

Neuroscience (NSCI)

Directors of Undergraduate Studies: Marvin Chun (Psychology), SSS 303, marvin.chun@yale.edu, and To-be-named (MCDB).

Neuroscience Faculty

Professors Amy Arnsten (School of Medicine and Psychology), Tom Brown (Psychology), Ty Cannon (Psychology), John Carlson (MCDB), BJ Casey (Psychology), Marvin Chun (Psychology), Paul Forscher (MCDB), Jutta Joorman (Psychology), Douglas Kankel (MCDB), Haig Keshishian (MCDB), Daeyeol Lee (School of Medicine and Psychology), Linda Mayes (School of Medicine and Psychology), Greg McCarthy (Psychology), Laurie Santos (Psychology), Jane Taylor (School of Medicine and Psychology), Nick Turk-Browne (Psychology), Robert Wyman (MCDB)

Associate Professors Sreeganga Chandra (School of Medicine and MCDB), Thierry Emonet (MCDB), Weimin Zhong (MCDB)

Assistant Professors Damon Clark (MCDB), Arielle Baskin-Sommers (Psychology), Steve Chang (Psychology), Molly Crockett (Psychology), Dylan Gee (Psychology), Avram Holmes (Psychology), Hedy Kober (School of Medicine and Psychology), Ifat Levy (School of Medicine and Psychology)

Lecturers Nelson Donegan (Psychology)

Neuroscience aims to understand how the brain produces the mind and behavior, with the goal of advancing human understanding, improving physical and mental health, and optimizing performance. This entails a broad, interdisciplinary effort that spans molecules to minds. At one end, molecular and cellular biology, chemistry, and physics are improving our understanding of the molecular and cellular mechanisms of neuronal signaling and development. At the other end, psychology, psychiatry, and neurology link neural processes and systems to the mind and behavior. At all levels, the rich array of methods and data analysis depends on a strong foundation in the basic sciences, mathematics, statistics, and computer science.

Requirements of the major The NSCI B.S. and B.A. degrees require a minimum of 18.5 credits, including two neuroscience foundation courses (2), coursework in the biological sciences (2), basic statistics (1), neuroscience methods (1), systems/circuits/behavior electives (2), molecular/cellular/biological electives (2), quantitative core electives (1), systems/circuits/behavior core electives (2), molecular/cellular/biological core electives (2), allied field electives (11), and a senior requirement (2). The B.S. degree requires 2 terms of empirical research for the senior requirement. The B.A. degree senior requirement does not require empirical research. No course may be used to fulfill more than one requirement for the major.

Biological Sciences Prerequisite Two credits in the biological sciences are required. This can be in the form of BIOL 101-104 (or their equivalents). Note that BIOL 101-104 is a prerequisite for many courses in the major.

BIOL 101+102 Biochemistry and Biophysics + Principles of Cell Biology and Membrane Physiology
BIOL 103+104 Genes and Development + Principles of Ecology and Evolutionary Biology

Statistics Prerequisite One course in statistics from the following is required: PSYC 200, STAT 103, or STAT 262.

Neuroscience Foundations One course in PSYC/NSCI and one course in MCDB/NSCI below are required.

PSYC/NSCI 160 The Human Brain or PSYC/NSCI 170 Fundamentals of Neuroscience
MCDB 320 Neurobiology (BIOL101-104 Required; Chemistry and Physics Recommended)

Neuroscience Lab One course from the following is required for .5 or 1 credit.

MCDB320L Neurobiology Lab (.5 credits, with MCDB 320)
PSYC 230L Research Methods in Human Neuroscience
PSYC 23_L Computational Methods in Human Neuroscience
PSYC 260 Research Methods in Behavioral Genetics
PSYC 270 Research Methods in Behavioral Neuroscience

Electives 11 courses required from the following. A minimum of one course must be from the Quantitative Core, two from the Systems/Circuits/Behavior Core, two from the Molecular/Cellular/Biological Core, one from the Basic Allied Core, and one from the Advanced Allied Core.

Quantitative Core (1+)

MATH 112, 115, or 120: Calculus
MATH 222, 225, or 230+231: Linear Algebra
MATH 246 or 247: Differential Equations
AMTH 262: Computational Tools for Data Science
MCDB 261 or MCDB 361 Dynamical Systems
CPSC 202 Mathematical Tools for Computer Science
PHYS 301 Mathematical Methods in Physics
Approved AMTH, MATH, STAT, S&DS, CPSC, and other QR courses

Systems/Circuits/Behavior Core (2+)

PSYC 316 Clinical Neuroscience
PSYC 321 Psychopharmacology
PSYC 376 Learning and memory
PSYC 335 Cognitive Neuroscience

PSYC 3xx Developmental Neuroscience
PSYC 3xx Social Neuroscience
PSYC 411 Systems Neuroscience

Molecular/Cellular/Biological Core (2+)

MCDB200 Molecular Biology
MCDB205 Cell Biology
MCDB210 Development
MCDB300 or MBB300 Biochemistry
MCDB202 Genetics
MCDB310 Physiology
MCDB361 Dynamical Systems in Biology
MCDB370 Biotechnology
MCDB450 The Human Genome
MCDB452 Bioinformatics: ... Simulation and Data Mining
MCDB440 Brain Development and Plasticity
MCDB4xx Cell Biology of the Neuron

Basic Allied STEM (1+)

PHYS 170, 171, 180, 181, 200, 201, 260, or 261: University/Introductory Physics
CHEM161/165/163/167 Freshman Chemistry
CHEM174/175/220/221 Organic Chemistry
Approved CHEM, CPSC, S&DS, MB&B, PHYS, and other SC courses

Advanced Allied (1+; or second Quant Core)

BENG 350 Physiological Systems
BENG 445 Biomedical Image Processing and Analysis
CPSC 100 Introduction to Computing and Programming
CPSC 201 Introduction to Computer Science
CPSC 202 Mathematical Tools for Computer Science
CPSC 223 Data structures
CPSC 323 Systems
CPSC 365 Algorithms
CPSC 475/476 Computational vision
PHYS 420 Thermodynamics and Statistical Mechanics
STAT361 Data analysis

Other Allied

PSYC161 Drugs, Brain, Behavior
PSYC141 The Criminal Mind
Approved PSYC courses
Approved MCDB courses

Senior Requirement In addition to the course requirements described above, all students must satisfy a senior requirement undertaken during the senior year. A booklet listing the senior requirements of the BA or BS degree is available in the office of the director of undergraduate

studies. All students must fill out a checklist of requirements and go over it with the undergraduate registrar, _____, by the spring term of the junior year.

For the B.A. degree, the senior requirement can be met either by submitting a senior essay of fifteen to twenty pages evaluating current research in a field of neuroscience, conducted through a yearlong reading course, NSCI 4xx, one term of which may be fulfilled with a research course, NSCI 4yy. A senior choosing to fulfill the requirement with a senior essay must consult with a faculty adviser on the scope and literature of the topic and submit the adviser's written approval to the director of undergraduate studies no later than the course selection period of the term in which the paper is due. The senior essay may be related to the subject matter of a course, but the essay is a separate departmental requirement in addition to any work done in a course and does not count toward the grade in any course. The senior essay must be completed and submitted to the office of the director of undergraduate studies by the last day of classes. Students electing this option should obtain an approval form from the office of the director of undergraduate studies.

For the B.S. degree, the senior requirement is usually fulfilled by completing a yearlong research course, NSCI 4yy. Alternatively, a student can take two consecutive terms of NSCI 4zz. With permission of the director of undergraduate studies, students taking two terms of NSCI 4zz can begin the project during the spring term of the junior year, continue it over the summer, and complete it during the fall term of the senior year. In all other cases, the senior requirement must be completed during the senior year. Yale College does not grant academic credit for summer research unless the student is enrolled in an independent research course in Yale Summer Session. Seniors working toward the B.S. degree are expected to spend at least ten hours per week in the lab conducting individual research. Research can be conducted over archival or consortium data sets.

Credit/D/Fail No course taken Credit/D/Fail may be counted toward the NSCI major, including prerequisites.

Departmental advisers Schedules for all majors must be discussed with, and approved by, the director of undergraduate studies in NSCI. Only then may a schedule be submitted to the residential college dean's office. For questions concerning credits for courses taken at other institutions or at Yale but outside the Department of Psychology, students should consult with the director of undergraduate studies.

Application to the major Students may apply to start the major at the end of their freshman year. Applications will be reviewed at the end of each term, and must be submitted by the last day of classes of each term at this <link>. Applications must include the application cover sheet, a current transcript, a one-page vita, and a brief application essay (less than 300 words). More information regarding the application process and the cover sheet is available on the program's Web site.

REQUIREMENTS OF THE MAJOR

Prerequisites BIOL 101, 102, 103, 104; STAT 103, STAT 262, or PSYC 200.

Number of courses 18.5 courses for the B.S. or B.A. degree.

Specific courses required PSYC 160 or PSYC 170; MCDB 320

Distribution of courses 1 neuroscience lab course; 1 quantitative core course; 11 electives including at least 2 systems/circuits/behavior core courses, 2 molecular/cellular/biological core courses, 1 basic allied STEM, 1 advanced allied course.

Senior Requirement B.S. – Two course credits in empirical research; B.A. – Two course credits in non-empirical research.

Unofficial Draft of April 6, 2017