NEUROSCIENCE

Directors of undergraduate studies: Damon Clark (MCDB), KBT 224 and Nicholas Turk-Browne (Psychology), SSS 305; neuroscience.dus@yale.edu; neuroscience.yale.edu

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.

PREREQUISITES

The foundational biology courses required of all Neuroscience majors are BIOL 101, 102, 103, and 104. All majors must also complete one of the following S&DS 103, 105, 262, or PSYC 200.

PLACEMENT PROCEDURES

Students must apply to enter the major. Applications are reviewed at the end of each term; decisions are based on a cover letter, transcript, completed Neuroscience major worksheet, and optional resume. More information regarding the application process is available on the program’s website.

REQUIREMENTS OF THE MAJOR

Both the B.S. and B.A. Neuroscience degrees require a minimum of 18.5 credits, including the three prerequisites, 15 lecture or seminar courses, and one laboratory, as follows:

1. Two neuroscience foundation courses, NSCI 160 and NSCI 320.
2. One neuroscience lab chosen from NSCI 321L, 235, 240, 260, 265 (ANTH 148L), NSCI 558.
3. Eleven electives from the following core groupings, with a minimum of two from the Systems/Circuits/Behavior Core, two from the Molecular/Cellular/Biological Core, one from the Quantitative Core, one from the Basic Allied Core, and one from the Advanced Allied Core (or a second course from the Quantitative Core). No more than two credits may be taken from the Other Allied Core.

   Systems/Circuits/Behavior Core: NSCI 340, 341, 346, 352, 355, 360, 442, 445
   Molecular/Cellular/Biological Core: NSCI 324; NSCI 325; NSCI 420; MB&B 300 or MCDB 300; MCDB 200; MCDB 202; MCDB 205; MCDB 210; MCDB 310; MCDB 370; MCDB 450; MCDB 452
   Quantitative Core: MATH 116 (recommended) or 112, 115, 120; MATH 222, 225, or MATH 230, 231; MATH 244; MATH 246 or 247; AMTH 262; NSCI 324 or 325; CPSC 202; PHYS 301
   Basic Allied Core: PHYS 170, 180, 200, or 260; PHYS 171, 181, 201, or 261; CHEM 161 or 163; CHEM 165 or 167; CHEM 174 or 220; CHEM 175 or 221
   Advanced Allied Core: BENG 350; BENG 444 or 485; CPSC 100 or 112; 201, 202, 223, 323, 365, 475 or 476; EENG 200; PHYS 420; S&DS 361

Other Allied Core: NSCI 141, 147, 161; CGSC 110

Credit/D/Fail

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

SENIOR REQUIREMENT

In addition to the course requirements described above, all students must satisfy a senior requirement undertaken during the senior year. More information about the senior requirements of the B.A. and B.S. degree is available on the department website. 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.

B.A. degree program

The B.A. degree requires two course credits in non-empirical research, NSCI 480 and 481; or one credit in non-empirical research, NSCI 480 or NSCI 481, and one credit in empirical research, NSCI 490 or 491. These courses are only open to Neuroscience seniors and they award a letter grade. Under faculty supervision, students are required to conduct a literature review, complete written assignments, and make a presentation. The final research paper is due to the sponsoring faculty member, with a copy submitted to the department, by the stated deadline near the end of the term. Seniors are also required to present their research once in either the fall or the spring term. To register, students must submit a form, and a written plan of study with bibliography, approved by the faculty research adviser and DUS, by the end of the first week of classes. More detailed guidelines and forms can be obtained from the department website.

B.S. degree program

The B.S. degree requires two course credits of empirical research, NSCI 490 and 491. These courses are only available to Neuroscience seniors (and second term juniors with DUS permission), and they award a letter grade. Students are expected
to spend at least ten hours per week in the laboratory, to complete written assignments, and to make a presentation. Research can be conducted over original, archival, or consortium data sets. Written assignments include a short research proposal summary due at the beginning of the term, and a full research report due at the end of the term. Students are encouraged to pursue the same research project for two terms, in which case, the first term full research report and the second term proposal summary may be combined into a full research proposal due at the end of the first term. Final papers are due by the stated deadline near the end of the term. Seniors are also required to present their research once in either the fall or the spring term. Students should line up a research laboratory during the term preceding the research. Yale College does not grant academic credit for summer research unless the student is enrolled in an independent research course in Yale Summer Session. To register for NSCI 490 and 491, students must submit a form, and a written plan of study with bibliography, approved by the faculty research adviser and DUS, by the end of the first week of classes. More detailed guidelines and forms can be obtained from the department website.

ADVISING

Departmental advisers  Schedules for all majors must be discussed with, and approved by, one of the directors of undergraduate studies. 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 courses not listed in the this bulletin, students should consult with one of the directors of undergraduate studies.

REQUIREMENTS OF THE MAJOR

Prerequisites  BIOL 101, 102, 103, 104; and one of S&DS 103, 105, 262, or PSYC 200
Number of courses  18.5 courses (incl prereqs and senior req)
Specific courses required  2 neuroscience foundation courses, NSCI 160 and NSCI 320
Distribution of courses  B.A. or B.S. — 1 lab course; 11 electives including at least 2 systems/circuits/behavior core courses, 2 molecular/cellular/biological core courses, 1 quantitative core course, 1 basic allied core course, 1 adv allied core course, and more than 2 other allied core courses
Senior requirement  B.A. – 2 courses in non-empirical research; or 1 course in empirical research and 1 course in non-empirical research; B.S. – 2 courses in empirical research

FACULTY OF THE NEUROSCIENCE MAJOR

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

Associate Professors  †Sreeganga Chandra (School of Medicine, Molecular, Cellular, and Developmental Biology), Thierry Emonet (Molecular, Cellular, and Developmental Biology), Weimin Zhong (Molecular, Cellular, and Developmental Biology)

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

Lecturer  Nelson Donegan (Psychology)

†A joint appointment with primary affiliation in another department or school.

Courses

NSCI 147a / PSYC 147a, Animal Models of Clinical Disorders  Nelson Donegan
An interdisciplinary approach to understanding and treating psychiatric disorders, integrating clinical psychology, psychiatry, and advances in basic neuroscience. Focus on how research with animal models can advance our understanding of psychiatric disorders and generate more effective treatments for patients. Topics include drug addiction, depression, Parkinson’s disease, and schizophrenia. sc, so

NSCI 160a / PSYC 160a, The Human Brain  Gregory McCarthy
Introduction to the neural bases of human psychological function, including social, cognitive, and affective processing. Preparation for more advanced courses in cognitive and social neuroscience. Topics include memory, reward processing, neuroeconomics, individual differences, emotion, social inferences, and clinical disorders. Neuroanatomy, neurophysiology, and neuropharmacology are also introduced. sc

NSCI 161b / PSYC 161b, Drugs, Brain, and Behavior  Hedy Kober
Psychoactive drugs and their effects on both brain and behavior. Pharmacological and brain mechanisms of different classes of legal, illegal, and medicinal drugs, including alcohol, caffeine, tobacco, stimulants, depressants, antidepressants, and hallucinogens. Individual
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<th>Course Code</th>
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<tr>
<td>NSCI 235a or b / PSYC 270a or b</td>
<td>Research Methods in Behavioral Neuroscience</td>
<td>Nelson Donegan</td>
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<tr>
<td>NSCI 240b / PSYC 330b</td>
<td>Research Methods in Human Neuroscience</td>
<td>Gregory McCarthy</td>
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<td>NSCI 265a / ANTH 148La / PSYC 248a</td>
<td>Hormones and Behavior</td>
<td>Claudia Valeggia and Eduardo Fernandez-Duque</td>
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<td>NSCI 320a / MCDB 320a</td>
<td>Neurobiology</td>
<td>Haig Keshishian and Paul Forscher</td>
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<td>NSCI 321La / MCDB 321La</td>
<td>Laboratory for Neurobiology</td>
<td>Haig Keshishian, Robert Wyman, and Fernando Vonhoff</td>
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<td>NSCI 324a / MB&amp;B 330a / MCDB 330a</td>
<td>Introduction to Dynamical Systems in Biology</td>
<td>Thierry Emonet and Kathryn Miller-Jensen</td>
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<td>NSCI 325b / BENG 465b / MB&amp;B 361b / MCDB 361b</td>
<td>Dynamical Systems in Biology</td>
<td>Damon Clark, Thierry Emonet, and Jonathan Howard</td>
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<td>NSCI 340a / PSYC 335a</td>
<td>Cognitive Neuroscience</td>
<td>Staff</td>
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<td>NSCI 341a / PSYC 376a</td>
<td>Learning and Memory</td>
<td>Thomas Brown</td>
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<td>NSCI 346b / PSYC 332b</td>
<td>Psychopharmacology</td>
<td>Thomas Brown</td>
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<td>NSCI 352b / CGSC 352b / PSYC 332b</td>
<td>Arrested or Adaptive Development in the Adolescent Brain</td>
<td>BJ Casey</td>
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NSCI 355b / PSYC 303b, Social Neuroscience  摩莉·克罗克特
探索心理和神经机制，使我们能够形成、维持和解散社会关系。 topics include the neuroscience of how we form impressions and decide whether to instigate relationships with others; how we build relationships through trust, cooperation, attachment, conflict, and reconciliation; and group-level processes including intergroup bias, moral judgment, and decision making. Prerequisite: PSYC 110 or permission of instructor.  SC

* NSCI 442a / PSYC 428a, Neuroscience of Decision-Making  摩莉·克罗克特
概览并检查决策的神经科学。跨学科课程强调来自认知神经科学、心理学、行为经济学、金融、市场营销、计算机科学和公共卫生的研究。主题包括效用和价值、 reinforcement learning, risky decision making, impulsivity and self control, social decision making, psychopathology, and commercial applications (e.g., neuromarketing and neurofinance). Permission of the instructor.  SC

* NSCI 470a and NSCI 471b, Independent Research  达蒙·克拉克和尼古拉斯·图尔克·布朗
在导师的监督下进行的研究项目不计入专业，但计入毕业要求。学生预计每周在实验室工作大约十小时。需要提交一份研究报告和/或演示，需要在课程结束前完成。学生在学期中途重新申请。要注册，学生必须提交一份计划和研究计划，包括文献，由导师和DUS批准，由课程开始前的第二周。更多的指南和信息可以从http://neuroscience.yale.edu获得。

* NSCI 480a and NSCI 481b, Senior Non-empirical Research  达蒙·克拉克和尼古拉斯·图尔克·布朗
在导师的监督下进行的研究项目不计入专业，但计入毕业要求。学生预计每周在实验室工作至少十小时，完成书面作业，进行研究演示。一次在秋或春学期。学生被鼓励从事同一研究项目。最终研究论文应在课程结束前的第二周。更多的指南和信息可以从http://neuroscience.yale.edu获得。

* NSCI 490a and NSCI 491b, Senior Empirical Research  达蒙·克拉克和尼古拉斯·图尔克·布朗
在导师的监督下进行的实验室或独立的实验研究项目不计入专业，但计入毕业要求。学生预计每周在实验室工作至少十小时，完成书面作业，进行研究演示。一次在秋或春学期。学生被鼓励从事同一研究项目。最终研究论文应在课程结束前的第二周。更多的指南和信息可以从http://neuroscience.yale.edu获得。