Proposal for a Neuroscience Major

Neuroscience Development Committee

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1. General Information

This proposal is to establish a new interdisciplinary major in Neuroscience. The committee responsible for developing this major consisted of faculty from the Department of Neuroscience, College of Medicine (COM; Drs. Georgia Bishop, James King, R. Thomas Boyd, Randy Nelson); Department of Evolution, Ecology, and Organismal Biology, College of Biological Sciences (Dr. Mitch Masters); and the Department of Psychology, College of Arts and Sciences (Dr. John Bruno). The goal is to provide undergraduates at The Ohio State University the opportunity to pursue an integrated course of study in Neuroscience. Although the university offers recognized graduate programs in Neuroscience and a Behavioral Neuroscience sub-specialization in Psychology, there is not a formally organized degree-granting program at the undergraduate level. For students interested in this area, this major provides a coherent framework for the courses and undergraduate research opportunities that exist within multiple departments and colleges. We request implementation of this major starting with the 2012/2013 academic year. Upon completion of the major, students will receive a Bachelor of Science degree.

The Neuroscience major, relying on coursework presently offered by faculty in the College of Arts and Sciences (ASC) and the College of Medicine (COM), will be administered by ASC. Oversight of this major will be assigned to one of the divisional deans in ASC. That dean will appoint and chair an Oversight Committee tasked with providing forward-looking stewardship of the major and its integrity and success.

Because the bulk of the faculty most centrally involved in the development of coursework for the Neuroscience major are in the Department of Psychology, the Executive Dean of the College of Arts and Sciences has assigned oversight responsibilities to the Dean of Social and Behavioral Sciences (SBS). Moreover, the major will be administratively housed within Psychology; ASC hopes to leverage and, over time, add to the existing advising and IT operations of Psychology in support of the Neuroscience major. We note that this administrative/advising arrangement has worked out quite well at two of our Big 10 peer institutions (University of Michigan and Indiana University). To handle the substantive and day-to-day aspects of the major, a director

will be appointed by the SBS Dean, and a steering committee of faculty across ASC and COM will be appointed by the director. Finally, major faculty advisors will be housed in Psychology (ASC), EEOB (ASC), and Neuroscience (COM) as well as a graduate student (Behavioral Neuroscience or Neuroscience areas) who will be located in the main advising office in Psychology and be available 20 hr/week. The Director, Oversight Committee, and advisors will keep close track of the major counts and other relevant issues (i.e. sufficient frequency of course offerings, particularly core courses). If, for example, it appears that the advising process is being taxed by increases in the number of majors, then the Dean of SBS will present a proposal to the Oversight Committee that additional staff be hired.

2. Rationale

Neuroscience, at its most basic levels, involves the study of the brain, its development, how it processes information, how it regulates behavior, and what goes wrong during disease. Ohio State has had a rich history of research in these areas, starting with the development of a free-standing Brain Research Center in 1956. Staffing of the Center reflected the multidisciplinary nature of the field and has included researchers from neuropsychiatry, neurophysiology, neuroanatomy, neurochemistry, and psychobiology and behavioral neuroscience. The Department of Neuroscience in the College of Medicine and Public Health was established in 1998 and is a major contributor to the university-wide graduate program in Neuroscience. In addition to 23-tenured faculty, the Department of Neuroscience is comprised of many faculty with joint appointments across departments in the colleges of Arts and Sciences, Dentistry, Engineering, and Medicine. The interdisciplinary Neuroscience Graduate Studies Program (NGSP) now has ~70 faculty members, many of whom have modern, state-of-the-art research opportunities for undergraduates at Ohio State. The resources of active Neuroscience researchers will make this major very appealing to students interested in fundamental research (see Appendix C for a listing of university-wide neuroscientists with actual or potential contributions to the Neuroscience major).

The areas of Behavioral Neuroscience and Cognitive Psychology are among the premier research subdisciplininary areas within the Department of Psychology. These Psychology faculty are joined by peers with active research programs in the Department of Oral Biology (College of Dentistry with focuses on sensory and neuroimmunology), EEOB (with focuses on behavioral neuroscience), Neuroscience and the associated Neuroscience Signature Programs in the College of Medicine, and Nationwide Children's Hospital, all of which have interests in

developing this major. We suspect that the establishment of an imaging center (fMRI)[1] in Psychology will drive major interest among undergraduates in social neuroscience, auditory and speech neuroscience, economic neuroscience, and neuroethics. The development of the major is a natural outgrowth of the interdisciplinary nature of the field of Neuroscience and reflects cooperation at its best. We see this major as an opportunity to develop excellent students for our own PhD programs as well as seed other PhD programs throughout the country. This major will also serve as an important pre- health professional major.

The field of Neuroscience is an exciting and burgeoning field. The annual meeting of the Society for Neuroscience now regularly attracts ~40,000 attendees, with an increasingly strong emphasis on undergraduate neuroscience research and education. Undergraduates regularly matriculate into college with the hope of studying neuroscience. According to admissions staff at Ohio State Medical Center, the fourth most common major for accepted medical students is now neuroscience (this despite the fact that OSU has no major in this area). All of the other Big 10 schools have an undergraduate neuroscience major (except Purdue which has a Behavioral Neuroscience major). All of our aspirational schools have an undergraduate neuroscience major (called neurobiology at UCLA). In Ohio, a number of state universities (including Kent State, Bowling Green, and the University of Cincinnati), as well as private colleges (including Baldwin-Wallace, Oberlin, Hiram, Kenyon, and Muskingum Colleges), and private universities (including Ohio Wesleyan and Case Western University) offer neuroscience majors. At Ohio University, the Department of Biological Sciences offers a BS degree in Biology with an emphasis in Neuroscience and the Honors Tutorial College offers a BS degree in Neuroscience. We fear that Ohio State University is losing some of the best and brightest of Ohio college applicants because of the lack of a neuroscience major at Ohio State.

3. Goals/Objectives and Evaluation of Program

The ongoing assessment plan for the Neuroscience major will focus on the following three fundamental questions: (1) What do we want our students to know and be able to do, and what

[1] fMRI (functional magnetic resonance imaging) is a technique to image brain activity related to a specific task or sensory process: 1) the signal does not require injections of radioactive isotopes, 2) the total scan time required can be very short, i.e., on the order of 1.5 to 2.0 min per run (depending on the paradigm), and 3) the in-plane resolution of the functional image is generally about 1.5 x 1.5 mm although resolutions less than 1 mm are possible. To put these advantages in perspective, functional images obtained by the earlier method of positron emission tomography, PET, require injections of radioactive isotopes, multiple acquisitions, and, therefore, extended imaging times. Further, the expected resolution of PET images is much larger than the usual fMRI pixel size

perspectives should they acquire? (2) What evidence do we have that Neuroscience majors are acquiring the intended knowledge, skills, and perspectives? (3) How is this evidence used for ongoing improvements in student learning? More specifically, our assessment plan includes the following:

a) Learning Goals: Students in the Neuroscience major will acquire, through gateway courses, a strong foundational background in core disciplines of the interdisciplinary field of neuroscience. As a result, majors will enter their advanced coursework with a solid understanding of the cellular specialization of neurons and non-neuronal cells of the nervous system; electrical/chemical components of synaptic transmission; non-synaptic intercellular transmission; structure/function of the nervous system; behavior and cognition as functional outputs of coordinated, distributed neuronal function. Students will also be expected to acquire statistical skills in order to understand and critically evaluate readings to which they are exposed during later stages of the major as well as in their post-graduate training. Such skills will also enhance their own undergraduate research experiences – such research, though not required, will be *highly* recommended by advisors and faculty in the program. As the students progress through the major they will also acquire in-depth knowledge within a subarea of neuroscience by declaring a 'specialization track' and pursuing a series of courses focusing on a specific discipline. These specialization tracks will provide our majors with advanced information in the areas of molecular/cellular neuroscience, systems/behavioral neuroscience, or cognitive/computational neuroscience. It is expected that majors will have significant experience with the critical reading of the primary scientific literature (i.e., journal articles) in several of their advanced courses.

b) Evidence of Acquisition of Learning Goals: The Neuroscience Major Development Committee (identified above) has evaluated the syllabi of each of the courses associated with the major with respect to the consistency of course material with the learning goals identified above. Thus, traditional evaluative methods (quizzes, exams, papers), used in each course will provide valuable assessment as to whether our majors are indeed acquiring the stated learning goals. The material in this major is inherently inter-related and progressive (as indicated by the prerequisite structure of many of the courses) such that, the information presented in the cores is necessary for the early courses of the specialization tracks and subsequently the information in these early courses is essential for success in the advanced courses of the specialization tracks. Thus, attention to group performance at these 3 nodes of progression through the major will provide important feedback as to whether our students are acquiring the essential learning outcomes that we expect. Every 2-3 years, the advising unit will summarize grades at each of these 3 critical nodes of the major. The Director and the Steering Committee will evaluate this performance to determine if our majors are acquiring the intended learning goals.

In addition to these more direct methods, we plan to conduct focus groups with students at various levels of the major every other year. While there will be some discussion of students' satisfaction with the major (important for a new major), the principal focus during these meetings, particularly during the early years, will be on identifying skill/knowledge sets that are not being adequately addressed by our coursework.

c) Assessment of Students Graduating in the Major: We anticipate using three methods (one indirect/two direct) to assess whether students who graduate with a degree in Neuroscience have met our learning goals. First, we will administer an exit survey to all graduating students. Second, in addition to assessing course delivery of instruction as noted above, as the majority of students who will select this major aspire to post-graduate training in professional schools (e.g. medicine, dental, nursing, physical therapy) or advanced research degrees in the field of neuroscience, we will use post-graduate placement as a measure of whether our students are acquiring the desired knowledge and experience that render them attractive for admission into post-graduate training programs.

4. Relationship to Other Programs / Benchmarking

There is currently an interdisciplinary minor in Neuroscience at Ohio State that has been in existence for several years. Over this time there has been rapid growth in the number of students seeking this minor (70 Neuroscience minors in SP10). There are also a large number of students in Psychology who have opted to develop Personalized Study Plans (PSPs) that essentially encompass a Neuroscience major. The Psychology major is currently the closest discipline to a Neuroscience major at Ohio State. However the Psychology major is broad and covers many aspects of psychology including social, developmental, clinical, cognitive, behavioral and several others. The Neuroscience major will have a distinct and different focus.

Although students majoring in Neuroscience will take some Psychology courses, the Neuroscience major will be unique and focus on the brain, its development, how it processes information, and its impact on behavior. Other foundational areas of Neuroscience include neurophysiology, neuroanatomy, neurochemistry, neuroimmunology, and molecular and cellular neuroscience. In contrast to many Psychology majors pursuing a B.A., students in the Neuroscience major will also be expected to acquire a strong background in chemistry, math, and physics. We anticipate that many of our Neuroscience majors will move on to professional schools (medical, dental, etc.) as well as to graduate programs in neuroscience.

Neuroscience is an important and rapidly growing field. Many of the top universities against which Ohio State benchmarks itself have majors in Neuroscience including Johns

Hopkins, University of Pittsburgh, Michigan, and the University of California, San Diego. Several schools in Ohio have Neuroscience majors including Case Western, Cincinnati and Oberlin. We feel that it is important for Ohio State to have a strong Neuroscience major in order to compete for students with these top schools. Some students who would prefer a neuroscience major are most likely attending other universities rather that Ohio State because of our lack of the major. Students who will be attracted to this major will tend to be very strong academically. The vast majority of them will aspire to post-graduate training in either health-related professional schools (medical, dental, nursing) or Ph.D. programs in various neuroscience disciplines. We maintain that as the major matures it will become one of the best programs in the nation for several reasons. First, the partnership between ASC and COM, as well as the physical integration of the medical school and the central campus, will facilitate an effective partnership for our undergraduates. Second, the quantity, quality, and breadth of expertise represented by our neuroscience faculty will ultimately provide our majors with a large number of courses taught by scientists who are at the front lines of research in this field. Finally, Ohio State has developed a culture of undergraduate research and our Neuroscience majors will have the opportunity to work with internationally-renowned scientists in some of the most contemporary research facilities in the nation.

We expect that a new Neuroscience major will draw some first-year students and early sophomores from Psychology, Biological Sciences, and other students who are pursuing pre-med programs at OSU during the first year, perhaps two. These will be students interested in neuroscience who had not known that the major was available at OSU when they matriculated. Moreover, with the introduction of the major, the dozen-to- twenty students who typically enroll in effective neuroscience PSPs will be able to enroll directly into a Neuroscience undergraduate program. We do not expect that late sophomores or higher ranks will change their majors to Neuroscience; the lock-step nature of the Neuroscience program would put upper level re-deciders at a disadvantage in terms of timely progress to their degrees. By the second year of the program, we expect that the majority of new first-semester students to come from external sources. Advertising, recruiting, pre-med advising, UAFYE promotions, and so forth will have become well-established by the second year.[2]

[2] Interestingly, Indiana University had the same expectations when their program was initially offered, but had been surprised when the majority of its first class had come from external, rather than internal sources.

5. Student Enrollment

Even without a formal major there are currently a nontrivial number of students at Ohio State currently with Personal Study Plans (PSP) who could be considered *de facto* neuroscience majors. Another indicator of the need for a formal Neuroscience major is the growing popularity of the Neuroscience minor, which was approved by OAA in 2005. By 2008, 35 students had declared a Neuroscience minor. In just two years the number of minors has doubled (70 neuroscience minors in SP10). Moreover, recruiting staff in ASC and telemarketing staff in UAFYE have been noticing increased numbers of requests over the past year from prospective students interested in an undergraduate neuroscience major. It is difficult to forecast, but based on other schools' experiences, it is likely that Ohio State will see >100 majors within 2-3 years. As our initial class of Neuroscience majors graduate and successfully matriculate into high quality professional schools and Ph.D. programs it seems reasonable to expect this number to double within the following 2-3 years. During the first four years, therefore, we anticipate accepting 35-60 new majors per year.

6. Curricular Requirements

The proposed major in Neuroscience will offer a central foundational core set of courses that each major will take early in his/her tenure (**15 credit hours)**. These core courses will serve as prerequisites for many of the advanced offerings. Majors then declare a specialization in one of three focal tracks in the neurosciences in order to obtain an in-depth knowledge of a sub-discipline within the field. Majors will also be required to take two additional courses in either or both of the other tracks in order to obtain a certain degree of breadth in the field **(21 credit hours)**. Collectively, the Neuroscience Major will require successful (C^- or better) completion of **36 degree hours**. In addition, the conduct of undergraduate research, particularly among those majors with graduate or professional school aspirations, will be highly advised. This proposal is accompanied by four appendices (A, B , C, & D). A more specific breakdown of the requirements of the major, as well as a list of all courses (department, title, description, and prerequisites), is presented in **Appendix A**. Three sample 'pathways through the major' are depicted in **Appendix B** to illustrate the number of credits typically taken in the major and the fact that graduation is possible within the student's four year tenure. **Appendix C** highlights the extensive number of neuroscience-related faculty (~80), representing multiple departments and colleges, located across our campus. A significant number of this faculty is already committed to the Neuroscience major as teaching faculty and potential supervisors of undergraduate research. We anticipate, with this large number of faculty specializing in every specialization area with the field of neuroscience, that additional courses will evolve over time. **Appendix D** provides information about distinguished undergraduate neuroscience programs culled from the websites of Indiana University, Johns Hopkins University, University of Pittsburgh, and two programs at the University of Michigan.

APPENDIX A
NEUROSCIENCE
PROPOSED BACHELOR OF SCIENCE MAJOR
(SEMESTER HOURS)

The proposed major in ***Neuroscience*** consists of a central foundational core of five courses which introduces students to the breadth of the field. These courses serve as prerequisites for many of the advanced offerings. It is expected that all core courses will be completed by the end of the 2nd year.

Upon completion of the core, students will declare one of three focal tracks of specialization in the neurosciences: *Molecular/Cellular Neuroscience*, *Systems/Behavioral Neuroscience*, and *Cognitive/Computational Neuroscience*. Majors will take five courses in their declared track, and two courses in at least one other track for additional breadth. Students will be strongly encouraged to include research hours in their programs. In some cases, a faculty advisor may approve substitution of research hours for one of the two breadth requirements when a student's research adds breadth to his/her declared specialization.

	COURSE	DESCRIPTION	PREREQUISITES
NEUROSCIENCE **REQUIRED CORE**	**Neurosci 3000**: *Introduction to Molecular/Cellular Neuroscience*	Introductory course covering organization &function of the nervous system at a level understandable to science & non-science majors.	Biology 1113.
	Neurosci 3050: *Introduction to the Structure & Function of the Nervous System*	The course will discuss basic principles of the anatomical & neurophysiological organization of the nervous system.	Biology 1114 **OR** Neurosci 3000 **OR** permission of instructor.
	Psych 2313: *Introduction to Behavioral Neuroscience*	Introduction to the structure & function of the nervous system in relation to behavior.	Psych 1100.
	Psych 2513: *Introduction to Cognitive Neuroscience*	Examination of the neuroscientific approach to the study of cognition; primary focus on the psychobiology of memory, attention, language, & spatial orientation.	Psych 1100.
5 COURSES **15 SEMESTER HRS**	**Data Analysis**: *Choose 1 from the list in the Description section to the right.*	1. Stats 2180: *Intro to Statistics for the Life Sciences* **OR** 2. Stats 2450: *Intro to Statistical Analysis* **OR** 3. Psych 2220: *Intro to Data Analysis in Psychology* **OR** 4. MolGen 5650: *Analysis & Interpretation of Biological Data*	1. Math 1151.01. 2. Math 1151.01. 3. Psych 1100 + (Stats 145 **OR** Math 130 **OR** Math 148). 4. Math 1150 + 9 hours at 300-level or higher in a dept of FAES **OR** Bio Sci.

TRACK: *MOLECULAR/CELLULAR NEUROSCIENCE*

	COURSE	DESCRIPTION	PREREQUISITES
MOLECULAR/ CELLULAR SPECIALIZATION **5 COURSES**	**Psych 2305**: *Drugs & Behavior*	Introduction to the psychology of licit & illicit psychoactive drug use.	Psych 1100.
	Neurosci 3010: *Neurophysiology*	The course will discuss basic principles of neurophysiology working from the level of the ion channel to the whole system.	NeuroSci 3000 or NeuroSci 3050 or permission of instructor.
	Psych 4501: *Advanced Behavioral Neuroscience*	Advanced discussion of contemporary issues in psychobiology, including: synaptic pharmacology, drugs, & behavior, neurodegenerative diseases & the biological bases of psychopathology.	Psych 2313.
	Psych 4644: *Hormones & Behavior*	Exploration of the interactions among hormones, brain & behavior through an integrative approach.	Psych 2313.
	Neurosci 7050: *Neurobiology of Disease*	This course will explore the basis of major diseases affecting the nervous system.	NeuroSci 3000 or permission of instructor.
	Molecular Virology & Immunology 7500: *Neuroimmunology*	This course will explore research & clinical applications of inflammatory processes within the central nervous system with special emphasis on neurodegenerative disorders, autoimmune disease & neurotrauma (e.g., spinal injury).	Permission of instructor.
	Neurosci 7001: *Foundations of Neuroscience*	This course will discuss basic principles of the cellular, molecular, and neurophysiological organization of the nervous system.	Permission of instructor.
	Neurosci 7900: *Neurodevelopment*	Interdisciplinary approach to the development of neural cells and the formation and maturation of vertebrate and invertebrate nervous systems.	Permission of instructor.
	Biochem 4511*: *Intro to Biological Chemistry.*	An introductory course in biochemistry dealing with the molecular basis of structure and metabolism of plants, animals, and microorganisms. ***Strongly recommended for pre-med students.***	(Chem 1220 or 1250) + (Chem 2310 or 2520) + 2 semesters of Bio Sci.
	MolGen 4500**: *General Genetics*	The principles of genetics, including molecular genetics, transmission genetics of prokaryotes and eukaryotes, developmental and non-chromosomal genetics, and the genetics and evolution of populations. ***Strongly recommended for pre-med students.***	Biology 1113 + 3 add'l hours in Bio Sci.

***** The prerequisites for Biochem 4511 as identified here are expected to change. Preliminary thoughts are that Bio 1113 + 1 Neurosci core course may become acceptable prerequisites. Faculty advisors will encourage Honors students to substitute Biochem 5613 + 5614 for Biochem 4511 in their contracts.
****** Faculty advisors will encourage Honors students to substitute MolGen 5606 for MolGen 4500 in their contracts.

TRACK: *SYSTEMS/BEHAVIORAL NEUROSCIENCE*

	COURSE	DESCRIPTION	PREREQUISITES
SYSTEMS/ BEHAVIORAL SPECIALIZATION **5 COURSES**	**Psych 2305**: *Drugs & Behavior*	Introduction to the psychology of licit & illicit psychoactive drug use.	Psych 1100.
	Psych 4501: *Advanced Behavioral Neuroscience*	Advanced discussion of contemporary issues in psychobiology, including: synaptic pharmacology, drugs, & behavior, neurodegenerative diseases & the biological bases of psychopathology.	Psych 2313.
	EEOB 4550: Neurobiology of Animal Behavior	Integration of studies of sensory, integrative and motor systems with evolution and ecology.	Two courses in the Biological Sciences or permission of instructor
	Psych 4623: *Biological Clocks & Behavior*	Biological rhythms of animals & humans, including ultradian, daily, lunar, tidal & annual cycles; role of nervous & endocrine systems in relation to behavioral rhythms.	Psych 2313 or permission of instructor.
	Psych 4644: *Hormones & Behavior*	Exploration of the interactions among hormones, brain & behavior through an integrative approach.	Psych 2313.
	Psych 5613H: *Biological Psychiatry*	Provides a contemporary overview of the biological bases of several significant psychopathologies, including: mood disorders, schizophrenia, & PTSD/dissociative identity disorders.	Psych 4501 or permission of instructor.
	Psych 5898: *Seminar in Behavioral Neuroscience*	Team-taught seminar on selected topics from contemporary research areas in the field of behavioral neuroscience	Psych 4501 or permission of instructor.
	Biochem 4511*: *Intro to Biological Chemistry.*	An introductory course in biochemistry dealing with the molecular basis of structure and metabolism of plants, animals, and microorganisms. ***Strongly recommended for pre-med students.***	(Chem 1220 or 1250) + (Chem 2310 or 2520) + 2 semesters of Bio Sci.
	MolGen 4500**: *General Genetics*	The principles of genetics, including molecular genetics, transmission genetics of prokaryotes and eukaryotes, developmental and non-chromosomal genetics, and the genetics and evolution of populations. ***Strongly recommended for pre-med students.***	Biology 1113 + 3 add'l hours in Bio Sci.

***** The prerequisites for Biochem 4511 as identified here are expected to change. Preliminary thoughts are that Bio 1113 + 1 Neurosci core course may become acceptable prerequisites. Faculty advisors will encourage Honors students to substitute Biochem 5613 + 5614 for Biochem 4511 in their contracts.
****** Faculty advisors will encourage Honors students to substitute MolGen 5606 for MolGen 4500 in their contracts.

TRACK: *COGNITIVE/COMPUTATIONAL NEUROSCIENCE*

	COURSE	DESCRIPTION	PREREQUISITES
COGNITIVE/ COMPUTATIONAL SPECIALIZATION **5 COURSES**	**Psych 2310**: *Sensation & Perception*	Examination of how observers perceive their environment through sensory information; emphasis on major sensory systems including vision, audition, spatial orientation, touch, taste & olfaction.	Psych 1100.
	Psych 5600: *Psychobiology of Learning & Memory*	Course will integrate coverage of animal learning & human memory, focusing on three key components of the field: behavioral processes, brain systems, & clinical perspectives.	Psych 1100.
	Psych 5606: *High-Level Vision*	Examines the perceptual processes by which humans & other animals are able to obtain knowledge about the three-dimensional environment.	Psych 2310.
	Psych 5608: *Introduction Mathematical Psychology*	Survey of mathematical & computational modeling in psychology. Topics include psychophysical scaling, information processing, probabilistic choice, signal detection theory, model comparison, & Bayesian graphical modeling.	Psych 3321.
	Psych 5609: *Introduction to Mathematical Models in Experimental Psychology*	An introduction to cognition with a focus on the application of mathematical models. Topic areas include memory, decision making, categorization, word recognition, priming, & reaction time.	Psych 5608.
	Psych 5612; **CSE 5612**; **Ling 5612**; or **Philos 5612**: *Introduction to Cognitive Science*	Cognitive science is an interdisciplinary study of the nature of human thought; psychological, philosophical, linguistic, & artificial intelligence approaches to knowledge representation.	12 credit hrs from 2 of the following areas: CIS, Linguistics, Philosophy, or Psychology.
	Psych 5614: *Cognitive Neuroscience*	Neuronal mechanisms of information processing	Psych 2313 or 2513 or permission of instructor.
	Psych 5617: *Models of Memory*	Basic principles of neural network modeling & their applications in perception, memory, & language.	Permission of instructor.
	CSE 5526: *Introduction to Neural Networks*	Survey of fundamental methods & techniques of neural networks. Single- and multi-layer perceptrons; radial-basis function networks; support vector machines; recurrent networks; supervised & unsupervised learning.	CSE 3521 or permission of instructor.
	CSE 788.A04: *Brain Theory & Neural Networks*	Neural network theories & computational models of brain functions. Topics include auditory & visual perception, learning, memory organization, & sensorimotor coordination.	Grad standing, any neural network course, or permission of instructor.
	SHS 765: *Neurology of Speech, Language, & Hearing Sciences*	Structure & function of the central & peripheral nervous systems as they relate to speech & hearing.	Grad standing in SHS or permission of instructor.

NEUROSCIENCE MAJOR: REQUIRED HOURS BY SPECIALIZATION		
Molecular/Cellular Specialization Core …… 15 hours Core Prerequisites[1] …… 12 hours Specialization …….. 21 hours Total Minimum Hours Required for Specialization[2] ……..… 48 hours	Systems/Behavioral Specialization Core …… 15 hours Core Prerequisites[1] …… 12 hours Specialization …….. 21 hours Total Minimum Hours Required for Specialization[2]..…… 48 hours	Cognitive/Computational Specialization Core …… 15 hours Core Prerequisites[1] …… 12 hours Specialization …….. 21 hours Total Minimum Hours Required for Specialization[2] …… 48 hours

[1] Core prerequisites: Biology 1113 (4 hours); Math 1150 or 1151.01 (5 hours each); Psychology 1100 (3 hours).
[2] Depending on the set of courses that a student chooses in a declared specialization, additional prerequisite hours may be required.

APPENDIX B

SAMPLE 4-YEAR PLANS FOR THREE TRACKS OF THE NEUROSCIENCE MAJOR

Sample four-year plan B.S. Neuroscience: Molecular/Cellular Specialization					
Year 1					
Autumn		**Spring**			
Psych 1100 (pre-req for Psych 2220)	3	Psych 2220	3		
Chem 1210 (co-req for Bio 1113)	5	NeuroSci 3000	3		
Bio 1113 (pre-req for NS 3000)	4	Bio 1114 (pre-req for BioChem 4511)	4		
GE	3	Chem 1220 (pre-req for BioChem 4511)	5		
Semester Hours	15	Semester Hours	15	Yearly Hours	30
Year 2					
Autumn		**Spring**			
NeuroSci 3050	3	Psych 2513	3		
Chem 2310 (pre-req for BioChem 4511)	5	Psych 2313	3		
GE	3	GE	3		
GE	3	GE	3		
GE	3	GE	3		
Semester Hours	17	Semester Hours	15	Yearly Hours	32
Year 3					
Autumn		**Spring**			
BioChem 4511	3	Research 4998	1		
Research 4998	1	NeuroSci 3010	3		
Psych 2305	3	GE	3		
GE	3	GE	3		
GE	3	GE	3		
		GE	3		
Semester Hours	13	Semester Hours	16	Yearly Hours	29
Year 4					
Autumn		**Spring**			
EEOB 4450	3	Research 4998	1		
Research 4998	1	Psych 4501	3		
MolGen	3	GE	3		
GE	3	Elective	3		
GE	3	Elective	3		
GE	3				
Semester Hours	16	Semester Hours	13	Yearly Hours	29
				Total Hours	120

Sample four-year plan B.S. Neuroscience: Systems/Behavioral Neuroscience					
Year 1					
Autumn		**Spring**			
Psych 1100 (pre-req for Psych 2220)	3	Psych 2220	3		
Chem 1210 (co-req for Bio 1113)	5	NeuroSci 3000	3		
Bio 1113 (pre-req for NS 3000)	4	Bio 1114 (pre-req for EEOB 4550)	3		
GE	3	GE	3		
		GE	3		
Semester Hours	15	Semester Hours	15	Yearly Hours	30
Year 2					
Autumn		**Spring**			
NeuroSci 3050	3	Psych 2513	3		
Psych 2313	3	Psych 4501	3		
GE	3	GE	3		
GE	3	GE	3		
GE	3	GE	3		
Semester Hours	15	Semester Hours	15	Yearly Hours	30
Year 3					
Autumn		**Spring**			
Psych 4644	3	EEOB 4550	3		
Psych 2305	3	Research 4998	1		
Research 4998	1	GE	3		
GE	3	GE	3		
GE	3	GE	3		
GE	3	Elective	3		
Semester Hours	16	Semester Hours	16	Yearly Hours	32
Year 4					
Autumn		**Spring**			
Psych 4623	3	Psych 5600	3		
Research 4998	1	Research 4998	1		
GE	3	Elective	3		
GE	3	Elective	3		
Elective	3	Elective	3		
Elective	3				
Semester Hours	14	Semester Hours	15	Yearly Hours	29
				Total Hours	120

Sample four-year plan B.S. Neuroscience: Cognitive/Computational Specialization					
Year 1					
Autumn		**Spring**			
Psych 1100 (pre-req for Psych 2220)	3	Psych 2220	3		
Chem 1210 (co-req for Bio 1113)	5	NeuroSci 3000	3		
Bio 1113 (pre-req for NS 3000)	4	GE	3		
GE	3	GE	3		
		GE	3		
Semester Hours	15	Semester Hours	15	Yearly Hours	30
Year 2					
Autumn		**Spring**			
NeuroSci 3050	3	CSE 3521 (pre-req for CSE 5526)	3		
Psych 2513	3	Psych 3321 (pre-req for Psych 5608)	3		
Psych 2313	3	GE	3		
GE	3	GE	3		
GE	3	GE	3		
Semester Hours	15	Semester Hours	15	Yearly Hours	30
Year 3					
Autumn		**Spring**			
Psych 5608	3	Psych 5609	3		
CSE 5526	3	Research 4998	1		
GE	3	GE	3		
GE	3	GE	3		
Elective	3	GE	3		
		Elective	3		
Semester Hours	15	Semester Hours	16	Yearly Hours	31
Year 4					
Autumn		**Spring**			
Psych 4501	3	Psych 5614	3		
Psych 5600	3	Research 4998	1		
Research 4998	1	GE	3		
GE	3	Elective	3		
GE	3	Elective	3		
Elective	3				
Semester Hours	16	Semester Hours	13	Yearly Hours	29
				Total Hours	120

APPENDIX C

THE NEUROSCIENCE MAJOR

NEUROSCIENCE-RELATED FACULTY AND AREAS OF EXPERTISE

DEPARTMENT OF PSYCHOLOGY

Bernhardt-Walther, Dr. Dirk	Cognitive Neuroscience
Bruno, Dr. John	Behavioral Neuroscience
Cunningham, Dr. William	Social Neuroscience
Givens, Dr. Bennet	Behavioral Neuroscience
Leuner, Dr. Benedetta	Behavioral Neuroscience
Lindquist, Dr. Derick	Behavioral Neuroscience
Petrov, Dr. Alexander	Cognitive Neuroscience
Prakash, Dr. Ruchika	Clinical Neuroscience
Ratcliff, Dr. Roger	Cognitive Neuroscience
Sederberg, Dr. Per	Cognitive Neuroscience
Wenk, Dr. Gary	Behavioral Neuroscience

NEUROSCIENCE GRADUATE STUDIES PROGRAM (NGSP)

Adeli, Dr. Hojjat	Cognitive & Computational Neuroscience; analysis of EEG data in epilepsy and alzheimers
Anand, Dr. Rene	Neuropharmacology; nAChR's in neurodevelopmental disorders
Askwith, Dr. Candice	Molecular & Cellular NS; function of acid-sensing ion channels (ASIC)
Barth, Dr. Rolf	Neurotrauma, Neurological Disorders, and Gene Therapy; brain tumor therapies
Basso, Dr. Michele	Neurotrauma, Neurological Disorders, and Gene Therapy; mechanisms of regeneration and repair in SCI
Beattie, Dr. Christine	Developmental Neuroscience & Genetics; zebrafish models of spinal muscular atrophy (SMA)
Bernston, Dr. Gary	Behavioral NS; brain mechanisms in social NS
Bishop, Dr. Georgia	Systems NS; synaptic plasticity in cerebellar circuits
Boulant, Dr. Jack	Systems NS; hypothalamic control of body temp and fever
Boyd, Dr. Robert	Neuropharmacology; regulation of nAChR gene expression
Brown, Dr. Anthony	Molecular & Cellular NS; mechanism of slow axonal transport
Bruno, Dr. John	Behavioral NS; animal models of attentional dysfunction and schizophrenia
Buffington, Dr. Charles	Systems NS; lower urinary tract disorders in cats, feline personaility traits
Buford, Dr. John	Systems NS; neural control of movement
Burry, Dr. Richard	Molecular & Cellular NS; signal transduction pathways in development and regeneration of neurons

Chiocca, Dr. Antonio	NeuroOncology; cytotoxic viral therapy for brain tumors
DeVries, Dr. Courtney	Stress and Neuroimmunology; neuroendocrine mechanisms underlying social behavior and stress
During, Dr. Matthew	Neurotrauma, Neurological Disorders, and Gene Therapy; in vivo gene transfer in learning and neurological disease
El-Hodiri, Dr. Heithem	Developmental Neuroscience & Genetics; genetic regulation of early neural development in Xenopus
Enyeart, Dr. John	Systems NS; ion channels that control secretion and gene expression in endocrine cells
Fischer, Dr. Andrew	Molecular & Cellular NS; neural development, regeneration, and survival in the vertebrate retina
Givens, Dr. Bennet	Behavioral NS; neurobiological mechanisms of cognition
Godbout, Dr. Jonathan	Stress and Neuroimmunology; aging, neuroimmunology, and behavior
Gu, Dr. Chen	Molecular & Cellular NS; ion channel trafficking and neurological disease
Gu, Dr. Howard	Neuropharmacology; monoamine transporters in neurological and psychiatric disorders
Hartwick, Dr. Andrew	Systems NS; light sensitivity of melanopsin-containing retinal ganglion cells and the role of these neurons in regulating mammalian circadian rhythms
Henion, Dr. Paul	Developmental Neuroscience & Genetics; molecular regulation of embryonic cell diversification in zebrafish
Herman, Dr. Gail	Developmental Neuroscience & Genetics; mouse models of complex human developmental disorders involving cholesterol biosynthetic genes
Herness, Dr. Scott	Systems NS; signal transduction mechanisms in mammalian taste receptor cells
Hoyt, Dr. Kari	Molecular & Cellular NS; molecular mechanisms underlying loss of neurons in neurodegenerative disease
Jakeman, Dr. Lyn	Neurotrauma, Neurological Disorders, and Gene Therapy; mechanisms of regeneration and repair in SCI

Jontes, Dr. James	Developmental Neuroscience & Genetics; mechanisms involved in synapse and circuit formation in zebrafish
Kaspar, Dr. Brian	Neurotrauma, Neurological Disorders, and Gene Therapy; mechanism(s) of neurodegeneration in Amyotrophic Lateral Sclerosis (ALS)
Kaur, Dr. Balveen	NeuroOncology; brain tumor therapy using cytotoxic "killer" viruses
Knopp, Dr. Michael	Cognitive & Computational NS; advanced imaging methods to assess function in the central and peripheral nervous system; PET/CT & PET/MRI
Kuret, Dr. Jeffrey	Molecular & Cellular NS; mechanisms underlying neurodegenerative disorders such as Alzheimer's disease
Kwon, Dr. Chang-Hyuk	NeuroOncology; mouse genetic models of glioblastoma
Lin, Dr. Chien-Liang	Molecular & Cellular NS; pathogenesis of neurodegenerative diseases - abnormal RNA processing and biology of glutamate transporters
Lovett-Racke, Dr. Amy	Stress and Neuroimmunology; pathophysiology of multiple sclerosis
Mangel, Dr. Stuart	Systems NS; synaptic plasticity and modulation in the retina; circadian rhythmicity
Martin, Dr. Paul	Molecular & Cellular NS; role of glycoyslation in synapse formation and muscular dystrophy
McTigue, Dr. Dana	Neurotrauma, Neurological Disorders, and Gene Therapy; mechanisms of regeneration and repair in SCI
Mykytyn, Dr. Kirk	Molecular & Cellular NS; physiology and pathophysiology of neuronal cilia and ciliary signaling in the mammalian brain
Nakano, Dr. Ichiro	NeuroOncology; signaling pathways regulating survival of brain tumor stem cells and development of novel chemotherapeutic agents
Neff, Dr. Maria (Hadjiconstantinou, Maria)	Neuropharmacology; cellular, molecular and genomic substrate(s) of CNS disorders
Neff, Dr. Norton	Neuropharmacology; Parkinson's disease and aging
Nelson, Dr. Randy	Behavioral NS; behavioral endocrinology and chronobiology in rodents
Nishijima, Dr. Ichiko	Molecular & Cellular NS; molecular genetics of autism and other developmental disorders

Oberdick, Dr. John	Molecular & Cellular NS; development and function of the cerebellum using genetically manipulated mouse models
Obrietan, Dr.Karl	Molecular & Cellular NS;mouse models of epilepsy and Huntingtons, neuronal signaling, circadian clock
Pitt, Dr. David	Neurotrauma, Neurological Disorders, and Gene Therapy; pathogenesis of chronic progression in MS
Quan, Dr. Ning	Stress and Neuroimmunology; pathophysiology of neuroimmune communication
Racke, Dr. Michael	Neurotrauma, Neurological Disorders, and Gene Therapy; animal model experimental autoimmune encephalomyelitis
Rafael-Fortney, Dr. Jill	Molecular & Cellular NS; pathogenesis of neuromuscular diseases, including Duchenne muscular dystrophy
Rotter, Dr. Andrej	Computational Neuroscience and Bioinformatics
Travers, Dr. Joseph	Systems NS; neuroanatomical, neurophysiological and neuropharmacological analysis of oromotor function
Travers, Dr. Susan	Systems NS; central nervous system processing of sensory signals arising from the mouth
Sadee, Dr. Wolfgang	Neuropharmacology; molecular structure and function of G-protein coupled receptors (GPCRs) with focus on opioid muscarinic cholincergic, and dopamine subtypes
Sheridan, Dr. John	Stress and Neuroimmunology; viral pathogenesis, anti-viral immunity and wound healing
Steinmetz, Dr. Joseph	Behavioral NS; psychobiology, neurobiology of learning and memory; clinical neuroscience; focus on cerebellum and hippocampus
Stephens, Dr. Robert	Systems NS; neurobiology of chronic pain syndromes such as fibromyalgia and related algesic disorders with a CNS component; visceral pain
Terman, Dr. David	Computational Neuroscience, Imaging, and Bioinformatics; mathematical and numerical techniques for analyzing neuronal network activity and rhythm
Trapp, Dr. Bruce	Neurotrauma, Neurological Disorders, and Gene Therapy; cellular and molecular biology of myelination, demyelination, and dysmyelination
Vaessin, Dr. Harald	Developmental Neuroscience and Genetics; regulation of cell proliferation and terminal differentiation during neurogenesis in Drosophila

Viapiano, Dr. Mariano	NeuroOncology; extracellular matrix in the central nervous system: organization and functions in neural development and disease
Wallace, Dr. Lane	Neuropharmacology; mechanisms underlying neurodegenerative diseases and drug abuse
Wenk, Dr. Gary	Behavioral NS; animal models of Alzheimer's disease and the impact of chronic brain inflammation upon neurodegenerative diseases
Whitacre, Dr. Caroline	Stress and Neuroimmunology; immune tolerance, CNS autoimmune disease, multiple sclerosis
Wood, Dr. Jackie	Systems NS; neurophysiologic control of mammalian gastrointestinal functions in health and disease states
Xu, Dr. Ronald	Computational Neuroscience, Imaging, and Bioinformatics; medical device design & innovation, biomedical imaging, tissue optics
Yoon, Dr. Sung	Molecular & Cellular NS; signal transduction of apoptosis, mechanisms of RacGTPase/RhoGTPase regulation in vitro and in vivo, spinal cord regeneration
Young, Dr. Anthony	Molecular & Cellular NS; regulation of gene expression in the CNS

PARTICIPANTS FROM OTHER DEPARTMENTS OR PROGRAMS

Davis, Dr. James W.	Computer vision methods; visual perception, human-computer interaction; motion capture; artificial intelligence (Department of Computer Science and Engineering)
Milman, Dr. Lisa	Communication disorders; aphasia treatment; assessment and quantitative modeling of adult language disorders; multilingualism. (Department of Speech and Hearing Science)
Wang, Dr. DeLiang	Computational audition; biologically plausible neural computation for auditory and visual information processing; identification of large networks of coupled neural oscillators and their applications to scene analysis (Department of Computer Science and Engineering)

APPENDIX D

UNDERGRADUATE NEUROSCIENCE MAJORS
INDIANA UNIVERSITY, JOHNS HOPKINS UNIVERSITY, UNIVERSITY OF PITTSBURGH
SUMMARY FROM WEBSITES

	Indiana	JHU	Pitt
Program Title	Program in Neuroscience	Undergraduate Neuroscience Program	Neuroscience Major
Housed in	Dept of Psychological & Brain Sciences in the College of Arts and Sciences	Dept of Psychological & Brain Sciences in the Krieger School of Arts and Sciences	Dept of Neuroscience in the School of Arts and Sciences
Degree(s) Conferred	Bachelor of Science in Neuroscience; Neuroscience Certificate	Bachelor of Arts in Neuroscience	Bachelor of Science in Neuroscience
Advising for the Major	3 advisors in the Dept of Psychological & Brain Sciences.	As soon as students declare their major, they will be assigned a faculty advisor with whom they will discuss their program completion.	Appears to be a single departmental advisor or, perhaps, an advising coordinator.
Minimum Required Hours for the Major		91 semester hours	59 semester hours
Major Requirements	**Introductory courses**: PSY P101 Introductory Psychology I **or** PSY P151 Introduction to Psychology I for Majors **or** PSY P155 Introduction to Psychological and Brain Sciences PSY P326 Behavioral Neuroscience **or** PSY P346 Neuroscience BIOL L112 Introduction to Biology: Biological Mechanisms **or** BIOL H112 Integrated Freshman Learning Experience II CHEM C117 Principles of Chemistry and Biochemistry CHEM C341 Organic Chemistry I Lectures **or** CHEM R340 Survey of Organic Chemistry	**Sequence/Core Coursework (12 credits)**: 080.203 Cognitive Neuroscience 080.305 The Nervous System I 080.306 The Nervous System II 080.250 Neuroscience Lab **Mathematics & Science (49 credits):** 110.106 Calculus I for Biological Sciences (or 110.108) 110.107 Calculus II for Biological Sciences (or 110.109) 030.101 Introductory Chemistry I 030.105 Introductory Chemistry Laboratory I 030.204 Introductory Chemistry II 030.106 Introductory Chemistry Laboratory II 030.205 Introductory Organic Chemistry I 171.101 General Physics I (or 171.103) 171.111 General Physics Laboratory I 171.102 General Physics II (or 171.104) 171.112 General Physics Laboratory II	**Required for the major:** **NROSCI 1000** Introduction to Neuroscience *or* **NROSCI 1003** UHC (University Honors College) **NROSCI 1011** Functional Neuroanatomy **Prerequisite:** NROSCI 1000/1003 **NROSCI 1012** Neurophysiology **Prerequisites:** NROSCI 1000/1003, CHEM 0120, PHYS 0110 & 0111, MATH 0220 **NROSCI 1017** Synaptic Transmission **Prerequisite:** NROSCI 1000/1003 **NROSCI 1800** Neuroscience Writing Practicum 1 *OR* **NROSCI 1962** Thesis Research Writing practicum Two advanced electives to be chosen from: **NROSCI 1020** Homeostasis **NROSCI 1030** Psychiatric Disorders and Brain Function **NROSCI 1032** Functional Organization of the Human Nervous System

CHEM C343 Organic Chemistry I Laboratory
PHYS P201 General Physics for Sci Majors
PHYS P202 General Physics II for Sci Majors

Mathematics courses:
MATH M211 Calculus I **or**
Both MATH M119 Brief Survey of Calculus I **and** MATH M120 Brief Survey of Calculus II

PSY (MATH) K300 Statistical Techniques

Basic non-neuroscience courses: Select three
CSCI A321 Computing Tools for Scientific Research
CHEM C342 Organic Chemistry II Lectures
BIOL L211 Molecular Biology
BIOL L312 Cell Biology
MATH M212 Calculus II
MATH M301 Linear Algebra and Applications
MATH M303 Linear Algebra for Undergraduates

Advanced neuroscience courses: Select four courses
PSY P337 Clinical Neuroscience
PSY P349 Cognitive Neuroscience
PSY P407 Drugs and the Nervous System
PSY P409 Neural Bases of Sensory Function

PSY P410 Development of the Brain and Behavior
PSY P411 Neural Bases of Learning and Memory
PSY P423 Human Neuropsychology
PSY P437 Neurobiology of Addictions
PSY P466 Molecular and Cellular Neurobiology
PSY P457 (any topic with P326 or P346 as a prerequisite) Topics in Psychology
BIOL L410 seminars as appropriate
Any graduate-level neuroscience course (PSY N500, N501).

Laboratory courses: Select one
PSY P426 Laboratory in Behavioral Neuroscience
PSY P433 Laboratory in Neuroimaging Methods
A neuroscience laboratory using one of the following for enrollment:
PSY P493 Supervised Research
PSY P494 Supervised Research II
PSY P499 Honors Thesis Research
BIOL L490 Individual Study

Add'l requirements for pre-med but not required by the major:
030.206 Introductory Organic Chemistry II
030.225 Organic Chemistry Laboratory

Cellular & Molecular Concentration (12 required):
020.305 Biochemistry
020.315 Biochemistry Lab
020.306 Cell Biology
020.315 Cell Biology Lab

Cognitive & Systems (12 required):
Students following a Cognitive or Systems Concentration track must complete either the above Biochemistry/Cell Biology sequence or the following:
020.151 General Biology I
020.153 General Biology Laboratory I
020.152 General Biology II
020.154 General Biology Laboratory II

Advanced Courses (12 credits):
Twelve (12) credits of advanced neuroscience coursework (300 level or above) are required for the major. Nine (9) of the credits must be in the student's chosen area of concentration. Only approved courses will be accepted. A list of applicable advanced level courses will be available two weeks prior to registration.

Research (6 credits):
Six (6) credits of research, obtained through work in one of the neuroscience laboratories participating in the program, are required for completion of the major. Students may take no more than 3 credits per term and no more that 6 credits per academic year.

NROSCI 1034 Neural Basis of Cognition
NROSCI 1035 Control of Movement
NROSCI 1036 Neurobiology of Aging
NROSCI 1040 Biological Bases of Learning and Memory
NROSCI 1041 Developmental Neuroscience
NROSCI 1042 Neurochemical Basis of Behavior
NROSCI 1046 Foundations of Clinical Neurophysiology

Required Capstone options:
NROSCI 1046 Topics in Neuroscience: Pro Seminar **Co-requisite:** NROSCI 1800
NROSCI 1046 Topics in Neuroscience: Foundations of Clinical Neurophysiology + Lab **Co-requisite:** NROSCI 1800
NROSCI 1901 Independent Research (2 terms, 2 credits per term)
NROSCI 1962 Thesis Writing Practicum
Prerequisites: 3 cr each, NROSCI 1901 & NROSCI 1961

Corequisite Courses:
BIOSC 0150, 0160, 0050, and 0060 Foundations of Biology 1 and 2 and labs
BIOSC 1000 Biochemistry

CHEM 0110 and 0120 General Chemistry 1 and 2
CHEM 0310 Organic Chemistry 1
CHEM 0320 Organic Chemistry 2
CHEM 0330 Organic Chemistry Lab 1
CHEM 0340 Organic Chemistry Lab 2
MATH 0220 Analytic Geometry and Calculus 1
NROSCI 1070 UHC Human Physiology **or** 1250 Human Physiology
PHYS 0174 and 0175 Basic Physics for Science and Engineering 1 and 2 **or** 0110 and 0111 Introduction to Physics 1 and 2

(Revised 12/11/09)

	CHEM C409 Chemical Research PHYS S406 Research Project for Physics Majors (Updated 01/10)		

UNDERGRADUATE NEUROSCIENCE MAJORS
UNIVERSITY OF MICHIGAN
SUMMARY FROM WEBSITE

	Michigan	Michigan
Program Title	Neuroscience Concentration (major)	Brain, Behavior, & Cognitive Science [BBCS] Concentration (major)
Housed in	Department of Psychology, and Department of Molecular, Cellular, and Developmental Biology, both in the College of Literature, Science, and the Arts (LSA)	Department of Psychology in the College of Literature, Science, and the Arts (LSA)
Degree(s) Conferred	Bachelor of Science	Bachelor of Science
Advising for the Major	LSA general advising. Concentration (major) advising: Concentration/Minor Advisors are usually faculty or staff members from LSA departments who help students shape and focus their academic goals. They discuss with students how best to progress in a concentration program (or minor) and provide official confirmation to the LSA Auditors when a student has completed it. Concentration Advisors are good resources for providing information about graduate school in their field, and should be able to discuss how the skills acquired in the study of their discipline provide an excellent foundation for the professional world. Students meet with most of these advisors in their departmental offices.	LSA general advising. Concentration (major) advising: Concentration/Minor Advisors are usually faculty or staff members from LSA departments who help students shape and focus their academic goals. They discuss with students how best to progress in a concentration program (or minor) and provide official confirmation to the LSA Auditors when a student has completed it. Concentration Advisors are good resources for providing information about graduate school in their field, and should be able to discuss how the skills acquired in the study of their discipline provide an excellent foundation for the professional world. Students meet with most of these advisors in their departmental offices.
Minimum Required Hours for the Major	60 semester hours	60 semester hours

Major Requirements	**Neuroscience requirements:** ~ minimum of 36 credits is required **~ Core: 4 courses required** All of the following: PSYCH 230: Intro to Biopsychology BIOLOGY 222: From Message to Mind: An Intro to Neurobiology BIOLOGY 305: Genetics 1 of the following: BIOLOGY 310: Intro Biochemistry BIOLOGY 311: Intro Biochemistry BIOLCHEM 415: Intro Biochemistry **~ Electives: 6 courses for a minimum 18 credits** **A. Lecture Courses at 200-300 level.** At least one, and up to two courses from: BIO 225: Principles of Animal Physiology MCDB 307: Developmental Biology PSYCH 240: Intro to Cognitive Psychology PSYCH 345: Intro to Human Neuropsych **B. Advanced lecture and discussion courses in Neuroscience.** At least three courses (and up to five courses). At least one course must be from Group B1 and one course from Group B2. One advanced course from List C may be used toward this requirement. **B1. Cell & Molecular Neuroscience:** MCDB 402: Molecular Biology of Pain & Sensation MCDB 403: Molecular & Cell Biology of the Synapse MCDB 418: Endocrinology MCDB 422: Cellular & Molecular Neurobiology MCDB 426: Molecular Endocrinology **B2. Behavioral Neuroscience:** BIO 541/PSYCH 532: Mammalian Reproductive Endocrinology PSYCH 346: Learning & Memory PSYCH 347: Perception PSYCH 402: Special Problems in Psychology PSYCH 433: Biopsychology of Motivation PSYCH 434: Biopsychology of Learning & Memory PSYCH 435: Biological Rhythms & Behavior PSYCH 436: Drugs of Abuse, Brain & Behavior PSYCH 437: Current Topics in Biopsychology PSYCH 438: Hormones & Behavior PSYCH 531: Advanced Topics in Biopsychology PSYCH 533/NEUROSCI 520: Sleep: Neurobiology, Medicine & Society Additional courses may be approved as advanced neuroscience courses by the concentration advisory panel. **C. Additional Advanced Courses** MCDB 411: Protein Structure & Function MCDB 427: Molecular Biology MCDB 428: Cell Biology	**BBCS requirements:** ~ minimum of 24 credits in post-into courses ~ of overall credit (prerequisites + concentration), 24 must be completed directly thru UMich's Psych Dept in Ann Arbor, letter graded, & 12 of these must at the 300-level or above ~ 3rd course from gateway requirement may be used toward concentration requirements ~ 12 credits in biopsychology or cognitive science, selected from the following list. Psychology 230, 335, 240, or 345 may be used only if they are not also used toward the Gateway Requirement above. PSYCH 230 (330): Intro to Biopsychology PSYCH 232: Evolutionary Bio & Human Disease PSYCH 240 (340): Into to Cog Psych PSYCH 335 : Intro to Animal Behavior PSYCH 338 (437): Primate Social Behavior I PSYCH 344: 2nd Language Acquisition PSYCH 345: Intro to Human Neuropsychology PSYCH 346 (443): Learning & Memory PSYCH 347 (444): Perception PSYCH 348 (447): Psychology of Thinking PSYCH 349: Talking Minds PSYCH 400: Special Problems in Psychology as a Natural Science *1-4 cr* PSYCH 420(507): Faculty Directed Advanced Tutorial Reading for Psychology as a Natural Science *1-6 cr* PSYCH 431: Biopsych of Animal & Human Behavior PSYCH 432: Reproductive Behavior in Mammals PSYCH 433: Biopsych of Motivation PSYCH 434: Biopsych of Learning & Memory PSYCH 435: Bio Rhythms & Behavior PSYCH 436: Drugs of Abuse, Brain & Behavior PSYCH 437: Current Topics in Biopsych PSYCH 438: Hormones & Behavior PSYCH 439: Behavioral Biology of Women PSYCH 445: Psychology of Language PSYCH 446: Human Factors Psychology PSYCH 447: Current Topics in Cognition & Perception PSYCH 448: Mathematical Psychology PSYCH 449(542): Decision Processes PSYCH 530: Advanced Topics in Comparative & Evolutionary Psychology PSYCH 531: Advanced Topics in Biopsychology PSYCH 532: Mammalian Reproductive Endocrinology PSYCH 533: Sleep: Neurobio, Medicine, & Society PSYCH 541: Advanced topics in Cognition & Perception Other (as approved by Faculty Concentration Advisor)

MCDB 435: Intracellular Trafficking
EEB 492: Behavioral Ecology
PSYCH 420: Faculty Directed Advanced Tutorial Reading for Psychology as a Natural Science
PSYCH 447: Current Topics in Cognition & Perception
STATS 350 or 400: Intro to Statistics & Data Analysis or Applied Statistical Methods
STATS 401 or 405: Applied Statistical Methods II or Intro to Statistics
Additional advanced courses may be approved as cognates by the concentration advisory panel.

~ Lab requirement
At least two different courses for a minimum of five credits total from the following categories, with at least one course being a Methods-Based laboratory (Note: Each course must be taken for a minimum of 2 credits each and be completed in a single academic term. Only 3 credits of independent study may count toward the concentration program):
A. Method-Based Laboratory courses:
Choose at least one course from:
PSYCH 231/UC 261: Brain, Learning, & Memory
BIOLOGY 226: Animal Physiology Laboratory
MCDB 306: Intro Genetics Laboratory
MCDB 308: Developmental Biology Laboratory
MCDB 419: Endocrinology Laboratory
MCDB 423: Into to research in Cellular & Mollecular Neurobiology
MCDB 429: Laboratory in Cell & Molecular Biology
B. Research-Based Laboratory Courses
MCDB 300: Undergrad Research
MCDB 400: Advanced Research
PSYCH 326: Faculty Directed Early Research for Psychology as a Natural Science
PSYCH 331/332: Labs in Biopsychology
PSYCH 422: Faculty Directed Advanced Research for Psychology as a Natural Science

~ Quantitative Requirement Cognate
2 courses are required. If Stats 350, 400, 401, or 405 is used in Elective Group C, it cannot be used for a Quantitative Cognate. (While 100-level courses may be used to satisfy this requirement, the credits for 100-level courses may not be used toward the minimum number of credits required for the concentration).

STATS 350: Intro to Statistics & Data Analysis or STATS 400: Applied Statistical Methods.
(Note: STATS 405 cannot be combined with STATS 350 or 400 to fulfill this requirement.)
STATS 401: Applied Statistical Methods or STATS 405: Intro to Statistics
PSYCH 448: Mathematical Psychology
MATH 115: Calculus I or MATH 185

~ Lab Requirement
At least two different courses for a minimum of five credits total from the following list of classes. At least one course must come from the Methods-based lab group. Each course must be taken for a minimum of two credits and be completed in a single academic term. Only one non-departmental course may be elected to satisfy the lab requirement.
Methods-Based Lab Courses
PSYCH 231: Brain, Learning & Memory
PSYCH 303: Research Methods in Psychology
PSYCH 331/332: Labs in Biopsychology
PSYCH 341: Advanced Lab in Cognitive Psychology
PSYCH 342: Lab in Judgment & Decision Making
Biology-based Labs (courses not offered through the Psych Department; also considered Methods-Based labs)
Only one biology-based lab may be used towards the BBC lab requirement.
Biology 226: Animal Physiology Lab
Biology 429: Lab in Cell & Molecular Biology
EEB 493: Lab in Animal Behavior
MCDB 306: Intro Genetics Lab
MCDB 308: Developmental Bio Lab
MCDB 429: Lab in Cell & Molecular Biology
Research-Based Lab Courses
PSYCH 322 (408): Field Practicum in Research Techniques/Natural Science (graded CR/NC) *1-4 cr*
PSYCH 326: Faculty Directed Early Research for Psychology as a Natural Science *1-4 cr*
PSYCH 331/332: Advanced Lab in Biopsychology *4 cr*
PSYCH 422 (505): Faculty Directed Independent Advanced Research/Natural Science *1-6 cr*
PSYCH 424 (510): Senior Honors Research I/Natural Science *2-4 cr*
PSYCH 426 (511): Seniors Honor Research II/Natural Science *2-4 cr*

~ Cognate Course Requirement
One course from the following list (or an approved substitute):
Anthro 467: Human Behavioral Ecology
Anthro 568: Primate Behavioral Ecology & Sociobio
Biology 208: Intro to Embryology
Biology 222: Intro to Neurobiology
Biology 225: Principles of Animal Physiology: Lecture
Biology 305: Genetics
Biology 310 (or 311 or 412): Intro to Biochemistry
Biology 390 : Evolution
Biochemistry 415: Intro to Biochemistry
Chemistry 351: Fundamentals of Biochem
EEB 381: General Ecology
EEB 433: Ornithology
EEB 440: Biology of Fishes
EEB 442: Biology of Insects
EEB 450: Biology of Amphibians & Reptiles

	MATH 116: Calculus II or MATH 186 PHYSICS 125 or 140 or 160: General Physics I PHYSICS 126 or 240 or 260: General Physics II It is recommended that students interested in pursuing advanced training in Cellular and Molecular Neuroscience elect MATH 115 and 116, CHEM 230, PHYSICS 125/126 & 127/128 OR 140/141 & 240/241. Those interested in advanced training in Behavioral Neuroscience should take at least one Statistics course. Students intending to go to graduate school should have at least 2 terms of research experience. Most graduate school-bound students will have 1-2 graded research courses (2-4 credits/each) on record. Students intending to go to graduate school in Neuroscience within a CMB-type program will need research experience as well as 2 terms of Calculus and 2 terms of Physics. Students intending to go to medical school will need to take 2 terms of Physics and CHEM 230.	EEB 451: Biology of Mammals EEB 478: Advanced Ecology EEB 481: Population Dynamics & Ecology EEB 492: Behavioral Ecology EECS 281: Data Structure & Algorithms EECS 492: Intro to Artificial Intelligence Linguistics 315: Intro to Sentence Analysis Linguistics 514: Semantics & Pragmatics Linguistics 555: Intro to Cognitive Grammar MCDB 307: Developmental Biology MCDB 418: Endocrinology MCDB 422: Cellular & Molecular Neurobiology MCDB 425: Systems Neurobiology MCDB 534: Developmental Neurobiology Philosophy 345: Language & Mind Philosophy 450: Philosophy of Cognition Philosophy 482: Philosophy of the Mind Statistics 406: Intro to Statistical Computing

LETTERS OF SUPPORT

FOR

THE PROPOSED NEUROSCIENCE MAJOR

THE OHIO STATE UNIVERSITY

Department of Psychology

225 Psychology Building
1835 Neil Avenue
Columbus, OH 43210

www.psy.ohio-state.edu

November 8, 2010

Dr. Joseph E. Steinmetz, Dean
Colleges of Arts and Sciences
The Ohio State University
186 University Hall
230 North Oval Mall
Columbus, OH 43210

Dear Dr. Steinmetz:

I am writing on behalf of the faculty of the Department of Psychology in strong support of the proposed undergraduate major in *Neuroscience*. As you are aware, the Department has a strong representation of faculty with considerable expertise in behavioral, cognitive, and computational neuroscience. For years now, we have participated, in a major way, in the Neuroscience minor program. Our faculty is committed to continue offering courses that will be of considerable interest (both core and elective courses) to the *Neuroscience Major*. Moreover, we are willing to help provide undergraduate research experiences, in the laboratories of our faculty, for those students who desire them.

In closing, when one surveys the state and national landscapes, it becomes quickly apparent that we are one of the few schools (within our benchmark cohort and within the State of Ohio) not to offer a degree program in Neuroscience. When you consider the popularity of this major and the large number of OSU faculty (in multiple departments and colleges) with expertise in the neurosciences, then you are left to conclude that we are quite overdue for the development of this major. Thus, the Department of Psychology concurs with the need for the *Neuroscience Major* here at The Ohio State University.

Sincerely,

Thomas E. Nygren
Interim Chair
Department of Psychology

Department of Neuroscience

Randy J. Nelson, Ph.D.
Dr. John D. and E. Olive Brumbaugh
Chair in Brain Research and Teaching
Department Of Neuroscience
Professor and Chair
4084 Graves Hall
333 West 10th Avenue
Columbus, OH 43210
Phone: 614-688-8327
Fax: 614-688-8742

25 October 2010

Dr. Joseph E. Steinmetz, Dean
College of Arts and Sciences
The Ohio State University
186 University Hall
230 North Oval Mall
Columbus, OH 43210-1319

Dear Dr. Steinmetz:

I am writing on behalf of the faculty of the Department of Neuroscience in strong support of the proposed undergraduate major in Neuroscience. Our faculty are committed to teaching a number of courses in the major and providing meaningful research experiences to undergraduate who seek them. Thus, we are in concurrence with the need for this major at Ohio State.

Sincerely,

Randy J. Nelson, Brumbaugh Chair in Brain Research and Teaching
Professor and Chair, Department of Neuroscience

Neuroscience Graduate Studies Program

4058 Graves Hall
333 W. 10th Avenue
Columbus, OH 43210
Phone (614) 292-2379
Fax (614) 292-0490

October 27, 2010

Dr. Joseph E. Steinmetz, Dean
College of Arts and Sciences
The Ohio State University
186 University Hall
230 North Oval Mall
Columbus, OH 43210-1319

Dear Joe,

We are writing in very strong support of the proposal for an undergraduate Neuroscience Major at Ohio State. This integrative and interdisciplinary course of study will fill a much needed gap in the current training opportunities for Ohio State undergraduates interested in careers in neuroscience research, and in our opinion, it is long overdue.

As you know the Neuroscience Graduate Studies Program (NGSP) currently has 70+ faculty and almost 40 graduate students engaged in all major subdisciplines of neuroscience research. This is an incredible training resource with fantastic potential for identifying, educating, and harnessing the best undergraduate talent Ohio State has to offer towards the goal of producing the next generation of top neuroscience researchers. At the same time the quality of undergraduates at Ohio State is very high, and the Neuroscience Major will potentially serve as a means to introduce a relatively untapped and well-educated work-force into neuroscience laboratories, as well as provide a potential feeder program for the NGSP and Psychology graduate programs. Many of our faculty members already teach introductory and advanced graduate courses as part of the NGSP core curriculum, ourselves included, and these courses are already incorporated in the proposed curriculum for the major. For example, NeuroSc7001, Foundations of Neuroscience, teaches basic principles of the cellular, molecular and neurophysiological mechanisms of neural development and function, and draws heavily from primary research papers and modern methodologies. Likewise NeuroSc7050, Neurobiology of Disease, instructs students in the molecular, genetic, and environmental bases of neurological and psychiatric disorders, and mechanisms of brain and spinal cord repair after trauma. These and other courses taught by our faculty are certain to attract and engage the best undergraduate minds interested in neuroscience, and our laboratories will be opened for those students interested to go to the next level: hands-on, cutting-edge research in some of the best labs in the country.

Once again we whole-heartedly endorse the proposed Neuroscience Major and will help in any way possible to make it a success.

Sincerely,

Dana McTigue and John Oberdick
Co-Directors, Neuroscience Graduate Studies Program
The Ohio State University

College of Arts and Sciences

186 University Hall

230 N. Oval Mall

John Bruno
Department of Psychology
057 Psychology Building
1835 Neil Ave
CAMPUS

Dear John:

On behalf of the Division of Natural and Mathematical Sciences (NMS) I am pleased to provide my support for an undergraduate neuroscience program at OSU and welcome in particular the interdisciplinary Neuroscience major that you are proposing. I am satisfied that the current version incorporates many of the suggestions as they were conveyed by members of the NMS Disciplinary Advisory Panel, including

- permitting research hours to substitute for one of the two breadth requirements,
- the addition of Statistics 2450 as a data analysis option in the core along with Statistics 2180, statistics for the life sciences, and
- the addition of Biochemistry 4511 and Molecular Genetics 4500 (or Molecular Genetics 5606 for honors students—note that both of these courses are listed in the current proposal under their quarter numbers) as options for the *Molecular/Cellular* and the *Systems/Behavioral* specializations.

This should be a strong program. I give you my best wishes for a successful effort.

Sincerely,

C. David Andereck
Professor of Physics
Associate Dean of Arts and Sciences

Prof. Joseph Steinmetz Executive Dean Arts and Sciences

Dear Dean Steinmetz:

I am writing in support of the new undergraduate interdisciplinary major in Neuroscience, to begin in the fall of 2012, that is being proposed. Neuroscience is an interdisciplinary area that is growing at many levels of analysis including cellular/molecular, systems/behavioral, and cognitive/computational.The last of these is of particular interest to our students and faculty, especially those with interests in artificial intelligence. Hence there are excellent opportunities for interactions and synergies between CSE and the students in the proposed program and we look forward to working closely with them.

If you have any questions or comments, please email me.

Thank you and best wishes.

Sincerely,

Neelam Soundarajan Acting Assoc. Chair, CSE Dept.