

# 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
<b>Core Courses</b>		
<i>Social and Cultural Foundations</i>		
CCSF-SHU 101L	Global Perspectives on Society	4
Interdisciplinary Perspectives on China (Two Courses)		8
<i>Writing</i>		
WRIT-SHU 102	Writing as Inquiry	4
WRIT-SHU 201	Perspectives on the Humanities	4
<i>Language</i> <sup>1</sup>		

Language Courses		8-16
<i>Mathematics</i>		
MATH-SHU 131	Calculus	4
<i>Algorithmic Thinking</i>		
Algorithmic Thinking Course		4
<i>Science</i>		
Experimental Discovery in the Natural World Requirement Fulfilled by Major Coursework		
Science, Technology, and Society Requirement Fulfilled by Major Coursework		
<b>Major Requirements</b>		
<i>Foundational Courses</i> <sup>2</sup>		
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	2
or CHEM-SHU 128	Foundations of Chemistry II Lab	
PHYS-SHU 11	General Physics I <sup>3</sup>	3
or PHYS-SHU 91	Foundations of Physics I Honors	
PHYS-SHU 12	General Physics II <sup>3</sup>	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
<i>Required Major Courses</i>		
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
<i>Upper-level Elective</i>		
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	
<i>Major Capstone Course</i> <sup>4</sup>		
Complete 4-8 credits of:		4-8

NEUR-SHU 997	Independent Study I - Neural Science Capstone
NEUR-SHU 998	Independent Study II - Neural Science
Major Electives	
Select two of the following:	
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 <sup>5</sup>	24-34
Total Credits	128

<sup>1</sup> 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>).

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> 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 courses listed in the "Recommended General Electives" list below.

General Electives

General Elective courses to meet 128 credit requirements. 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.

Course	Title	Credits
Recommended Computer Science General Electives		
CSCI-SHU 101	Introduction to Computer and Data Science	4
CSCI-SHU 220	Algorithms	4
CSCI-SHU 360	Machine Learning	4
EENG-SHU 251	Circuits	4
Recommended Mathematics General Electives		
MATH-SHU 140	Linear Algebra	4
MATH-SHU 151	Multivariable Calculus	4
MATH-SHU 235	Probability and Statistics	4
MATH-SHU 238	Honors Theory of Probability	4
MATH-SHU 263	Partial Differential Equations	4

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.*

Course	Title	Credits
1st Semester/Term		
CCSF-SHU 101L	Global Perspectives on Society	4
MATH-SHU 131	Calculus	4
PHYS-SHU 11 or PHYS-SHU 91	General Physics I or Foundations of Physics I Honors	3
CHEM-SHU 125	Foundations of Chemistry I	3
PHYS-SHU 71	Foundations of Physics Lab I	2
Chinese or EAP		2
Credits		18

<b>2nd Semester/Term</b>		
WRIT-SHU 102	Writing as Inquiry	4
Core or Neural Science Elective		4
BIOL-SHU 21	Foundations of Biology I	3
CHEM-SHU 126	Foundations of Chemistry II	3
CHEM-SHU 128	Foundations of Chemistry II Lab	2
Chinese or EAP		2
<b>Credits</b>		<b>18</b>
<b>3rd Semester/Term</b>		
WRIT-SHU 201	Perspectives on the Humanities	4
NEUR-SHU 201	Introduction to Neural Science	4
NEUR-SHU 100	Math Tools for Life Sciences	4
BIOL-SHU 22	Foundations of Biology II	3
BIOL-SHU 123	Foundations of Biology Lab	2
<b>Credits</b>		<b>17</b>
<b>4th Semester/Term</b>		
NEUR-SHU 251	Behavioral and Integrative Neuroscience	4
NEUR-SHU 210	Cellular and Molecular Neuroscience	4
PHYS-SHU 12 or PHYS-SHU 93	General Physics II or Foundations of Physics II Honors	3
PHYS-SHU 94	Foundations of Physics Lab II	2
NS elective, Core, Chinese or EAP, or General Elective		4
<b>Credits</b>		<b>17</b>
<b>5th Semester/Term</b>		
Neural Science Elective		4
Neural Science Elective		4
General Elective		4
Chinese or General Elective		4
<b>Credits</b>		<b>16</b>
<b>6th Semester/Term</b>		
Approved upper-level course in either Psychology or Biology		4
Neural Science Elective		4
General Elective		4
Chinese or General Elective		4
<b>Credits</b>		<b>16</b>
<b>7th Semester/Term</b>		
General Elective		4
Major Capstone or General Elective		4
General Elective		4
General Elective		2
<b>Credits</b>		<b>14</b>
<b>8th Semester/Term</b>		
Major Capstone or General Elective		4
General Elective		4
General Elective		4
<b>Credits</b>		<b>12</b>
<b>Total Credits</b>		<b>128</b>

## Sample Plan 2

Course	Title	Credits
<b>1st Semester/Term</b>		
CCSF-SHU 101L	Global Perspectives on Society	4
MATH-SHU 131	Calculus	4
Core Cloass		4
Chinese or EAP or General Elective		4
<b>Credits</b>		<b>16</b>
<b>2nd Semester/Term</b>		
WRIT-SHU 102	Writing as Inquiry	4
Core Class		4
BIOL-SHU 21	Foundations of Biology I	3

Chinese or EAP or General Elective		4
<b>Credits</b>		<b>15</b>
<b>3rd Semester/Term</b>		
WRIT-SHU 201	Perspectives on the Humanities	4
NEUR-SHU 201	Introduction to Neural Science	4
NEUR-SHU 100	Math Tools for Life Sciences	4
BIOL-SHU 22	Foundations of Biology II	3
CHEM-SHU 125	Foundations of Chemistry I	3
<b>Credits</b>		<b>18</b>
<b>4th Semester/Term</b>		
NEUR-SHU 251	Behavioral and Integrative Neuroscience	4
NEUR-SHU 210	Cellular and Molecular Neuroscience	4
CHEM-SHU 126	Foundations of Chemistry II	3
CHEM-SHU 128	Foundations of Chemistry II Lab	2
Chinese or General Elective		4
<b>Credits</b>		<b>17</b>
<b>5th Semester/Term</b>		
Neural Science Elective		4
Neural Science Elective		4
General Elective		4
Chinese or General Elective		4
<b>Credits</b>		<b>16</b>
<b>6th Semester/Term</b>		
BIOL-SHU 123	Foundations of Biology Lab	2
Neural Science Elective		4
General Elective		4
Chinese or General Elective		4
<b>Credits</b>		<b>14</b>
<b>7th Semester/Term</b>		
PHYS-SHU 11 or PHYS-SHU 91	General Physics I or Foundations of Physics I Honors	3
PHYS-SHU 71	Foundations of Physics Lab I	2
Major Capstone or General Elective		4
General Elective		4
General Elective		4
<b>Credits</b>		<b>17</b>
<b>8th Semester/Term</b>		
PHYS-SHU 12 or PHYS-SHU 93	General Physics II or Foundations of Physics II Honors	3
PHYS-SHU 94	Foundations of Physics Lab II	2
Major Capstone or General Elective		4
General Elective		4
General Elective		2
<b>Credits</b>		<b>15</b>
<b>Total Credits</b>		<b>128</b>

## 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/>).