health

1: Objectives

1.1: Mission of the programs
The programs’ mission is to provide a multi-faceted learning experience that equips students with a strong foundation in Neuroscience and Mental Health, to produce graduates with the skills to acquire, assimilate, communicate and generate knowledge, to provide flexibility for students to explore individual learning objectives, and enable them to transfer their skills and knowledge to academic, business, industry, government and vocational health settings.

1.2: Learning objectives of the programs

i) Content-based learning objectives
   1.2a. Ensure students develop expertise in core Neuroscience topics, in the methodologies employed within Neuroscience, and the relationship of this knowledge to our current understanding of mental health and disease.
   1.2b. Ensure in-depth knowledge within specific areas of Neuroscience and Mental Health, selected by students based on their individual interests, and which include an understanding of the limits of current knowledge.
   1.2c. Ensure that students have the opportunity to tailor their program towards their individual interests and career objectives, by developing strengths in multiple disciplines.

ii) Skill-based learning objectives
   1.2d. Students will be able to critically assess research, formulate ideas, and evaluate concepts through independent literature-based research.
   1.2e. Students will be able to appropriately apply their acquired knowledge to the design, conduct, and analysis of research studies.
   1.2f. Students will be able to communicate effectively with both the scientific community and the general public about Neuroscience and mental health.

1.3: Strategic enrolment objectives
Mental health diseases represent one of the largest classes of illness affecting Canadians, second only to cardiovascular disease. It is an area of increasing public interest and scientific investigation, reflecting an increased public awareness of mental illness plus incidence of mental illness (due in part to our aging population). The proposed programs will be the first B.Sc. Neuroscience programs in Canada with a titular Mental Health component, and we anticipate strong interest from students with interests in health, medicine, and general science. We therefore project a conservative enrolment objective of 40 students per year within three years, combined across the three programs. We
envision that most of the new recruitment will be for the Major and General programs. While we anticipate considerable interest in the honours program, intake will be limited by the number of honours thesis research projects that can be supported by a unit composed of just 6.5 research faculty, particularly given that Neuroscience faculty already supervise honours students through the Combined Honours in Neuroscience program, offered jointly by the Departments of Neuroscience and Biology, as well as students from Integrated Science. Enrolments in the Major and General programs will not be subject to similar constraints of enrolment.

1.4: Consistency of the programs with the objectives of the degree and the university

Health is one of Carleton University’s four Interdisciplinary Themes of Focus detailed within Defining Dreams and reflects the emphasis placed on Health by our society. New programs in Neuroscience and Mental Health are thus clearly consistent with university themes, while the addition of novel programs designed to attract new students to Carleton will contribute to the goal of increased student enrolment. We are confident that through these new programs, several health-related courses of particular interest to students in other programs will be developed, including (but not limited to) psychology, biology, food sciences, and chemistry. These programs also have the potential to contribute significantly towards the new minor in Public Health, currently under development within the Faculty of Science.

As described in the Carleton Academic Plan, when developing a strategic theme, one facet is that the theme should build upon existing research in the area, and a potential for growth. All of our faculty members are actively pursuing research agendas related to mental illness, thus mental health is a natural progression for a new undergraduate program. Mental Health viewed from the perspective of Neuroscience (as opposed to Psychology) is also an area with real potential for growth at Carleton, both due to public interest in the subject, plus the observation that it is poorly represented in the current undergraduate curriculum. For example, the current B.Sc. Neuroscience program (run jointly between the Departments of Biology and Neuroscience) has little formal emphasis on mental health.

Finally, the proposed programs allow for a substantial amount of flexibility in terms of course selection for our students, providing a far greater capacity to explore minors within the context of this program, facilitating and promoting interdisciplinary studies, and therefore consistent with the aims of Defining Dreams and the Carleton Academic Plan. This increased capacity for interdisciplinary pursuits will, in turn, promote interdisciplinary research within Neuroscience driven in part by student-led research questions. It will also enable students to augment their degrees with specific minors that will improve their employment opportunities.

2 Description

2.1: Course requirements with special emphasis on core requirements

The programs as they would appear in the undergraduate calendar are as below.
Neuroscience and Mental Health

B.Sc. Honours (20.0 credits)

Credits Included in the Major CGPA (9.5 credits):
1. 4.0 credits in NEUR 1201, NEUR 2001, NEUR 2002, NEUR 2200, NEUR 3200 [1.0], NEUR 3204 and NEUR 4200
2. 1.0 credits in BIOL 1103 and BIOL 1104
3. 1.0 credits in PSYC 1001 and PSYC 1002
4. 1.0 credits from NEUR 3202, NEUR 3301, NEUR 3302, NEUR 3303, NEUR 3304, NEUR 3305 or NEUR 3306
5. 0.5 credits from NEUR 3401, NEUR 3402, or NEUR 3403
6. 0.5 credits from NEUR 3501 or NEUR 3502
7. 1.0 credits from NEUR 4907 [1.0] or NEUR 4908 [1.0]
8. 0.5 credits in Advanced Science Faculty Electives

Credits Not Included in the Major CGPA (10.5 credits):
9. 1.0 credits in (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006) or (PHYS 1007 and PHYS 1008)
10. 0.5 credits in MATH 1007 or MATH 1107
11. 1.0 credits in BIOL 2104 and BIOL 2200
12. 1.0 credits in STAT 2507 and STAT 2509
13. 0.5 credits in PSYC 2100, PSYC 2301, PSYC 2500, PSYC 2700, PHIL 2501
14. 2.0 credits in Science Continuation courses (not in NEUR)
15. 1.5 credits in Approved Arts or Social Sciences
16. 0.5 credit in NSCI 1000 or Approved Arts or Social Sciences
17. 2.5 credits in free electives
Neuroscience and Mental Health

B.Sc. Major (20.0 credits)

Credits Included in the Major CGPA (9.5 credits):
1. 4.0 credits in NEUR 1201, NEUR 2001, NEUR 2002, NEUR 2200, NEUR 3200 [1.0], NEUR 3204 and NEUR 4200
2. 1.0 credits in BIOL 1003 and BIOL 1004
3. 1.0 credits in PSYC 1001 and PSYC 1002
4. 1.0 credits from NEUR 3202, NEUR 3301, NEUR 3302, NEUR 3303, NEUR 3304, NEUR 3305 or NEUR 3306
5. 0.5 credits from NEUR 3401, NEUR 3402, or NEUR 3403
6. 0.5 credits from NEUR 3501 or NEUR 3502
7. 1.0 credits in NEUR courses at the 2000-level of above
8. 0.5 credits in Advanced Science Faculty Electives

Credits Not Included in the Major CGPA (10.5 credits):
9. 1.0 credits in (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006) or (PHYS 1007 and PHYS 1008)
10. 0.5 credits in MATH 1007 or MATH 1107
11. 1.0 credits in BIOL 2104 and BIOL 2200
12. 1.0 credits in STAT 2507 and STAT 2509
13. 0.5 credits in PSYC 2100, PSYC 2301, PSYC 2500, PSYC 2700, PHIL 2501
14. 2.0 credits in Science Continuation courses (not in NEUR)
15. 1.5 credits in Approved Arts or Social Sciences
16. 0.5 credit in NSCI 1000 or Approved Arts or Social Sciences
17. 2.5 credits in free electives
Neuroscience and Mental Health

B.Sc. General (15.0 credits)

Credits Included in the Major CGPA (7.5 credits):
1. 3.5 credits in NEUR 1201, NEUR 2001, NEUR 2002, NEUR 2200, NEUR 3200 [1.0], NEUR 3204
2. 1.0 credits in BIOL 1003 and BIOL 1004
3. 1.0 credits in PSYC 1001 and PSYC 1002
4. 1.0 credits from NEUR 3202, NEUR 3301, NEUR 3302, NEUR 3303, NEUR 3304, NEUR 3305 or NEUR 3306
5. 0.5 credits from NEUR 3401, NEUR 3402, NEUR 3403, NEUR 3501 or NEUR 3502
6. 0.5 credits in Advanced Science Faculty Electives

Credits Not Included in the Major CGPA (7.5 credits):
7. 1.0 credits in (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006) or (PHYS 1007 and PHYS 1008)
8. 0.5 credits in MATH 1007 or MATH 1107
9. 1.0 credits in BIOL 2104 and BIOL 2200
10. 2.0 credits in Science Continuation courses (not in NEUR)
11. 1.5 credits in Approved Arts or Social Sciences
12. 0.5 credit in NSCI 1000 or Approved Arts or Social Sciences
13. 1.0 credit in free electives

Neuroscience and Mental Health

Minor (4.0 credits)

The Minor in Neuroscience is available to students registered in degree programs other than those offered by the Department of Neuroscience.
1. 1.5 credits in NEUR 1201, NEUR 2200, and NEUR 3204
2. 1.0 credits from NEUR 3202, NEUR 3301, NEUR 3302, NEUR 3303, NEUR 3304, NEUR 3305 or NEUR 3306
3. 0.5 credits from NEUR 3401, NEUR 3402, NEUR 3403, NEUR 3501 or NEUR 3502
4. 1.0 credits in any NEUR 2000-level course or above

To provide a comparison between the new Neuroscience and Mental Health programs, and the existing Combined Honours program run by the departments of Biology and Neuroscience, the combined honours program is listed below:

Neuroscience
B.Sc. Combined Honours (20.0 credits)

A: Credits Included in the Major CGPA (12.5 credits):
1. 3.0 credits in BIOL 1103, BIOL 1104, BIOL 2001, BIOL 2200, BIOL 2104, and BIOL 3305;
2. 1.0 credit in BIOL, BIOC or CHEM;
3. 1.5 credits in BIOL, BIOC or CHEM at the 3000-level or above;
4. 5.0 credits in PSYC 1001, PSYC 1002, PSYC 2001, PSYC 2002, PSYC 2200, PSYC 2700, PSYC 3200 [1.0] and PSYC 4200;
5. 1.0 credit from PSYC 3202, PSYC 3203 (BIOL 3605), PSYC 3204, PSYC 3205, PSYC 3207, PSYC 3700 [1.0], PSYC 4001 (with permission), PSYC 4207;
6. 0.5 credit from BIOL 3802, BIOL 4317 or BIOC 4007;
7. 1.0 credit in PSYC 4907 [1.0] or BIOL 4908 [1.0];

B: Credits Not Included in the Major CGPA (7.5 credits):
8. 1.0 credit in MATH 1007 and MATH 1107;
9. 1.0 credit in PSYC 3000 [1.0];
10. 1.5 credits in (CHEM 1001 and CHEM 1002) and CHEM 2203 (see Note 2, below);
11. 1.0 credit in (PHYS 1007 and PHYS 1008) or (PHYS 1001 and PHYS 1002);
12. 0.5 credit in NSCI 1000 or in the Faculty of Arts and Social Sciences or Faculty of Public Affairs, not in Psychology;
13. 1.5 credits in Approved Arts or Social Sciences, not in PSYC or BIOL;
14. 1.0 credits in free electives

NEUR course list

NEUR 1201 [0.5 credit]
Introduction to Mental Health and Disease
This course focuses on common mental health diseases and examines both clinical symptoms of disease, genetic, developmental, experiential and environmental risk factors contributing to disease, and the neurobiological basis of disease. Topics may include depression, Alzheimer’s Disease, Schizophrenia and ADHD.
Lecture three hours a week.

NEUR 2001 [0.5 credit] (Existing course)
Introduction to Research Methods in Psychology
A general introduction to research methodologies employed within contemporary psychology. Topics covered include research designs (experimental, quasi-experimental) and techniques (observations, surveys), basic descriptive statistics, and how to interpret and report research findings. (Also listed as PSYC 2001.)
Precludes additional credit for PSYC 2000.
Prerequisite: PSYC 1001 and PSYC 1002.
Lecture three hours a week.

Note that a request will be made to Psychology to alter the course name to “Introduction to Research Methods in Behavioural Sciences” to reflect the recent cross-listing of this course.

NEUR 2002 [0.5 credit] (Existing course)
Introduction to Statistics in Psychology
A general introduction to statistical techniques employed within contemporary Psychology. Topics covered include basic data analysis using descriptive and inferential statistics (t-tests, ANOVA, correlation, chi-square). (Also listed as PSYC 2002.)
Prerequisite: PSYC 1001, PSYC 1002, and PSYC 2001.
Precludes additional credit for GEOG 2006

Note that a request will be made to Psychology to alter the course name to “Introduction Statistics in Behavioural Sciences” to reflect the recent cross-listing of this course.
NEUR 2003 [0.5 credit]
Introduction to Techniques in Neuroscience
An introduction to common techniques used in neuroscience research. Topics covered include brain imaging, animal behaviour, electrophysiology, immunohistochemistry and microscopy, genomics, transgenics, cell culture, and DSM-IV-based clinical assessment.
Lectures three hours a week.

NEUR 2200 [0.5 credit] (Existing course)
Biological Foundations of Behaviour
An introduction to the biological basis of behaviour with reference to biological mechanisms associated with sensory and perceptual processes, motivation, emotion, learning and cognition. (Also listed as PSYC 2200.)
Prerequisite: PSYC 1001 and PSYC 1002.
Lectures three hours a week.

Note that the following changes will be proposed to this course description, to be agreed with the Department of Psychology:
- Title changed to “Introduction to Neuroscience”
- Course description changed to “This course introduces core concepts in neuroscience, and examines how cellular, molecular, and systems-level processes primarily within the brain underlie sensation, movement, motivation, emotion, learning and cognition. (Also listed as PSYC 2200).” Note that this is a more accurate description of the current content of this course.
- Pre-requisites changed to “PSYC 1001 and PSYC 1002, or permission of the Department of Neuroscience”. This change will ensure that students are able to complete the Minor in Neuroscience without the need for prior completion of 1.0 credits of first year PSYC courses.

NEUR 2801 [0.5 credit]
Neuroscience and Creativity
Abnormal brain function, associated with mental illness or substance abuse, has been commonly depicted in, or been the inspiration for important cultural works including movies, music, paintings and literature. This course examines the neurobiological basis of creativity in individuals with and without mental illness.
Prerequisite: NEUR 2200 or PSYC 2200.
Lectures and seminars three hours a week.

NEUR 3200 [1.0 credit] (Existing course)
Behavioural Neuroscience (Honours Seminar)
A detailed consideration of biological approaches to the study of behaviour and of research methods used in behavioural neuroscience. Intended for Honours students.
Precludes additional credit for PSYC 3200.
Prerequisites: enrolment in Honours Neuroscience with a CGPA of 9.00 or higher in the major; PSYC 2001 or NEUR 2001, PSYC 2002 or NEUR 2002, and PSYC 2200 or NEUR 2200, third-year standing and permission of the Department.
Lectures, seminars and laboratory tutorials six hours a week.
Note that this course description will be changed to that shown below

**NEUR 3200 [1.0 credit]**

**Principles of Neuroscience**

This course reviews core principles of Neuroscience, including neural signaling, sensation, movement, neurodevelopment, neuroplasticity, neuroendocrinology, learning and memory, and other complex brain functions.

Prerequisites: NEUR 2001 or PSYC 2001, NEUR 2002 or PSYC 2002, NEUR 2200 or PSYC 2200, third-year standing and permission of the Department.

Precludes additional credit for PSYC 3200

Lectures, colloquia and seminars, three to six hours a week.

**NEUR 3202 [0.5 credit] (Existing course)**

**Sensory Processes**

The neurobiological basis of sensation. Topics include sensory mechanisms, neuropsychological bases of perception and psychological phenomena encountered in the various senses.

Prerequisite: NEUR 2200 or PSYC 2200.

Precludes additional credit for PSYC 3202

Lectures and seminars three hours a week.

**NEUR 3204 [0.5 credit] (Existing course)**

**Drugs and Behaviour**

Introduction to synaptic mechanisms and the arrangements of the transmitter-specific brain systems, followed by a discussion of neuropharmacological bases of normal and abnormal behaviour and of the behavioural effects of various classes of psychoactive drugs such as stimulants, tranquilizers, opiates.

Precludes additional credit for PSYC 3204.

Prerequisite: PSYC 2200 OR NEUR 2200.

Lectures and seminars three hours a week.

Note that this course description will be changed to that shown below

**NEUR 3204 [0.5 credit] Existing course, modified calendar entry**

**Principles of Pharmacology: From Drugs to Behaviour, Synapse to System**

Introduction to synaptic mechanisms and the arrangements of the transmitter-specific brain systems, followed by a discussion of neuropharmacological bases of normal and abnormal behaviour and of the behavioural effects of various classes of psychoactive drugs such as stimulants, tranquilizers, opiates.

Prerequisite: NEUR 2200 or PSYC 2200.

Precludes additional credit for PSYC 3204

Lectures and seminars three hours a week.

**NEUR 3301 [0.5 credit]**

**Genetics of Mental Health**

Most common mental health diseases have a genetic component. By focusing on specific diseases, this course will discuss how disease susceptibility genes are identified, and describe the genetic, genomic and epigenetic mechanisms through which DNA alterations can predispose to disease.

Prerequisite: BIOL 2104 and either NEUR 2200 or PSYC 2200.

Lectures and seminars three hours a week.
NEUR 3302 [0.5 credit]
Sex and the Brain
This course will examine neurobiological processes behind reproductive behaviours in various animal species including humans. The course will also evaluate data concerning neurobiological differences between sexes, biological determinants of sexual orientation, and will critically evaluate data relating to neurobiology of sex disorders.
Prerequisite: NEUR 2200 or PSYC 2200.
Lectures and seminars three hours a week.

NEUR 3303 [0.5 credit]
The Neuroscience of Consciousness
Consciousness remains one of the least understood aspects of the nervous system. This course explores neural mechanisms underlying consciousness, changes in consciousness associated with sleep, coma, vegetative states, drugs, and other stimuli, and considers the evolutionary basis of consciousness, and its relationship with awareness.
Prerequisite: NEUR 2200 or PSYC 2200.
Lectures and seminars three hours a week.

NEUR 3304 [0.5 credit]
Hormones and behaviour
This course will focus on the effects of hormones throughout life at all levels of the nervous system. Topics will include the role of hormones in mediating behaviours that are both basic (feeding, reproduction and social interactions) and complex (motivation, emotion, learning and memory).
Prerequisite: NEUR 2200 or PSYC 2200.
Lectures and seminars three hours a week.

NEUR 3305 [0.5 credit]
Immune-brain interactions
This course will discuss growing evidence of communication between the brain and the immune system, and of the messengers mediating the interaction. We will discuss how disturbances of immune-brain signaling can lead to autoimmune disease (multiple sclerosis, arthritis) and to changes in mood and cognition.
Prerequisite: NEUR 3200 or PSYC 3200.

NEUR 3306 [0.5 credit]
The Neural basis of Addiction
This course will examine how substance and behavioural addictions impact neural function to ultimately lead to the neuropathology of addiction in vulnerable populations. The neurobiological mechanism of action of each drug class will be explored, as well as contemporary neurobiological theories of addiction.
Precludes additional credit for PSYC 3403.
Prerequisite: NEUR 3204 or PSYC 3204.

NEUR 3401 [0.5 credit]
Environmental Toxins and Mental Health
Exposure to environmental toxins from the air, water or food can interfere with neuronal function, alter neurodevelopment, and damage the brain. This course will explore associations between toxins and diseases such as Parkinson’s disease, multiple sclerosis and depression, focusing on mechanisms underlying development of pathology.
Prerequisite: NEUR 2200 or PSYC 2200.
Lectures and seminars three hours a week.

NEUR 3402 [0.5 credit]
**Impact of Lifestyle and Social Interactions on Mental Health**
Healthy lifestyle choices and positive social interactions can reduce the incidence of pathological conditions such as depression, obesity, cardiovascular disease and impaired immunity. This course focuses on psychosocial and neurobiological mechanisms that underlie the relationship between lifestyle, social interactions and health.
Prerequisite: NEUR 2200 or PSYC 2200.
Lectures and seminars three hours a week.

NEUR 3403 [0.5 credit]
**Stress and Mental Health**
Stressful events can have profound repercussions on physical and psychological well-being. This course examines the psychosocial and biological processes by which stressors predispose to both physical (immune-related disorders, diabetes, heart disease) and psychological (acute stress disorder, posttraumatic stress disorder, depression, anxiety) pathologies.
Prerequisite: NEUR 2200 or PSYC 2200.
Lectures and seminars three hours a week.

NEUR 3501 [0.5 credit]
**Neurodegeneration and Aging**
Neurodegeneration is particularly acute in the aging population, and is characteristic of diseases such as Alzheimer's, Parkinson's, multiple sclerosis and Huntington’s disease. This course will explore mechanisms underlying neurodegeneration, plus recent advances aimed at the restoration of nervous tissue, potentially curing these pathologies.
Prerequisite: NEUR 2200 or PSYC 2200.
Lectures and seminars three hours a week.

NEUR 3502 [0.5 credit]
**Neurodevelopmental Determinants of Mental Health**
This course explores development of the human brain, the generation and differentiation of the various cell types, and the formation of the vast network of neural connections. We will also discuss how neurodevelopmental dysregulation can result in pathologies including dyslexia, ADHD, schizophrenia and autism.
Prerequisite: NEUR 2200 or PSYC 2200.
Lectures and seminars three hours a week.

NEUR 4001 [0.5 credit]
**Special Topics in Neuroscience**

Neuroscience and Mental Health  Page 10
Each section of NEUR 4001 deals with a different topic. Topics change yearly. Students may register in more than one section of NEUR 4001 but can register in each section only once.
Prerequisites: each section will have its own.
Lectures three hours a week.

NEUR 4200 [0.5 credit] *(Existing course)*
Seminar on Current Research in Neuroscience
A discussion of important current research developments in behavioural and other fields of neuroscience.
Precludes additional credit for PSYC 4200.
Prerequisites: PSYC 3200 or NEUR 3200.

*Note that this course description will be changed to that shown below*

NEUR 4200 [0.5 credit]
Seminar on Current Research in Neuroscience
A seminar discussing how research on brain structure and function can lead to development of novel pharmacological, surgical and behavioral therapies of mental health diseases. Students will gain insight into the relationship between clinical observations and hypothesis-driven research into the biological basis of disease.
Prerequisites: NEUR 3200 or PSYC 3200.
Precludes additional credit for PSYC 4200

NEUR 4801 [0.5 credit]
Neuroethics
This course explores ethical issues of key importance to current neurobiological research. Topics may include the use of animals in research, stem cell research, genetic diagnosis and gene therapy, neuroimaging, and the effect on identity and autonomy of manipulations such as psychopharmaceuticals and psychosurgery.
Prerequisite: NEUR 3200 or PSYC 3200.
Lectures and seminars three hours a week.

NEUR 4900 [0.5 credit]
Independent Study
A reading or research course for selected students who wish to investigate a particular topic of interest. Available to third- and fourth-year students only. Normally students may not offer more than one credit of independent study in their total program.
Prerequisite: permission of the Department.

NEUR 4907 [1.0 credit]
Honours Essay and Research Proposal
An independent critical review and research proposal modeled on an NSERC Discovery Grant, prepared under the direct supervision of a faculty advisor. Evaluation is based on a written report and poster presentation.
Prerequisite: fourth-year standing in an Honours program and permission of the Department of Neuroscience.
NEUR 4908 [1.0 credit] (Existing course)
Honours Research Thesis
An independent research project undertaken under the direct supervision of a faculty advisor typically from the Department of Neuroscience.
Prerequisite: fourth-year standing in an Honours program and permission of the Department of Neuroscience.

Brief description of the Honours program, focusing on core program elements
A brief description will be provided here, organized on a year-by-year basis, with a broader discussion of the various design elements detailed in section 3. Note that to avoid redundancy, the description is provided only for the honours program. The Honours program is designed primarily for future graduate students who benefit from research training, though enrolment in this program will be limited based on the capacity of our research labs for thesis students. In contrast, the Major and General programs will allow further growth in enrolments. Students in these programs will receive less hands-on research experience, but students in the Major will have more opportunities to expand their breadth of Neuroscience knowledge, while students in the General program will have a faster time to completion.

Typical first year
BIOL 1003 and BIOL 1004
MATH 1007 or 1107
(CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006) or (PHYS 1007 and PHYS 1008)
PSYC 1001 and PSYC 1002
NEUR 1201
NSCI 1000
0.5 credits in Approved Arts or Social Sciences or free electives
• Students gain a broad grounding in University-level Science courses with biology, math, and either chemistry or physics (or both through use of electives)
• A basic understanding of introductory psychology reflects the fact that Neuroscience as an independent discipline arose from the integration of many other disciplines, most notably psychology and biology
• Students are exposed to Neuroscience as an independent discipline within their first year in the form of NEUR 1201: Introduction to Mental Health and Disease. The course will focus on clinical symptoms of disease, the biological basis of disease, and the biological/environmental susceptibility factors that predispose to disease. Given the focus on mental health, and the absence of prerequisites to the course, we anticipate that it will rapidly become a popular course throughout the university. In addition, the focus on pathology will ensure minimal overlap with other first year courses that incorporate introductory neuroscience topics (particularly first year biology and psychology courses), for which the focus is more typically on normal biological/psychological processes as opposed to pathological processes.

Typical second year
NEUR 2001, NEUR 2002
NEUR 2200
BIOL 2104 and BIOL 2200
Either PSYC 2100, PSYC 2301, PSYC 2500, PSYC 2700, or PHIL 2501
2.0 in Approved Arts or Social Sciences, free electives, or Science Continuation courses

- Through NEUR 2001 and NEUR 2002, students receive a firm and early grounding in both research methods and statistics, central to their capacity for critical thinking, research design and analysis, and competency with scientific literature and literature searches.
- NEUR 2200 is the first course to focus on core material in the discipline of Neuroscience. It introduces and reviews key concepts, all of which will be expanded in the following year through NEUR 3200. Many of these topics will also be expanded in great detail through other 3000-level and 4000-level courses.
- The program ensures students are fully grounded in core material from biology that is of greatest relevance to neuroscience and mental health (specifically genetics and cell physiology/biochemistry). Gaining increased breadth in the context of how other disciplines approach ‘the mind’ is mediated by the requirement for at least one course from a relevant subdiscipline from psychology, or alternatively a relevant course in philosophy (PHIL 2501: Introduction to Philosophy of Mind).

Typical third year

NEUR 3200 [1.0]
NEUR 3204
STAT 2507 and STAT 2509
At least 1 credit in advanced NEUR courses
Up to 1.5 credits in Approved Arts or Social Sciences, free electives, Science Continuation courses, or Advanced Science Faculty Electives

- NEUR 3200 ensures firm grounding in all major content areas within the Neuroscience discipline. Topics include neural signaling, sensation and sensory processing, movement and its central control, development and neural plasticity, plus complex brain functions such as language, sleep, emotion and motivation, sex and memory. This course also encourages critical reading of scientific literature, and develops communication skills. Importantly, NEUR 3200 includes the requirement to attend the Neuroscience Colloquium series; a series of 12-14 research talks every year delivered primarily by esteemed researchers from Canada and abroad. This series provides all students with an excellent understanding of the scientific process, of research as a potential career, and the breadth of research questions being addressed along with the tools being employed to address them. Students also have the opportunity to meet socially with speakers, to provide early exposure to networking skills.
- NEUR 3204 ensures students gain a firm understanding of pharmacology, which is central both to the understanding of the nervous system, plus also to treatment strategies aimed at Mental Health issues.
- STAT 2507 and STAT 2509 ensure students get a firm grounding in statistical analyses and the use of statistical software packages. This furnishes students with the skills required for them to perform their own data analysis for their upcoming Honours thesis.
• As described below, NEUR 3000-level courses are broadly split into 3 categories based on content. By requiring at least one course from each category, students will develop depth in a wide diversity of topics. Note that we anticipate that each of these courses will most likely be offered once every 2 years. In this way, students will have the opportunity to take most courses in either third or fourth year, ensuring a wide range of course options without excessive teaching load to the Department.
  o NEUR 3202, 3301, 3302, 3303, 3304, 3305 and 3306 each broadly focus on specific function of the nervous system, or a specific basic science sub-discipline (immunology, genetics) that pertains to the nervous system.
  o NEUR 3401, 3402 and 3403 each focus on a different aspect of the relationship between the environment and Mental Health.
  o NEUR 3501 and 3502 each focus on age-related effects (development, aging) on mental health.

Typical fourth year

NEUR 4200, and NEUR 4908 [1.0]

At least one credit in advanced NEUR courses

Up to 2.5 credits in Approved Arts or Social Sciences, free electives, Science Continuation courses, or Advanced Science Faculty Electives

• In the culminating year of their degree, students will conduct an honours thesis research project, typically in the lab of one of our faculty members or adjuncts. This research experience will capitalize on their training, both in terms of core knowledge, plus skills learned. Alternatively, students (with permission) have the option of preparing a NEUR 4907 review paper and grant. The review paper will be in the format of a Trends In Neuroscience article, due at the end of the first semester. The grant proposal, due at the end of the second semester, will take the form of an NSERC Discovery Grant (Individual). A formal budget will not be required, but the research should be possible on a budget of $30,000 per year.

• By their final year, students should have a sound grasp of what topics are of greatest interest to them, or may help them optimally prepare for their professional life after graduation. It is thus entirely appropriate that they have the greatest amount of flexibility of course options at this stage. At the same time, NEUR 4200, as a seminar in neuroscience required by all fourth year students, not only provides students with a forum to discuss recent advances in the field, but by providing a forum in which all fourth year students are brought together in a single class, which contributes towards a sense of belonging within ‘the class’ and the Department.

2.2: Admission requirements

Admission requirements to these programs will be identical to the standard admission requirements for students pursuing B.Sc. degrees in the Faculty of Science, as described in the Undergraduate Calendar at http://www.carleton.ca/calendars/ugrad/current/regulations/admdegScience.html.
3 Academic Merit and Program Delivery

3.1: Appropriateness of admission requirements in the context of learning objectives
The admission requirements are essentially standard for the majority of B.Sc. programs at Carleton, and the first year in our proposed programs is similarly typical of other programs. The main difference is that we require 1.0 credits in either chemistry or physics and not both (though students are able to take both if they wish through electives), requiring 1.0 credits in first year psychology in its place. This does mean that Neuroscience students will theoretically be able to graduate from our programs without having taken physics at the high school 4U/4M levels or above, or without having taken chemistry at the high school 4U/4M levels or above. While we certainly recognize that specific aspects of both physics and chemistry are important in understanding many core concepts in neuroscience, this material will be covered where needed in the context of our core Neuroscience courses such as NEUR 2200 (for which first year chemistry and physics are already not listed as prerequisites). Admission requirements are thus sufficiently stringent to ensure students are adequately prepared for entry.

3.2: Appropriateness of program curriculum and structure in the context of learning objectives

Content-based learning objectives
Objective 1.2a: Ensure students develop expertise in core Neuroscience topics, in the methodologies employed within Neuroscience, and the relationship of this knowledge to our current understanding of mental health and disease.
Through the compulsory Neuroscience courses NEUR 2200, NEUR 3200, NEUR 3204, and NEUR 4200, students will develop expertise in all core areas of Neuroscience. For example, NEUR 2200 and NEUR 3200 will each cover core concepts of brain evolution, neuroanatomy, cells of the central nervous system, cell communication and neurotransmission, brain development, pharmacology, sensation, movement, emotion and motivation, sleep and rhythmicity, attention, learning and memory, plus the neural basis of consciousness. NEUR3204 focuses on pharmacology, signaling circuitry and synaptic function, while 4200 exposes students to discussions on current research advances in neuroscience.

Students will be introduced to mental health and disease through the new NEUR 1201 course, which will provide a basic overview of common mental illness in terms of their symptoms, their causes, their neurobiological underpinnings, and their treatments. The relationship however between basic neuroscience and pathology will be explored in far greater detail through our more advanced courses. Indeed, of the 15 totally new courses proposed in the context of this new program, 11 explore this relationship (specifically NEUR 2801, 3301, 3302, 3304, 3305, 3306, 3401, 3402, 3403, 3501, and 3502).

A firm grounding in fundamental concepts in research methodologies and data analysis will be conveyed through NEUR 2001, NEUR 2002, STAT 2507 and STAT 2509, through the experience of the honours research thesis, and through the optional courses of NEUR 2003 (Introduction to Techniques in Neuroscience) when available.

Objective 1.2b: Ensure in-depth knowledge within specific areas of Neuroscience and Mental Health, selected by students based on their individual interests, and which include an understanding of the limits of current knowledge.
With the exception of NEUR 3200, NEUR 3204 and NEUR 4200, the remaining 3000-level NEUR courses will be taught on a rotating basis, each being offered once every two years. Students will be able to enroll in most of these courses following the completion of NEUR 2200 (the common prerequisite), as early as 4 semesters into the program. Students will thus have up to 2.5 years within their 4-year degree to select from a range of new in-depth NEUR courses, in addition to advanced courses offered by other departments. Each of these 3000-level rotating courses will focus on the current state of knowledge, including the limits of that knowledge, within the chosen field. In depth knowledge on very specific topics will also be provided through our Neuroscience Colloquium series, attendance of which is a required component of the NEUR 3200 course.

**Objective 1.2c: Ensure that students have the opportunity to tailor their program towards their individual interests and career objectives, by developing strengths in multiple disciplines.**

There is a growing perception that a Bachelor’s degree, while often necessary, may sometimes not be sufficient to provide our graduates with the competitive edge when seeking employment. In this context, gaining qualifications particularly well-suited to specific employment opportunities is likely to be viewed favorably by students. We have therefore been careful to ensure that students in our new Honours and Major programs have the opportunity to complete the 4.0 credits required for most minors, without exceeding the 20.0 credits of their degree. Indeed, with the exception of a small number of minors that are not open to B.Sc. students (plus the Minor in Psychology, which is prohibited to Neuroscience students by a current artifact in the calendar), Neuroscience students in the proposed programs will be able to complete every minor offered by the Faculties of Science, Arts and Social Science, or Public Affairs For example, a Neuroscience student interested in applying their knowledge of neuroscience to patent law may be keen to pursue a minor in law, while a student with interests in the pharmaceutical business or government may wish to pursue a minor in economics. These choices, plus the list of Minors shown below, are all currently feasible without exceeding the 20.0 credits of the program.

- Minor in African
- Minor in Art History
- Minor in Biology
- Minor in Indigenous Studies
- Minor in Canadian Studies
- Minor in Chemistry
- Minor in Computer Science
- Minor in Earth Science
- Minor in Economics
- Minor in English Language and Literature
- Minor in Film Studies
- Minor in Food Science
- Minor in French
- Minor in French Interdisciplinary
- Minor in Geography
- Minor in Geography: Physical Geography
- Minor in Geomatics
- Minor in Greek and Roman Studies
- Minor in History
Importantly, the Honours and Major programs also retain flexibility to suit Carleton students with interests in medical school (the PreMed population), for whom we anticipate these will be popular programs. Indeed, based on information contained in the Admission requirements of Canadian Faculties of Medicine (Admission in 2010), generated by The Association of Faculties of Medicine of Canada, students would meet the requirements for entry into every English-speaking medical school within Canada, if they made the course selections listed below (courses required for medical school entry are underlined, shown here in the context of the Honours program).

**Neuroscience and Mental Health (course selection recommended for PreMed students)**

**B.Sc. Honours (20.0 credits)**

**Credits Included in the Major CGPA (9.5 credits):**

1. 4.0 credits in NEUR 1201, NEUR 2001, **NEUR 2002**, NEUR 2200, NEUR 3200 [1.0], NEUR 3204 and NEUR 4200
2. 1.0 credits in **BIOL 1103** and **BIOL 1104**
3. 1.0 credits in PSYC 1001 and PSYC 1002
4. 1.0 credits from NEUR 3202, NEUR 3301, NEUR 3302, NEUR 3303, NEUR 3304, NEUR 3305 or NEUR 3306
5. 0.5 credits from NEUR 3401, NEUR 3402, or NEUR 3403
6. 0.5 credits from NEUR 3501 or NEUR 3502
7. 1.0 credits from NEUR 4907 [1.0] or NEUR 4908 [1.0]
8. 0.5 credits in Advanced Science Faculty Electives

Credits Not Included in the Major CGPA (10.5 credits):
9. 1.0 credits in (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006) or (PHYS 1007 and PHYS 1008)
10. 0.5 credits in MATH 1007 or MATH 1107
11. 1.0 credits in BIOL 2104 and BIOL 2200
12. 1.0 credits in STAT 2507 and STAT 2509
13. 0.5 credits in PSYC 2100, PSYC 2301, PSYC 2500, PSYC 2700, PHIL 2501
14. 2.0 credits in Science Continuation courses (not in NEUR)
   14.1 0.5 credits in BIOC 2300
   14.2 0.5 credits in CHEM 2203
15. 1.5 credits in Approved Arts or Social Sciences
   15.1 1.0 credits in ENGL 1000 [1.0]
16. 0.5 credit in NSCI 1000 or Approved Arts or Social Sciences
17. 2.5 credits in free electives
   17.1 1.0 credits in PHYS 1007 and PHYS 1008
   17.2 0.5 credits in MATH 1107*

* Note that courses in MATH are not required by English-speaking medical schools in Canada. However, certain medical schools (Universities of Toronto, Manitoba and Saskatchewan) each require 1.0 credits in Biochemistry and, due to pre-requisites in biochemistry courses, this cannot be achieved at Carleton without 1.0 credits in MATH. In the above program, the 1.0 credits in biochemistry requirement is satisfied through BIOC 2300 and BIOL 2200 (cross-listed as a BIOC course).

Skill-based learning objectives

Objective 1.2d: Students will be able to critically assess research, formulate ideas, and evaluate concepts through independent literature-based research.

Students receive formal introductions to the critical assessment of research designs, and approaches to literature-based research through the introductory methods course (NEUR 2001). However, throughout 3000-level and 4000-level courses which typically incorporate discussions of published research, plus require written and oral presentations to be researched and developed, students will obtain extensive skills of obtaining and evaluating primary and secondary sources of information. For example, in a recent 4th year seminar class (Hellemans), students given an oral presentation based on a primary research paper. Subsequently, they are required to write a proposal for a follow-up experiment based on the paper that was presented. Moreover, within each course, emphasis is placed on the multidisciplinary nature of neuroscience, particularly the interplay between brain neuronal activity and psychosocial factors, as well as the knowledge transfer that might be relevant to
Objective 1.2e: Students will be able to appropriately apply their acquired knowledge to the design, conduct, and analysis of research studies.

In the context of the Honours program, the honours thesis will require students to integrate both content- and skill-based knowledge to complete either a research project and thesis, or a review paper/grant proposal. Both honours thesis options build upon laboratory experience acquired during the first year science courses, knowledge of statistics and methods acquired through NEUR 2001, NEUR 2002, STAT 2507 and STAT 2509, and skills in information gathering/processing developed primarily through 3000-level courses. This will ensure that graduates are equipped with the basic skills/knowledge necessary to design experiments for the investigation of scientific questions. While the honours thesis is undoubtedly the single component of the various programs with the greatest emphasis on student-led research, research design, conduct and analysis also features in several of our other courses that are not restricted to the Honours program. For example, assignments for 3rd year course focusing on human development (D'Angiulli) included electrophysiology mini-projects, ecological field observations of children’s interactions or coding of goal-oriented behaviors in youtube videos. Similarly, assignments in the 3rd year genetics and neuroscience course (Stead) include bioinformatic analyses employed to design gene-specific molecular genetic techniques such as real-time PCR, and the optimal selection of genetic variants for gene association analyses.

Objective 1.2f: Students will be able to communicate effectively with both the scientific community and the general public about Neuroscience and mental health.

Graduates will develop considerable experience in communicating knowledge, ideas, issues and analyses in both oral and written forms. Many of our 3000-level and 4000-level courses include student-led seminars and essays. Similarly, through the honours thesis (where applicable) students will gain considerable experience in writing (including detailed feedback on writing from faculty), and in presenting their research in the form of a poster presentation within the annual Faculty of Science Undergraduate Research Day. All students will also be exposed to talks delivered by accomplished national and international researchers through the colloquium series, through which they will have considerable exposure to high quality presentations. Our courses are also beginning to evolve beyond the more traditional methods of communication (such as the essay, or seminar) by embracing New Digital Media (one of Carleton’s four Interdisciplinary Themes of Focus detailed in Defining Dreams). For example, one of our faculty (Hellemans) has been developing YouTube channels to accompany select courses, in which students are encouraged to generate lay presentations of scientific concepts in the form of internet videos.

3.3: Appropriateness of program mode of delivery in the context of learning objectives

Neuroscience faculty members have a keen interest in pedagogy. Indeed, from the eight faculty in our unit, 4 have already completed the Carleton University Certificate in University Teaching, and the strength of teaching in our unit is reflected in our teaching evaluations. For 2009-2010, the departmental mean teaching evaluation across all faculty and all courses (Q13: How do you evaluate the instructor?) was 4.77/5.0 (median 4.83/5.0), while our members have received a Faculty of Science Teaching Award, a Capital Educator’s Award, and two Top 20 placings in TVO’s Best Lecturer...
competition, all within the last 3 years. There is thus clear evidence of a desire to promote student learning and student development within the context of individual courses.

More formally, modes of delivery for specific program elements clearly support the learning objectives. Our three content-based learning objectives (1.2a-1.2c) are met through the incorporation into formally taught lectures (the format for most of our courses) of student-directed learning in the form of essays or seminars, which typically feature in our more advanced courses. In addition, one important aspect of learning objective 1.2c (flexibility of program) is that students enjoy flexibility in their program. To accompany this flexibility, it is necessary for students to be provided with sufficient information regarding their options within the program, so they can tailor course selection to their individual interests from an early stage in their academic career, even prior to their admission to Carleton. To support this flexibility, we intend to develop a resource within the Department of Neuroscience website that provides multiple examples of program course selections, tailored to the specific interests of individual students (including suggested course selections for PreMed students, and course selections for students with interests in French, Law, Economics, Chemistry, etc.). In addition, we aim to develop online resources helping students to target specific careers. For example, a ‘spotlight on patent law’ webpage would be generated by soliciting information from patent law professionals, asking which courses would be most beneficial, plus any other information that would be useful for students considering that career path.

In the context of skill-based learning objectives, methodological and statistical courses will provide students with the skills for research design and analysis – skills that students will be required to apply within the context of their Honours thesis. This will be supplemented by practical laboratory skills developed through first year labs (including compulsory BIOL 1003 and BIOL 1004 labs), plus the honours thesis (if they select the research thesis option). While at first blush it may appear non-optimal to rely on first year lab courses exclusively from other units, the introduction of a compulsory first year Neuroscience lab may actually be to the detriment of a sizeable proportion of our student population. Specifically, if we introduced a first year Neuroscience lab course, it would be as an alternative to first year biology lab courses (to which the neuroscience labs would be most closely related). We would not propose making Neuroscience labs additional to biology, as the additional course requirements would limit the flexibility of our program. However, most Canadian medical schools require students to take three full lab courses, and specify Biology as one of those labs. Introduction of a compulsory Neuroscience lab would therefore serve as an addition for many students with interests in Medical School, as opposed to a replacement for another lab course.

We anticipate that many of our courses will take advantage of CUOL delivery, including NEUR 1201, NEUR 2001, NEUR 2002, NEUR 2003, NEUR 2200, and NEUR 3204. While CUOL is not appropriate for every course (particularly smaller, discussion- or presentation-based courses), in the case of larger courses it provides students with greater flexibility in terms of both when and how they learn, does not prevent interactions between students or between students and faculty (due in large part to WebCT support), and can actually enhance the learning experience, particularly in a discipline such as Neuroscience. For example, it is common in our NEUR 2200 course for faculty to perform brain dissections in class (using a rat brain), which the students can watch via the overhead camera (with images projected in class). Picture quality is, however, far better if broadcast on CUOL, compared with in-class projection. There is also greater potential for the seamless integration of live lectures with multi-media in this format. This use of multi-media will be a particular advantage in NEUR 2003, a
methods course in which students will not only learn about various techniques commonly used in Neuroscience, but also view these techniques being used, either through archival footage, or wherever possible by custom videos made by faculty (in conjunction with the EDC) demonstrating techniques being used in their own laboratories.

Finally, we have an extremely active student society that encourage informal discussions on neuroscience issues, and gives formal presentations both within Carleton and throughout the city. The Ottawa Chapter of the Society for Neuroscience (http://www.sfn-ottawa.ca/) includes both graduate and undergraduate student members and is involved in hosting speakers for the Neuroscience Colloquium Series, organizing and delivering journal clubs, and delivering ~50 presentations each year in local elementary schools and high schools aimed at promoting Neuroscience in general (through Brain Awareness Week, every February) and more specifically Neuroscience at Carleton (through recruitment week every November). Through these forums, students gain the opportunity to discuss Neuroscience both with their peers at Carleton, plus with members of the local community.

3.4: Description of appropriateness of the co-operative education option
We currently have a co-operative education option for the Combined Honours in Neuroscience program, with 4 students enrolled in the option (2 working on campus, 2 at Health Canada). Provided that students are able to find suitable placements (with the assistance of the co-op office) this can be a very valuable experience, with real benefits in terms of future career options. However, we are reluctant to push strongly for an expansion of the program due to difficulties in finding sufficient numbers of appropriate placements for our students. The co-op program will therefore only be supported in the context of placements that are likely to fully justify the delay towards graduation, and the associated investment for our students.

3.5: Appropriateness of methods used for student evaluation in the context of learning objectives
Approaches for evaluation of students are diverse and course-specific. We anticipate that lower-year courses will have large enrolments (across all sections, NEUR 2200 typically has ~700 students, NEUR 2001 and 2002 each have ~1000 students, while even our third year NEUR 3204 course has ~240 students). Consistent with current teaching practices, evaluation of these courses will continue to involve midterms and final exams composed of multiple choice and short answer questions. These assessment tools suffice in the context of ensuring a general knowledge and understanding of core content and research methodologies in Neuroscience, and of how it relates to mental health (learning objective 1.2a).

Typically, students will develop a greater understanding of course content if they are asked to use and manipulate the material, as opposed to simply regurgitate content as is relatively common in multiple choice exams. The 3000-level and 4000-level courses will therefore have a far stronger emphasis on seminar presentations and essay writing/problem solving as a method of evaluation. This approach is certainly preferably to (for example) multiple-choice exams in terms of both encouraging learning (particularly self-directed learning) plus the assessment of that learning. Due to resource implications, these approaches can only be routinely applied within the context of upper-year courses.

Assessment of the Honours thesis will be modeled on the approach currently used with success by the Department of Biology, the discipline that is arguably the most closely related to Neuroscience. For a
research thesis, the thesis is presented in the form of a written document formatted with sections headings common to most Neuroscience journals (i.e.: Abstract, Introduction, Methods, Results, Discussion, References). In addition, each student will present a poster describing their research project, within the context of the Faculty of Science Undergraduate Research Day. This is a very common form of scientific presentation within Neuroscience. Indeed, the most recent conference of the Society for Neuroscience had in excess of 10,000 individual poster presentations.

In terms of evaluation, 70% of the thesis grade will be awarded by the thesis supervisor based on the quality of the written document, plus their view of the performance given by the students during the course of the thesis project. The remaining 30% will be awarded by each of three faculty judges providing a mark out of 10 based on the quality of the poster and the presentation of that poster. Of the three judges, one will be the supervisor, with the other two assigned by the Undergraduate Administrator. The only difference from the system currently employed by the Department of Biology is that the 70% awarded by the supervisor must be approved by the Undergraduate Chair. This will encourage consistency of grading standards between laboratories.

The honours essay thesis (NEUR 4907) has two components; a review paper based on the Trends in Neuroscience format, and a research grant on a related theme, based on the NSERC Discovery Grant format, each of which will contribute 50% towards the final thesis grade. Documents will be prepared under the supervision of a faculty member, commonly (though not necessarily) exploring a research topic relating to activities of the faculty member’s lab (thus providing motivation for the integration of the thesis students into the lab in the context of formal lab meetings, etc). The supervising faculty member will provide a grade for the completed thesis, with the grade subject to approval by the Undergraduate Chair.

3.6: Availability of faculty sufficient in number, quality and expertise in the relevant areas to support the new program

The Department of Neuroscience is a relatively small academic unit formed in May 2010, with the following composition:

<table>
<thead>
<tr>
<th>Name</th>
<th>Rank</th>
<th>Appointment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abizaid</td>
<td>Associate Professor</td>
<td>100% Neuroscience, 0% Psychology</td>
</tr>
<tr>
<td>Anisman</td>
<td>Full Professor, Tier I CRC</td>
<td>100% Neuroscience, 0% Psychology</td>
</tr>
<tr>
<td>D’Angiulli</td>
<td>Associate Professor</td>
<td>50% Neuroscience, 50% Child Studies, 0% Psychology</td>
</tr>
<tr>
<td>Hayley</td>
<td>Associate Professor, Tier II CRC</td>
<td>100% Neuroscience, 0% Psychology</td>
</tr>
<tr>
<td>Hellemans</td>
<td>Instructor II</td>
<td>100% Neuroscience, 0% Psychology</td>
</tr>
<tr>
<td>Holahan</td>
<td>Associate Professor</td>
<td>100% Neuroscience, 0% Psychology</td>
</tr>
<tr>
<td>Smith</td>
<td>Assistant Professor</td>
<td>100% Neuroscience, 0% Psychology</td>
</tr>
<tr>
<td>Stead</td>
<td>Associate Professor</td>
<td>100% Neuroscience, 0% Psychology</td>
</tr>
</tbody>
</table>

Amongst these faculty we already have the expertise to teach the courses proposed within the context of the new program. All of the NEUR courses that already exist in the calendar (previously listed as PSYC courses), specifically NEUR 2001, NEUR 2002, NEUR 2200, NEUR 3200, NEUR 3202, NEUR 3204 and NEUR 4200, have already been taught successfully by Neuroscience faculty (Abizaid, Hayley, Hellemans, Holahan, Smith, Stead). The remaining courses were all proposed by existing faculty, each of whom expressed a personal interest in offering that course in the future. There are two courses however that we anticipate will be offered through consultation with other units: NEUR 2801 (Neuroscience and Creativity) and NEUR 4801 (Neuroethics). D’Angiulli is well placed to teach...
NEUR 2801, having published on the psychology of art and creativity. He is also associate editor of the journal *Imagination Cognition & Personality*, which includes publications on the interface between clinical disorders and creativity. However, to complement his teaching it would be of great interest to include discussions focusing on specific works of art. For example, works of art (paintings, film, music, books) that were either inspired by, or were the products of abnormal neural states (i.e.: mental illness, drug abuse) would be discussed from various different perspectives, including faculty in Neuroscience with greatest expertise in the research behind that neural state, faculty from within the School for Studies in Art and Culture with expertise in the artistic medium being examined, and ideally local clinicians (or even patients) with experience of the underlying condition). Examples would include works of Van Gogh, Velvet Underground, William Burroughs, or movies such as Easy Rider or Memento. Offering the course would thus be a collaborative effort involving multiple units.

For NEUR 4801 (Neuroethics) we have faculty who are currently members of the Carleton ethics committees for animal and human use in Psychological and Neuroscience research, and who have themselves submitted multiple ethics applications for research on animals and humans (including transgenic animal research, and human genetic research). In addition, D’Angiulli has published work on ethics, while Hellemans has contacted the Neuroethics chair at UBC (Judy Illes) regarding this course, and is receiving assistance in course development. However, this course would also benefit from collaboration from the Department of Philosophy, which routinely offers courses at the 1000-, 2000-, 3000- and 4000-levels.

In addition to teaching expertise, we are a strong research unit suited to the training of honours students during their research projects, and with the capacity of readily integrating our own research projects and research experiences into teaching. For example, amongst out 6.5 research faculty are 2 Canadian Research Chairs (Hayley and Anisman). Anisman became a Fellow of the Royal Society of Canada in 2010. Abizaid and D’Angiulli each received a Research Achievement Award in 2010. Anisman, Hayley and Abizaid each receive funding from CIHR, with NSERC support for Anisman, Hayley, Abizaid, Holahan and Stead, SSHRC support for D’Angiulli, support from the Ontario Problem Gambling Research Centre for Stead, and recent Canadian Foundation for Innovation/Ontario Research Fund support for each of Smith, Hayley, Anisman, Abizaid, Holahan and Stead. The annual research support from operating grants across the department is currently ~$1.35 million.

In terms of our faculty *numbers*, we are also close to having sufficient numbers to offer the proposed program. However, we anticipate that 2.0 credits of teaching will be required annually through contract instructors. This is in addition to any contract instructor requests that arise through grant-related course buy-outs (which are self-funding). Details of teaching capacity and predicted load are as detailed below:

**Teaching capacity**

With no teaching reductions, 7.5 faculty within the Faculty of Science (including one instructor) would teach 12.75 credits annually. Amongst our faculty we have 2 Canadian Research Chairs (0.5 credits annual teaching reduction), and the position of Departmental Chair carries 1.0 credits teaching reduction, leaving a balance of 10.75 credits. (Faculty also currently carry 1.5 credits in total of teaching buy-outs through research grants, though these buy-outs are not incorporated into teaching capacity as they would fund contract instructors, thus require no additional university resources).
Assuming that every faculty member takes a 1 year sabbatical every 6th year, the average teaching capacity of our current unit is $\frac{5}{6} \times 10.75 = 8.96$ or ~9 credits per annum.

It should be noted that:
- At present, the position of Graduate Chair in Neuroscience carries no course reduction
- At present, the position of Undergraduate Chair in Neuroscience carries no course reduction

With predicted growth of the undergraduate program, plus the addition of new M.Sc. and Ph.D. programs in Neuroscience (launched in 2011), we anticipate that in time, course reductions will be required for these positions which will impact teaching capacity by an additional 1.0 credits annually.

**Teaching demands of the new program**
A minimum Departmental teaching load of 11.0 credits annually is initially required to support the three new programs and the minor. Note that this number incorporates existing teaching load, both at the undergraduate level in the existing combined honours in Neuroscience program, plus at the graduate level in both the new M.Sc. in Neuroscience, the new Ph.D. in Neuroscience (both offered from 2011), plus the existing M.Sc. and Ph.D. programs in Behavioural Neuroscience that are offered as joint specializations between (officially) the Department of Biology (Carleton), the Department of Psychology (Carleton) and the Department of Psychology (University of Ottawa).

Estimates of annual course offerings, plus sections offered per course are detailed in the table below. Note that CUOL teaching is assumed to carry no additional teaching load (based on a departmental agreement, and in comparison to the additional 0.5 credits of teaching load stipulated by the collective agreement). The new programs thus leave a teaching deficit of 2.0 credits annually. Initially, we request that this deficit be supported through contract instructors.

<table>
<thead>
<tr>
<th>Course</th>
<th>Number of sections</th>
<th>Teaching load</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEUR 1201 (CUOL)</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>NEUR 2200 (2 x CUOL)</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>NEUR 2003</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>NEUR 2801</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>NEUR 3204 (CUOL)</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>NEUR 3200 [1.0 credits]</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NEUR 4200</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>NEUR 5100 [1.0 credits]</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NEUR 5201</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>NEUR 5202</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>NEUR 5800</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>NEUR 6100</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>3 of NEUR 3202, NEUR 3301, NEUR 3302, NEUR 3303, NEUR 3304 or NEUR 3305</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>1 of NEUR 3401, NEUR 3402 or NEUR 3403</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>1 of NEUR 3501 or NEUR 3503</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>1 of NEUR 4001 or NEUR 4801</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total annual teaching load</strong></td>
<td></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>

With demonstrated success of the new programs, the teaching and administrative demands on our unit will undoubtedly increase. We will therefore be requesting additional faculty members and administrative support staff to support the growing program. However, additional personnel for the purpose of supporting these programs will not be requested without demonstrated success in the programs.
4 Demand and Impact

4.1: Evidence of student and faculty demand, based on past, current and projected course and program enrolments, including the number and kinds of students who have been taking this group of courses (e.g., full-time, part-time, special, majors and honours both within and outside the department(s))

Neuroscience is an expanding discipline for undergraduate studies

Based on data from universities in the USA collated in by Ramos et al. (2011), during the 10 years from 1986 to 1996 the number of undergraduate programs tripled, and then tripled again in the following decade, until in 2008 there were more than 2000 graduates from undergraduate neuroscience programs. *(Undergraduate Neuroscience Education in the U.S.: An Analysis using Data from the National Center for Education Statistics. R.L. Ramon, G.J. Fokas, A. Bhambri, P.T. Smith, B.H. Hallas & J.C. Brumberg. 2011, The Journal of Undergraduate Neuroscience Education, 9: A66-70.)* A similar increase has taken place for Neuroscience at Carleton, with enrolments increasing 3.5-fold since 2001. As can be seen below, the number of institutions to offer undergraduate neuroscience programs continues to grow, as do the number of neuroscience graduates.

Figures 3 and 4 reproduced from Ramos et al (2011)

Interestingly, relatively few existing neuroscience programs are housed within independent departments. The 2009 Survey of Neuroscience Graduate, Postdoctoral, & Undergraduate Programs (Stricker, 2009) published by the Society for Neuroscience surveyed 27 institutions in North America (including Canada) that offered undergraduate programs, and found that only five of these programs were housed within departments of neuroscience or behavioural neuroscience. Importantly, across all institutions, the median number of majors in a neuroscience program in 2009 was 110 (with 5 programs in excess of 200). This compares with a median number per program of just 22 in 2001. Indeed, the median number of students per program rose in every biannual survey from 2001 until 2009 (the 2011 report has yet to be published).

Expansion of Neuroscience is a strategic goal in Canada.
Neuroscience and mental illness is recognized as an important area of investment in Canada. For example, the 2009 CIHR roadmap reported that one of the five major health and health system challenges that currently confront the Canadian population, or likely will do so within the next few years, is “Growing prevalence and burden of chronic diseases, including mental illness and neurodegenerative diseases, in aging populations.” Neuroscience is also recognized in the strategic plans of other Canadian Universities. For example, the 2009-2013 strategic plan of the University of Lethbridge lists Neuroscience as one of its five research priorities. The University of Western Ontario’s Strategic Research plan (2008-2011) identifies “Neuroscience/Brain and Mind” as one of 10 signature areas. Other universities for whom Health is a strategic priority, and which specifically name Neuroscience under that heading, include University of Ottawa, University of British Columbia, Memorial University, University of Toronto, University of Montreal, and Queen’s University.

**Neuroscience and Mental Health**

There is considerable interest from prospective students in pursuing undergraduate degrees in health sciences. For example, a survey of 212 High School students conducted by Sue Bertram (Faculty of Science) at CU day in 2009 was designed to gauge interest in potential new programs at Carleton. Six possible new programs were explored (Life Sciences, Food Sciences, Health Sciences, Actuarial Science, Kinesiology and Physics/Nuclear), and 48% of prospective students expressed interest in Health Sciences, almost twice as many as any other option. Similar interest in health sciences is expressed at other university fairs such as OUF. Despite the growing interest in both health sciences, and the continued expansion of Neuroscience as an independent discipline at the undergraduate level, Canadian universities presently cater for the area of Neuroscience and Mental Health poorly. Indeed, the proposed Neuroscience and Mental Health programs will be the first Neuroscience programs in Canada to have a titular Mental Health component. We therefore anticipate that they will become highly popular programs in coming years.

**Expansion of Neuroscience at Carleton**

Neuroscience at Carleton is in an excellent position for expansion into new undergraduate programs. As with many universities, the course composition of the existing Combined Honours Neuroscience B.Sc. program reflects the main academic roots of Neuroscience as a discipline, being composed primarily of courses taken from Biology and Psychology programs. With the emergence of Neuroscience as an independent discipline, and the formation of Neuroscience as a new department at Carleton, now is an optimal time to develop new programs that include a marked expansion of neuroscience-specific courses, plus greater emphasis on the relationship between neurosciences and mental health. We anticipate that enrolment in undergraduate Neuroscience will increase with the new programs for the following reasons:

- In 2010, Neuroscience formed a new Department within the Faculty of Science, which will facilitate promotion of the unit and consequently recruitment to our programs. For example, recruitment to Neuroscience was typically done in combination with Biology, or more commonly Psychology – less emphasis was thus placed on Neuroscience as an independent discipline. Furthermore, most of the previous recruitment efforts involving neuroscience faculty were done in the context of the Faculty of Arts and Social Sciences, thus would be unlikely to optimally target students with the appropriate interests.
- In 2011 we are offering new M.Sc. and Ph.D. programs in Neuroscience. This will help to solidify the identity of the unit within Carleton, in part through informal interactions between graduate and undergraduate students. For example, TAs for our courses will now be drawn
primarily from the Neuroscience graduate student population (as opposed to having psychology graduate students TA for undergraduate neuroscience courses). In addition, interactions will be further promoted through our student societies, and the regular Neuroscience Colloquium Series (to which all students from every academic level will be encouraged to attend).

- Following formation of a new Department, and the approval of new independent M.Sc. and Ph.D. programs in Neuroscience, the number of completed graduate student applications to our unit has doubled from 19 to 38 within just 12 months.

- There is a keen interest in Health, as is reflected in Defining Dreams and the Carleton Academic Plan. These new programs are designed to cater to students with interests in mental health (including the relationship between mental and physical health). Importantly, while these programs have been designed with the PreMed student population as one of our priorities, we recognize that many students with strong interests in Health do not succeed in medical school applications. Critically we have therefore built in substantial flexibility into our Honours and Major programs enabling students to easily pursue almost any minor offered by the faculties of Science, FPA, or FASS. Completion of a minor within the context of a 20.0 credit program will thus provide students with a competitive edge towards gainful employment that builds upon their interests in health, in instances where Medical School may no longer be a realistic option.

- Recent years has seen considerable increases to the enrolment in neuroscience courses here at Carleton, reflecting increased interest amongst existing students (not limited to Neuroscience Honours students). To illustrate, NEUR 3204 Drugs and Behaviour (formerly PSYC 3204) is the only third year neuroscience course that is currently offered every year, and is open to students outside of the Neuroscience Honours stream. Enrolments in this course have more than quadrupled since 2007 and now stand at ~240 students per year.

- The last two years have seen considerable investment by our Neuroscience faculty and students in promoting Neuroscience in local schools. Through the Ottawa Chapter of the Society for Neuroscience (run jointly by graduate students from Carleton and the University of Ottawa), graduate students and faculty have delivered ~50 talks per year in local elementary schools and high schools (with regular coverage by local press). This has raised awareness of Neuroscience as a discipline, and of Neuroscience at Carleton, both amongst the students, the teachers, and the broader community. This will likely have positive repercussions for future recruitment.

- Mental illness is the second largest class of diseases to affect Canadians, second only to cardiovascular illness. This observation, combined with how little is really understood about the operations of the human brain (as arguably the most complex organ on earth), suggests that research funding for Neuroscience and Mental Health is more likely to remain a national and international priority compared with many other disciplines within the Life Sciences. We therefore believe that researchers trained in Neuroscience and Mental Health have particularly bright future employment prospects, both within academic, government and industry. Students interested in careers in life science research are thus likely to view Neuroscience and Mental Health as a strong choice in terms of long-term career prospects.

4.2: Evidence that the new programs would attract a potential clientele not now at the University
There is a real public interest in mental health and mental illness, born in part from the fact that most members of our community probably have close experience of mental illness amongst family and
friends. At present, the only mentions of mental health or mental illness in Carleton’s undergraduate calendar are in courses from the Department of Law or Philosophy. While all faculty in the Department of Neuroscience actively conduct research on mental illness (including eating disorders, depression, gambling, Parkinson’s disease, Alzheimer’s disease, spinal cord injury, and addiction), there are no courses in the current undergraduate Neuroscience joint program that focus on either the causes of, or symptoms of disease. It is thus reasonable to conclude that, despite an active research program in mental health, we simply do not cater towards undergraduate students with an interest in mental health as viewed from the perspective of Neuroscience (note in this context that the Department of Psychology do offer courses in Health Psychology, abnormal psychology, etc). The present proposal aims to rectify this situation, and in doing so is likely to appeal to a new demographic amongst prospective students.

One potential alternative to the new programs would be modification of the existing honours program, which is operated jointly by the Departments of Biology and Neuroscience. However, discussions between these units decided that the existing program should instead evolve towards a program with a stronger focus on comparative neurobiology, thus providing students with a choice between two very different, and therefore two different target populations.

4.3: Description of the nature and extent of any scholarly activity of faculty members that may result from the proposed development

As described previously, all faculty within the Department of Neuroscience are already actively engaged in mental health research. Development of these new programs will enable us to better attract undergraduate students with specific interests in our research programs, identify those students at an earlier stage of their academic careers, and include them in our own research activities far earlier than previously (potentially from the first year). This will increase the number of highly motivated undergraduate students in our labs, with positive implications for recruitment of the best students at the graduate level. Furthermore, by earlier incorporation of the best students into our groups, we increase the probability that students will generate scientific publications as undergraduates, which will greatly improve their chances of receiving external funding if they wish to pursue graduate studies at Carleton. In addition to recruiting individuals with specific interests in our research, the new collection of courses will ensure that students have a considerably stronger academic background that relates directly to our research programs, thus ensuring that students in our labs (both undergraduate and future graduate) will not only be better selected based on personal interest, but also be better trained and educated in a manner that benefits our research program.

If, as we anticipate, successful implementation of our new programs results in increased enrolment in neuroscience, we anticipate that this success may lead to new faculty positions in Neuroscience to strengthen what is currently a very small Department. Faculty will be recruited based on their research and teaching potential, and the capacity for synergism between the interests of new hires and of existing faculty. We thus anticipate that the new programs will have considerable long-term benefits to neuroscience as a research unit at Carleton.

4.4: Description of possible employment opportunities for graduates of the program

Graduates can pursue career opportunities in academia, health, business/industry, education or government. For example, students interested in health professions could pursue careers (in some cases following further education) as a rehabilitation counselor, behavioural therapist, speech-
language pathologist, public health officer, neurologist, microbiologist, genetic counselor, biomedical lab technician, health planner/consultant, toxicologist, or mental health worker. Within business or industry, career paths may include technical writer, pharmaceutical sales, consultant, researcher or analyst. Within education, graduates may find positions in journalism, teaching, as instructors, or as policy developers. Graduates interested in academia can apply to M.Sc. and Ph.D. programs (either at Carleton or elsewhere) with potential careers as research scientists/postdoctoral fellows or biologists in universities, Health Canada or NRC. Finally, government positions include patent officer, forensic scientist, and management positions within health-related organizations. Opportunities are therefore diverse, and include many careers in health-related professions.

4.5: Relationship of proposed programs to existing programs, including effects on enrolments in existing programs

Carleton currently offers a B.Sc. Combined Honours program in Neuroscience, offered jointly by the Department of Biology and the Department of Neuroscience. Prior to 2011, the program was run jointly by the Department of Biology and the Department of Psychology (until the Department of Neuroscience was founded from within Psychology). The new programs proposed here will be offered independently by the Department of Neuroscience, and are viewed as an addition to (as opposed to a replacement of) the existing Combined Honours program. The relationship between the new programs proposed here, and the existing program, is discussed below.

1) Main similarities and differences between the existing and the new programs

The training of students in core principles of neuroscience will take place in courses shared between the two programs, specifically NEUR 2200 (Introduction to the Neurobiological Basis of Behaviour), NEUR 3200 (Principles of Neuroscience) and NEUR 4200 (Seminar on Current Research in Neuroscience). Training of students in research design and statistics will similarly be shared between the two programs, specifically NEUR 2001 (Introduction to Research Methods in Neuroscience), NEUR 2002 (Introduction to Statistics in Neuroscience) and STAT 2507 and STAT 2509. Other similarities between the programs reflect common requirements for B.Sc. Honours programs.

The main difference between the programs is the emphasis placed by the new programs on Mental Health, as is reflected in the title. All faculty members in the Department of Neuroscience are engaged in Mental Health research, Health is an Interdisciplinary Theme of Focus within Defining Dreams, and so new programs focused on Mental Health is an obvious progression for our unit. The new proposal includes details for 15 new proposed courses, 11 of which are focused on the causes or consequences of Mental Health problems. Importantly, these new courses are designed from the very specific perspective of Neuroscience as an independent discipline. This is in contrast to the design of the present Combined Honours program, which is composed primarily of an amalgamation of existing courses from Psychology and Biology.

One additional distinction between the existing and new programs is that the new programs incorporate a marked increase in flexibility of course selection for students. The Combined Honours program allows at most 3.0 credits to be taken outside of the Faculty of Science or Department of Psychology, preventing honours students from pursuing minors external to the Faculty of Science. Students in the new Honours or Major programs will have the flexibility to pursue any minor available to B.Sc. students, available through either FASS of FPA.
To allow for this marked expansion in program flexibility, in comparison to the Combined Honours program, the number of required first year science courses has been reduced. While all students are required to take 1.0 credit of first year biology, they have the option of 1.0 credits of first year physics or chemistry, as opposed to both being required. While aspects of physics and chemistry are certainly considered required knowledge for neuroscience students (such as understanding electrical transmission along neurons, ionic currents, etc), the key concepts are covered in the context of neuroscience courses where necessary. While many students will therefore be encouraged to take both physics and chemistry courses, it would limit the scope of the minors available to students within the context of a 20-credit program.

2) Impact of the new programs on the existing program
There is likely to be a reduction, at least in the short-term, in enrolment in the existing Combined Honours program, as students interested in Neuroscience will now have multiple options within Carleton from which they can choose. However, we do anticipate that the new programs will appeal to a new and different demographic of prospective students. Importantly, we anticipate that the new programs will actually have a positive effect on the existing Combined Honours program for several reasons. 1) The new courses proposed in the context of the new programs will be available to students in the existing combined honours program, enhancing the choice of courses available to those students. 2) We anticipate that the new programs will lead to the invigoration and evolution of the existing program, which through the addition of a small number of new courses will lead to a program with a greater emphasis on comparative neurobiology. These programs will therefore target different groups of incoming students.

The new diversity of courses proposed here may also facilitate the future addition of new programs or streams through collaboration with other units, including neuroinformatics (with bioinformatics), computational neuroscience (with computer sciences) or neuroengineering (with engineering) as well as neurochemistry (with chemistry).

3) Evolution of, and potential enhancement of the existing program
With the approval of the proposed programs, the intention (through discussions with the Department of Biology) is that the existing Combined Honours program should develop a greater emphasis on neurobiology, with the resulting development of new courses for that program. Indeed, there are numerous courses offered in Neuroscience programs at other institutions that are deliberately omitted for the present proposal, but may serve as excellent future additions to the Combined Honours program, including comparative/evolutionary neurobiology, invertebrate nervous systems, comparative sensory systems, and animal behaviour. In this way, the two programs would evolve to cater towards the interests of two very different populations of undergraduate students.

4) Future support for both programs
The Combined Honours program will continue to be fully supported by the Department of Neuroscience. Every course that is required in the Combined Honours program, and that is run by the Department of Neuroscience, will continue to be offered in the future. Some courses listed as options in the existing program may no longer be offered, but those courses have rarely been taught in recent years, or were primarily taught by recently retired faculty. We anticipate that the Departments of Neuroscience and Biology will collaborate to reassess the Combined Honours program, to ensure it caters optimally to its target demographic.
5 Consultation

5.1: Evidence of consultation with other academic units
Document to be sent to:

- Department of Biology
  o iain_lambert@carleton.ca
- Department of Chemistry
  o robert_burk@connect.carleton.ca
- Department of Philosophy
  o jay_drydyk@carleton.ca
- Department of Physics
  o godfrey@physics.carleton.ca
- Department of Psychology
  o janet_mantler@carleton.ca
- Institute of Biochemistry
  o bill_willmore@carleton.ca
- School for Studies in Art and Culture (see page 21)
  o brian_foss@carleton.ca
- School of Mathematics and Statistics
  o zhao@math.carleton.ca

5.2: Evidence of consultation with the Registrar's Office
Document to be sent to:

- Suzanne Blanchard
  o suzanne_blanchard@carleton.ca

5.3: Evidence of consultation with the Office of Admission Services
Document to be sent to:

- Jean Mullan
  o jean_mullan@carleton.ca

5.4: Evidence of consultation with the Library
Document to be sent to:

- Flavia Renon? (Neuroscience area consultant)
  o flavia_renon@carleton.ca

6 Business plan
The Department of Neuroscience is a relatively small academic unit, formed in May 2010, and composed of 7.5 full-time faculty (including one instructor). Teaching reductions apply to two faculty who hold CRCs, and to the Department Chair. There are an additional 1.5 credits of teaching reduction due to grant-funded teaching buy-out (though these credits are not incorporated in the business plan, as they are self-financing thus do not require additional resources from the university). Accounting for sabbaticals, the average annual teaching capacity of our unit is ~9.0 credits. A minimum of 11.0 credits of teaching is required to support the three new programs plus the minor. This teaching load includes all teaching requirements for our existing undergraduate and graduate
programs (which currently includes two M.Sc. and two Ph.D. programs). At present, we are therefore able to support three new undergraduate programs (Honours, Major and General) plus a Minor with the initial investment of just 2.0 credits of additional contract instructor teaching.

If the new programs are successful and lead to increased enrolment in our Department, new positions will be requested. At present, we have a single administrator responsible for Departmental issues, plus both graduate and undergraduate programs. Increased enrolments will result in the need for additional administrative support (either part-time or full-time depending on student numbers). Similarly, increased enrolment will lead to increased demands on teaching, primarily to add additional sections for compulsory upper-year seminar-based courses to prevent class sizes becoming unwieldy. Additional faculty will also allow expansion in the number of honours thesis projects supported, and lead to increased enrolment in graduate programs. Depending on enrolment, at least two new faculty positions may therefore be requested, but would be financed through increased enrolments. With the exception of one faculty position to be requested based on OCGS recommendations on our new graduate programs, no new positions (either faculty or administrative) are being requested prior to the demonstrated success of these undergraduate programs. We therefore consider this proposal as a low-risk investment for the university.

Beyond salary costs, the new programs will require increased support from CUOL. Indeed, from 2010/11 to 2011/12 the number of course sections requiring CUOL support will increase from 1 to 3, with further increases planned. The programs will also require increased support from the library. At present, there are several key Neuroscience journals to which Carleton library does not subscribe, including Neuron and the Journal of Neuroscience, each of which are amongst the 20 most important Neuroscience journals (based on impact factor). We have yet to consult with the library about resources for the new program, thus the estimated costs are a very rough estimate. However, access to these journals will not only benefit the new programs, but will also support existing neuroscience graduate and undergraduate programs, in addition to programs in other units.

To summarize, while it is clearly not possible to accurately predict future enrolments in the proposed programs, we estimate an increase in net annual enrolment across all programs of 40 students per year within 3 years. Increased revenue from the minor is not included in the business plan. While these numbers may seem optimistic, they are based on 1) increasing numbers of neuroscience undergraduate students across North America; 2) clear interest in the incoming student population in Health programs, reflecting a growing awareness of health-related issues within society; 3) the fact that our Neuroscience and Mental Health programs will be the first of their kind in Canada; 4) the active role that our student society plays in recruitment, with ~50 talks given annually in local schools; and 5) the observation that our number of graduate applications has doubled in the last 12 months, following approval of new graduate programs within the new Department.