NEURAL SCIENCE (BS)

CIP: 26.1501

Program Description

Neural science (NS) is a collection of disciplines unified by a concern for the function of the brain. Experimental approaches in neural science vary from analyses of molecular and cellular mechanisms in nerve cells and groups of nerve cells to behavioral and psychological studies of whole organisms. Theoretical tools include mathematical and computational modeling approaches that have proved useful in other areas of science. We attract students who are interested in understanding the brain's command of all its diverse functions including but not limited to the following questions: How do cell circuits enable us to perceive, communicate, and solve problems? How do we think, remember, despair, or motivate? What are possible causes of devastating disorders of the brain and body, as well as ways to prevent or cure them?

The NS major studies the brain and its impact on behavior and cognitive functions, the understanding of which is regarded as the Holy Grail of the current century. Increasing understanding of the brain will enable scientists to develop treatments for neurodegenerative diseases (such as Parkinson's disease & Alzheimer's disease) and mental illnesses. NS research will also help us find out more about normal human behavior and mental wellbeing, and can thus help develop artificial intelligence as well as treating illnesses. NS research could also lead to better understanding of how we learn, allowing us to optimize our intelligence. These developments are likely to provide significant benefits for society and have implications for a diverse range of public policy areas such as health, education, law, and security.

The undergraduate NS curriculum blends courses from many of the basic sciences (such as mathematics, biology, physics, & chemistry) as a foundation for higher level work in NS. NS major requirement contains 6 required courses including one capstone course and 2 elective courses. In addition, students who demonstrate a genuine interest in research and achieve a cumulative grade point average of 3.65 or higher in all courses required for the major and over all courses taken for credit can apply to be on Honors Track.

Admissions

New York University’s Office of Undergraduate Admissions supports the application process for all undergraduate programs at NYU. For additional information about undergraduate admissions, including application requirements, see How to Apply (https://www.nyu.edu/admissions/undergraduate-admissions/how-to-apply.html).

Program Requirements

Course Title Credits

Core Courses

Social and Cultural Foundations

CCSF-SHU 101L Global Perspectives on Society 4

Interdisciplinary Perspectives on China (Two Courses) 8

Writing

WRIT-SHU 102 Writing as Inquiry 4

WRIT-SHU 201 Perspectives on the Humanities 4

Language 1

Language Courses 8-16

Mathematics

MATH-SHU 131 Calculus 4

Algorithmic Thinking

Algorithmic Thinking Course 4

Science

Experimental Discovery in the Natural World Requirement Fulfilled by Major Coursework

Science, Technology, and Society Requirement Fulfilled by Major Coursework

Major Requirements

Foundational Courses 2

Biol-SHU 21 Foundations of Biology I 3

Biol-SHU 22 Foundations of Biology II 3

Biol-SHU 123 Foundations of Biology Lab 2

Chem-SHU 125 Foundations of Chemistry I 3

Chem-SHU 126 Foundations of Chemistry II 3

Chem-SHU 127 Foundations of Chemistry I Lab or Chem-SHU 128 2

Phys-SHU 11 General Physics I 3

or Phys-SHU 91 Foundations of Physics I Honors

Phys-SHU 12 General Physics II 3

or Phys-SHU 93 Foundations of Physics II Honors

Phys-SHU 71 Foundations of Physics Lab I 2

Phys-SHU 94 Foundations of Physics Lab II 2

Required Major Courses

Neur-SHU 100 Math Tools for Life Sciences 4

Neur-SHU 201 Introduction to Neural Science 4

Neur-SHU 251 Behavioral and Integrative Neuroscience 4

Neur-SHU 210 Cellular and Molecular Neuroscience 4

Upper-level Elective

Select one approved upper-level Psychology or Biology course: 4

Psych-UA 29 Cognition

Psych-UA 44 Lab in Perception

Psych-UA 46 Lab in Cognition and Perception

Psych-UA 60 Illusions to Inference

Biol-SHU 30 Genetics

Biol-SHU 263 Developmental Biology

Chem-SHU 881 Biochemistry I

Chem-SHU 882 Biochemistry II

Biol-UA 25 Physiology

Biol-GA 1501 Math in Medicine/Biology

Biol-GA 1502 Computers in Medicine & Biology

Neur-SHU 222 Perception

Neur-SHU 131 Neural Bases of Speech and Language

Major Capstone Course 4

Complete 4-8 credits of: 4-8
Students who did not attend a Chinese-medium high school fulfill the Core language requirement by demonstrating proficiency of the Chinese language through the Intermediate level. Chinese speakers who did not attend an English-medium high school fulfill the Core language requirement through completion of EAP-SHU 100 English for Academic Purposes I and EAP-SHU 101 English for Academic Purposes II. Additional information can be found on the NYU Shanghai Core Curriculum page (https://bulletins.nyu.edu/undergraduate/shanghai/core-curriculum/#text).

Relationship between General Physics and Foundations of Physics Honors: General Physics I & II is a calculus-based course for pre-meds, engineers, and others who want a broad introduction and survey of basic physics including classical mechanics, electricity and magnetism, optics and waves, and thermal and statistical physics. Foundations of Physics I-IV Honors covers a similar set of topics in considerably greater depth, plus special relativity and an introduction to quantum mechanics, over four semesters. Please note that Foundations of Physics I & II Honors alone do not include some important topics, such as optics, thermal and statistical physics, which are included in Foundations of Physics III Honors, and introduction to mechanics and condensed matter physics in Foundations of Physics IV Honors. Therefore, students electing to take the Honors Physics track are highly recommended to take Foundations of Physics III Honors and Foundations of Physics IV Honors as well. Students with a strong high-school background in physics and mathematics are also highly recommended to take Foundations of Physics Honors I-IV.

NEUR-SHU 997/998 Independent Study I & II - Neural Science Capstone

Major Electives

Select two of the following: 8

MATH-SHU 160 Networks and Dynamics

NEUR-SHU 261 Neurobiology of Decision Making

NEUR-SHU 131 Neural Bases of Speech and Language

NEUR-SHU 270 Introduction to Theoretical Neuroscience

NEUR-SHU 301 Action and Cognition

NEUR-SHU 130 Introduction to Linguistics: The Science of Human Language

NEUR-SHU 132 Meaning

CCEX-SHU 122 Perception and the Brain

NEURL-UA 302 Special Topics in Neural Science

NEURL-UA 305 Development and Dysfunction of the Nervous System

Other Elective Credits 5 24-34

Total Credits 128

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2 1) NS majors are encouraged to complete the above classes in their first 2 years. 2) Relationship between General Physics and Foundations of Physics Honors: General Physics I & II is a calculus-based course for pre-meds, engineers, and others who want a broad introduction and survey of basic physics including classical mechanics, electricity and magnetism, optics and waves, and thermal and statistical physics. Foundations of Physics I-IV Honors covers a similar set of topics in considerably greater depth, plus special relativity and an introduction to quantum mechanics, over four semesters.

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4 NEUR-SHU 997/998 Independent Study in Neural Science (can be repeated once): Open to senior neural science majors. Prerequisite: All Neural Science Major Required Courses (Introduction to Neural Science, Cellular and Molecular Neuroscience, Behavioral and Integrative Neuroscience, Math Tools for Behavioral Science), permission of a Neural Science faculty member (at NYU-Shanghai, NYU-Abu Dhabi, or NYU-New York) who will act as a sponsor and mentor.

Independent Study must have a combined total of at least 4 credits but no more than 8 credits to fulfill the major capstone course requirement. The 4-credit requirement can be fulfilled in 1 semester with a 4-credit load or over 2 semesters with a 2-credit load in each semester.

5 Students may take any courses in the NYU system to meet the general elective requirements. They are strongly encouraged (but not required) to take Introduction to Programming and choose from the following listed courses to develop research skills.

General Electives

Recommended Computer Science General Electives

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CSCI-SHU 101</td>
<td>Introduction to Computer and Data Science</td>
<td>4</td>
</tr>
<tr>
<td>CSCI-SHU 220</td>
<td>Algorithms</td>
<td>4</td>
</tr>
<tr>
<td>CSCI-SHU 360</td>
<td>Machine Learning</td>
<td>4</td>
</tr>
<tr>
<td>EENG-SHU 251</td>
<td>Circuits</td>
<td>4</td>
</tr>
</tbody>
</table>

Recommended Mathematics General Electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH-SHU 140</td>
<td>Linear Algebra</td>
<td>4</td>
</tr>
<tr>
<td>MATH-SHU 151</td>
<td>Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH-SHU 235</td>
<td>Probability and Statistics</td>
<td>4</td>
</tr>
<tr>
<td>MATH-SHU 238</td>
<td>Honors Theory of Probability</td>
<td>4</td>
</tr>
<tr>
<td>MATH-SHU 263</td>
<td>Partial Differential Equations</td>
<td>4</td>
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</tbody>
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Sample Plan of Study

Sample Plan 1

This is just one example of how a student could organize their courses if pursuing a NS major. It assumes a student begins taking NS major courses in the first semester of their first year. Sample Schedule 2 offers an alternate plan that involves beginning to pursue a NS major in the spring semester of the first year. Students may propose alternative schedules to their advisors as well.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CCSI-SHU 101L</td>
<td>Global Perspectives on Society</td>
<td>4</td>
</tr>
<tr>
<td>MATH-SHU 131</td>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td>PHYS-SHU 11</td>
<td>General Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS-SHU 91</td>
<td>General Physics I Honors</td>
<td>3</td>
</tr>
<tr>
<td>CHEM-SHU 125</td>
<td>Foundations of Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS-SHU 71</td>
<td>Foundations of Physics Lab I</td>
<td>2</td>
</tr>
<tr>
<td>Chinese or EAP</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
### Learning Outcomes

Upon completion of this program, students will:

1. Demonstrate basic understanding of core findings from across the discipline of neuroscience, including the areas of molecular and cellular neuroscience, neural circuits and systems, & cognitive and behavioral neuroscience.

2. Use the knowledge in neuroscience to critically evaluate neuroscience research.

3. Apply theories, concepts, and research findings to solving problems in novel situations.

4. Demonstrate ability to design/evaluate methods of experiments to test research hypotheses, implement research designs, and be able to conduct relevant statistical tests to analyze data.
5. Write a clear individual/group research report of a neuroscience study including synthesis of relevant material, derivation of hypotheses, report of appropriate statistical tests, and discussion of theoretical and practical implications of the research.

**Policies**

**Prerequisite Courses for Declaring a Major**
Final grade of C/ current semester midterm grade of B or higher in Foundations of Biology I.

**Global Network Courses**
Requirements may be met through taking equivalent courses in the Global Network with the prior approval from the Director of Undergraduate Studies (DUS) for Neural Science.

**Neural Science and Biology Double Major Guidelines**
Students can not double major in Neural Science and Biology.

**Neural Science and Data Science Double Major Guidelines**
Students who are interested in pursuing a Data Science major along with a Business major, an Economics major, a Mathematics major, a Neural Science major or a Social Science major have the option to double-count more than two courses between the majors. To complete both majors successfully, students would need to complete the course requirements for both majors. However, the following courses are allowed to be double-counted toward both majors:

**Neural Science and Data Science (Concentration in Genomics)**
- MATH-SHU 140 Linear Algebra
- MATH-SHU 235 Probability and Statistics
- BIOL-SHU 21 Foundations of Biology I
- BIOL-SHU 22 Foundations of Biology II
- BIOL-SHU 123 Foundations of Biology Lab

*Students who take Linear Algebra and Probability and Statistics are not allowed to take NEUR-SHU 100 Math Tools for Life Science course. If you have not decided yet to pursue a double major and take NEUR-SHU 100 Math Tools for Life Science first, you are required to take Linear Algebra and Probability and Statistics.*

**NYU Policies**
University-wide policies can be found on the New York University Policy pages (https://bulletins.nyu.edu/nyu/policies/).

**NYU Shanghai Policies**
Additional academic policies can be found on the NYU Shanghai Academic Policies page (https://bulletins.nyu.edu/undergraduate/shanghai/academic-policies/).