ARIZONA BOARD OF REGENTS
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Request to Establish New Academic Program in Arizona

University: University of Arizona

Name of Proposed Academic Program: Neuroscience
Academic Department: Department of Neuroscience, College of Science
Geographic Site: Tucson, Main Campus.
Instructional Modality: In-person
Total Credit Hours: 120 units
Proposed Inception Term: Fall 2024
Brief Program Description: ***Outline of content and skills***. Modern Neuroscience is the interdisciplinary study of the nervous system, from the level of individual genes and proteins that control neural activity to mechanisms that govern complex (human) behavior in health and disease. Earning a degree in Neuroscience will prepare students exceptionally well for advanced training in Medical School and Graduate School in Neuroscience or related fields, careers in the pharmaceutical, biotech, biomedical or other industries, or for other science-related careers such as public policy, science communication, journalism, or patent law. Neuroscience students can expect to gain a strong intellectual foundation and deep understanding of mechanisms underlying brain function through a core curriculum, which spans molecular, genetic, and cellular mechanisms of nervous systems. The core curriculum also requires courses in Biochemistry, Genetics and Genomics, and a programming course. The core curriculum is based on a robust foundation in biology, mathematics, chemistry, and physics. Four emphases (themes) provide students with opportunities to gain specialized expertise in multiple aspects of contemporary neuroscience. Students will gain critical skills in research, critical thinking and communication through coursework addressing experimental techniques and approaches relevant to Neuroscience, including design, analysis, strengths, and limitations, as well as statistical and computational methods for data analysis through related coursework.

To further strengthen research skills, hands-on research opportunities and experiences are offered at levels ranging from molecular neuroscience, cellular neuroscience, systems neuroscience to computational neuroscience and translational neuroscience by taking advantage of the broad and multidisciplinary research expertise of more than 60 neuroscience laboratories campuswide.

Fit into the institutional mission of the University of Arizona
The new major advances pillar 1 of the strategic plan of the University of Arizona, which states: the "UA will build a diverse and high potential student body, providing students with an integrated support ecosystem, the skills and mindsets to lead in the 4th Industrial Revolution Economy, and a degree that launches them to achieve their hopes and dreams."

The new major will address the need for a competitive and stand-alone neuroscience undergraduate program at the University of Arizona. Out of the 15 peer institutions of the University, 12 institutions offer very successful majors in Neuroscience or Neurobiology that are directly comparable to the new proposed major. 2 peer institutions offer a major that is comparable to the currently offered interdisciplinary Neuroscience and Cognitive Science (NSCS) joint major. Only one institution does not offer a neuroscience or related major. In comparison, the University lags most of its peers. The new BS in Neuroscience will rectify this situation.

Existing related or complementary academic programs at the University of Arizona.
At the University of Arizona, the School of Mind, Brain and Behavior (MBB) in the College of Science offers an interdisciplinary B.S. in Neuroscience & Cognitive Science (NSCS). MBB comprises the Department of Neuroscience, the Department of Psychology, and the Department of Speech, Language and Hearing Sciences, as well as the Graduate Interdisciplinary Program (GIDP) in Neuroscience, and the Program and GIDP in Cognitive Science. The core units of MBB collaborate to offer the NSCS program which covers aspect of neuroscience, cognitive science, psychology, philosophy, sociology, and linguistics. The Departments of Psychology and of Speech, Language and Hearing Sciences also offer specialized degree programs while the Department of Neuroscience does not. The Program in Cognitive Science offers a graduate minor in Cognitive Science.

The NSCS major is jointly administered by the Program in Cognitive Science and the Department of Neuroscience. The Head and the Faculty of the Department of Neuroscience will continue to support the existing NSCS major and the neuroscience track in the major. The proposal for the new major in Neuroscience has been shared with the Director of the Cognitive Science program who agrees that the new major is a strong degree and supports the initiative. The proposal is welcomed and supported by the Dean of the College of Science.

The proposed new Neuroscience major differs from the existing NSCS program in several important ways: The NSCS program requires a common core curriculum including a Neuroscience-Cognitive Science gateway course, 2 core courses in Cognitive Science, and 2 core courses in Neuroscience plus a scientific programing course. Students then choose one of two focus areas (tracks): Neuroscience (NS) or Cognitive Science (CS). Each focus requires a focus-specific core curriculum consisting of 2 core courses followed by a series of elective courses in 1 of 7 emphases. The emphases of the NSCS program include Cognition, Computation, Development and Aging, Language and Communication Science, Neurobiology, Philosophy of Mind, and Thematic.

In contrast, the core curriculum of the proposed new major requires 2 colloquia and 6 core courses (20 units) plus 1 optional course. The core courses cover molecular, biochemical, cellular, systems, and genetic aspects of Neuroscience with greater rigor than is currently

possible in the existing NSCS major. This core curriculum differs from the core of the NSCS program, most notably by 2 colloquia designed to retain students and by the courses covering systems neuroscience, biochemistry, and genetics & genomics. In addition, the proposed neuroscience major requires 3 units of lab research/internship, in contrast to the existing NSCS major which requires none.

The proposed major will offer 4 emphases: Emphasis 1: “Neuroscience and Human Health” (absent in NSCS) addresses the growing area of translational and clinical research on neurological, neurodegenerative, and neuropsychiatric disease. It especially prepares students for US Medical School, Graduate School, research careers in academia and industry and Allied Health Professions.

Emphasis 2: “Integrated Neuroscience” reflects the contemporary vertical approach on neuroscience, studying a problem from molecules to cells to neural circuits and networks, and vice versa. It prepares students for Medical School, Graduate School and research careers in academia and industry. This emphasis is similar, but not identical, to the ‘neurobiology’ emphasis of the NSCS major.

Emphasis 3: “Neuroscience, Communication, Public Health and Policy” (absent in NSCS) provides basic insights into public health law, policy making, and journalism. It will prepare students to communicate neuroscience information to the general public and advise policy makers.

Emphasis 4: “Thematic Emphasis”. Neuroscience is a broadly and rapidly advancing field and students can design their own curriculum with a qualified advisor.

The new program will satisfy most requirements for US Medical Schools and Graduate Schools.

The new B.S. in Neuroscience is expected to have only a modest impact on the enrollment and retention of the existing NSCS major. The major reason for this prediction is that the new major is tailored to a different target group, one that expects to gain a detailed knowledge of the molecular, cellular and systems mechanisms underlying nervous system function instead of being interested in a broad focus covering adjacent fields (neuroscience and cognitive science).

Even though the new degree may attract some of the students in the NSCS major, these are likely limited to students in the NSCS neuroscience track.

Given that the college already divides NSCS tuition revenue proportionally based on enrollment in each of the 2 NSCS tracks, the tuition revenue flow to the Program of Cognitive Science is not expected to significantly change with the addition of the new degree.

Learning Outcomes and Assessment Plan:
Define the core concepts and competencies that the program will convey and stipulate how these key learning outcomes will be measured and assessed.

Learning Outcomes

Learning Outcome 1: Demonstrate a well-founded knowledge of cellular and physiological core concepts and principles underlying neuronal communication (**Basic Knowledge**).
Concepts: Cellular and physiological core concepts and principles of neurons include structure and function of axons and dendrites, mechanisms of membrane potential, mechanisms of membrane

excitability by action potentials and synaptic potentials, mechanisms of dendritic integration of synaptic potentials, and mechanisms of synaptic physiology.
Competencies: Students will apply their knowledge to explain the fundamental anatomical and functional organization of neuronal axons and dendrites, to identify neuronal structures, to explain the formation of a membrane potential as a prerequisite of membrane excitability, to calculate membrane potentials by using known ion concentrations, to explain ionic currents underlying action potentials and synaptic potentials, and to predict the consequences of genetic or drug-induced alterations of key components mediating neuronal excitability and synaptic physiology.
Assessment Methods: This outcome will be assessed in a special exam in NROS 307 (direct) and through a student exit survey (indirect).
Measures: Instructor grading of the special exam with the use of rubrics and answer keys, and responses to a student exit survey.
Learning Outcome 2: Demonstrate a comprehensive knowledge of neuroscience across all levels of analysis – molecular, cellular, circuits, systems, and behavior (**Comprehensive Knowledge**).
Concepts: Mechanisms by which proteins are expressed, assembled to mediate common cellular processes (e.g., protein synthesis trafficking, and degradation; signal detection and transduction pathways; organelle assembly and trafficking; cell division, axon growth and pathfinding). Basic organization and functional properties of neural circuits mediating vision, hearing, olfaction, and touch, as well as common behaviors such as eating, emotion, and social interactions.
Competencies: Students will apply their knowledge to explain how proteins mediate cellular processes enabling neuronal function. Students also will be able to draft experiments testing involvement of various molecular pathways in particular cellular processes. Students will be able to explain, compare, and contrast how neuronal circuits detect, process, and transduce sensory information across all modalities, and how neuronal networks enable behaviors such as eating, emotion, and social interactions. Students also will be able to predict the consequences of disease-related genetic or drug-induced alterations in these systems.
Assessment Methods: This outcome will be assessed in special exams in NROS 310 and NROS 3xx (direct) and through a student exit survey (indirect).
Measures: Instructor grading of the special exams with the use of rubrics and answer keys, and responses to a student exit survey.
Learning Outcome 3: Design and execute research experiments, evaluate experimental outcomes quantitatively and statistically, interpret their biological implications, and apply these skills in a guided research project (**Laboratory Skills**).
Concepts: Genetic, molecular, cellular and systems approaches, methodologies, and research practices.
Competencies: Students will demonstrate theoretical and practical laboratory skills common to modern neuroscience laboratories.
Assessment Methods: This outcome will be assessed through a student exit survey (indirect) and through a poster presentation, which is based on the students' individual laboratory work (direct). Students are required to present their independent research projects from a CURE course or independent study/internship at a program-wide poster session.
Measures: Grading committee evaluating performed experimental work based on presented poster using rubrics and answer keys, and responses to a student exit survey.
Learning Outcome 4: Communicate scientific knowledge, ideas, and reasoning objectively, clearly, accurately, logically, concisely, and effectively in written and oral form (**Communication Skills**)
Concepts: Communication of, often complex, neuroscientific information to other scientists and the public in a form that is appropriate for the needs of the audience. Use of terminology and phrasing that comprises accurate and complete information and is consistent with the semantic competency of the audience.

Competencies: Students will demonstrate their ability to communicate complex principles and concepts of neuroscience to others.
Assessment Methods: This outcome will be assessed through a student exit survey (indirect) and through a poster presentation, which is based on the students' individual laboratory work.
Measures: Grading committee evaluating effectiveness of (oral and written) poster presentation using rubrics and answer keys, and responses to a student exit survey.
Learning Outcome 5: Critically evaluate scientific literature, identify open questions and problems, and develop innovative and creative solutions (**Scientific Reasoning and Critical Thinking**).
Concepts: Thinking in a disciplined and evaluative manner: evaluation of information, evidence, arguments, theories, questioning of different and competing perspectives, and challenging the (sometimes hidden) assumptions and inferences that determine what will count as evidence or argument.
Competencies: Students will demonstrate critical thinking skills and scientific reasoning to analyze, interpret, and evaluate research data, and develop follow-up project-based activities.
Assessment Methods: This outcome will be assessed through a student exit survey (indirect) and through a poster presentation, which is based on the students' individual laboratory work.
Measures: Grading committee evaluating scientific reasoning skills poster presentation using rubrics and answer keys (direct), and responses to a student exit survey (indirect).
Learning Outcome 6: Apply ethical and professional standards for the practice of research (**Ethics**).
Concepts: Relevant laws, regulatory & ethical guidelines for basic, animal, and clinical neuroscience research and human subjects' protections.
Competencies: Students will demonstrate an understanding of the ethical standards for the responsible conduct of scientific neuroscience research and its applications.
Assessment Methods: This outcome will be assessed by a (pass/fail) questionnaire (direct) and a student-self assessment in a student exit survey (indirect).
Measures: Grading of questionnaire and student-self assessment using rubrics and answer keys.

Assessment map

	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5	Outcome 6
NROS 19x Neuroscience Colloquium	I	I		I		I
NROS 2xx Contemporary Approaches to Neuroscience	R	R	I	R	I	R
NROS 307 Cellular Neurophysiology	R/A	R		R	R	
NROS 308 Methods in Cellular Neurophysiology			R			
NROS 310 Molecular and Cellular Biology of Neurons	R/M	R/A	R	R		R

NROS 3xx Systems Neuroscience	R/M	R/A	R	R	R	R
NROS 311 Neuroinformatics and Scientific Coding			R			
NROS 3xx Genetics & Genomics in Neuroscience			R		R	R
NROS 3xx Neuroscience Research Experience CURE, NROS 397 Brain Communication Networks VIP-CURE, and Independent Studies (NROS 199, 299, 399, 499)	R/M		R	R	R	R
Program-wide Poster Session (Required)			R/A	R/A	R/A	
Exit Survey & Questionnaire (Required)	A	A	A	A	A	A

I = Introduced; R = Reinforced; A = Assessed; M = Mastered

Program assessment plan

Assessment Measure	Source(s) of Evidence	Data Collection Point(s)
1) Program assessment while students are in the program		
- Learning Outcomes 1-2 (direct)	Exams using rubrics	Annually
- Learning Outcomes 3-5 (direct)	Poster and presenter evaluation using rubrics	Annually
- Learning Outcome 1-6 (indirect)	Exit assessment using rubrics	Annually
2) Program assessment after completion of the major		
Length of time to graduate	Internally generated statistics	Annually
Student program assessment	Senior exit survey	Annually
Job placement statistics	Student/Alumni survey	At graduate and as part of alumni survey

Academic program review (APR)	Reviewer' APR report	Every 7 years

Projected Enrollment for the First Three Years:
Please provide anticipated enrollment numbers for each of the first three years of the proposed program

3-Year Projected Enrollment		
Year 1	Year 2	Year 3
60	120	180

The projected enrollment is guided by 3 data sets: the initial 3-year enrollment in the existing NSCS program, the interest of NSCS students in pursuing Biochemistry (the proposed major requires a Biochemistry course), and a recent survey of undergraduate students in the existing NSCS major and other majors mostly in the College of Science.

Evidence of Market Demand:
Please provide an estimate of the future state-wide and national demand for graduates of the proposed academic program. Please specify the source (e.g. Burning Glass; Jobs EQ; US Department of Labor) of workforce demand data and detail the assumptions that underpin these projections. If job market data is unavailable or not applicable please explain why and elaborate another justification for the proposed program.

Evidence demonstrating demand, interest and need for the proposed Neuroscience major is provided by:
1) a “Burning Glass” market analysis from 2021-22;
2) a Program Development & Review of non-distance offered Neuroscience programs (Program Development & Review; Lightcast Q3 2023 Data Set, August 2023);
3) and a market demand report for Bachelor's degrees in Neuroscience (Program Development & Review; Lightcast Q3 2023 Data Set).

1) “Burning Glass” market analysis from 2021-22 (used in preliminary proposal).

The Burning Glass market analysis reported significant growth of biomedical employment nationwide and in Arizona. For Arizona, it projected significant growth in demand by up to 38% between 2022 and 2028. The largest area of projected growth was predicted for research-oriented careers requiring a bachelor’s degree. The career outcomes mapped to Neuroscience include Laboratory Technician, Medical Scientist, Biological Technician, Research Associate, Laboratory Technologist, Laboratory Manager, Clinical Research Coordinator/Manager, Biologist.

The analysis reported 4,057 job postings in Arizona in the 12 months prior to 2021-22 that were suitable for graduates of the proposed major. In comparison, there were a total of 1,019,379 job postings in Arizona.

2) Nationwide Program Development & Review of non-distance offered Neuroscience programs (Program Development & Review; Lightcast Q3 2023 Data Set, August 2023).

The nationwide analysis of Neuroscience programs reports growth by 305% for Bachelor's degree completions for the period from 2012 to 2021, which is indicating a high demand for a B.S. degree in Neuroscience. The top-5 programs with the largest market share are listed below. 3 of those 5 programs are offered by peer institutions (highlighted).

Institution	Bachelor's Degree Completions (2021)	Growth % YOY (2021)	Market Share (2021)
Binghamton University	258	11.7%	5.4%
University of Wisconsin-Madison	249	9.7%	5.2%
The University of Texas at Austin	241	5.7%	5.0%
Michigan State University	234	7.8%	4.9%
The University of Texas at Dallas	214	10.9%	4.5%

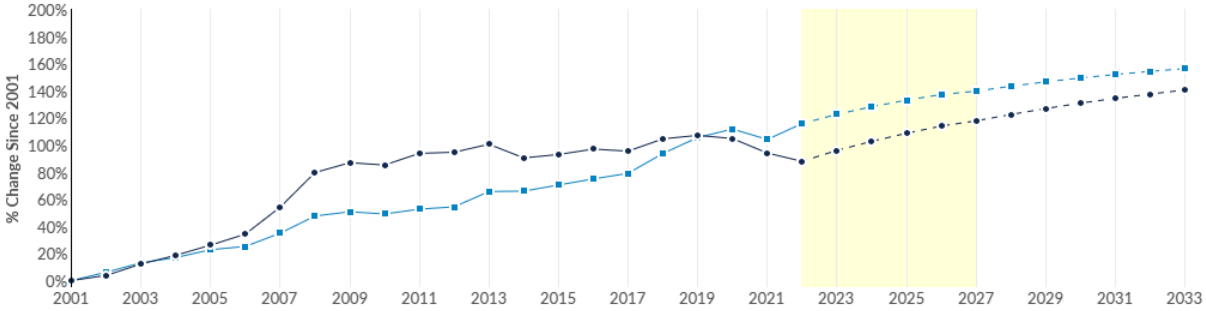
Neuroscience Completions by Institutions (source Lightcast: Q3 2023 Data Set, August 2023)

3) Lightcast market demand report for B.S degrees in Neuroscience from August 2023 (Lightcast Q3 2023 Data Set).

The analysis of the nationwide labor market demand for Neuroscience graduates with a B.S. degree reported a total of 103,399 jobs in 2022 and 93,814 unique job postings from August 2022 to July 2023 (adequate for the proposed major). The analysis reported 902 regional (Arizona) jobs and 1,590 unique job postings for the same period.

The top-10 posted job titles include Medical Laboratory Scientist, Clinical Research Coordinators, Clinical Laboratory Scientists, Clinical Research Associates, Associate Scientists, Clinical Trial Managers, Research Associates, Biologists, Clinical Research Assistants, and Research Coordinators, which is consistent with the career target groups of the proposed major. The regional top-10 posted job titles are similar to the nationwide postings. Notably, San Diego, CA is nationwide the second-largest city labor market (next to Boston), and likely attractive for Arizona neuroscience graduates. In Arizona, the largest city labor market is in Phoenix, AZ.

The analysis predicts a 11.1% nationwide growth in market demand by 2027. Regionally, it predicts a 15.9% growth, which is larger than the nation-wide projection.



Trends in nationwide and regional (Arizona) labor market demand from 2001 to 2033. Dark-blue – regional trend; light-blue nationwide trend (2023-2033 predicted; source Lightcast Q3 2023 Data Set, August 2023).

Similar Programs Offered at Arizona Public Universities:

The only other institution in Arizona that offers an undergraduate degree in Neuroscience is Arizona State University (ASU). ASU started an online major in Neuroscience in 2022 and an on-campus major in 2023.

The ASU neuroscience curriculum and targeted student populations significantly differ from the newly proposed neuroscience program. The ASU Neuroscience B.S. is strongly aligned with Cognitive Science and Psychology and therefore comparable to the existing Neuroscience and Cognitive Science (NSCS) major at the University of Arizona.

Objection(s) Raised by Another Arizona Public University? NO

Has another Arizona public university lodged a written objection to the proposed program with the proposing university and the Board of Regents within seven days of receiving notice of the proposed program?

If Yes, Response to Objections:

Please provide details of how the proposing university has addressed the objection. If the objection remains unresolved, please explain why it is in the best interests of the university system and the state that the Board override it.

New Resources Required? (i.e. faculty and administrative positions; infrastructure, etc.):

In addition to existing resources, the new major will require one advisor (0.25 FTE year 1, 0.5 FTE year 2, 1.0 FTE by year 3) and one program coordinator (1 FTE by year 2). The corresponding costs are estimated to amount to $58,700 for the first year, $110,292 for the second and $147,210 for the third year.

A new career-track faculty member will be desirable by year 2 but not essential since this need may be met through reassignments. The corresponding costs are estimated to amount to $85,000 in year 2 and $88,374 in year 3.

Operations costs are to amount to $5,000 for year 1, $8,000 for year 2, and $10,000 for year 3.

Once the program is fully established, 7 new teaching assistantships will be required to cover 2 new core courses (2), 1 new CURE course (2), and potentially 3 electives assuming these have a high enrollment (3; year 3 and thereafter). The corresponding costs over for the first 3 years is estimated to be $77,502 (year 1), $121,648 (year 2) and $127,358 for year 3.

The existing training lab space of the Department of Neuroscience is expected to accommodate the new CURE course “Neuroscience Research Experience” only during the first year. This arrangement will not impact existing courses. However, as enrollment increases, the CURE course will need a larger training lab space. The required space is available but requires renovation and new lab equipment estimated to amount to $175,000 in year 2.

Costs are expected to be covered by tuition revenue received from enrollments and majors, COS support for the advisor, and potentially adjusted contributions from the planned college fees.

Plan to Request Program Fee/Differentiated Tuition? NO

Estimated Amount:

Program Fee Justification:

If planning to levy a program fee, please justify the estimated amount. Note: The fee setting process requires additional steps, and forms need to be completed. Please work with your university and the ABOR Finance team (Leatta.McLaughlin@azregents.edu) to complete a fee request.
Specialized Accreditation? NO **Accreditor:** The name of the agency or entity from which accreditation will be sought