# NEUROSCIENCE, BACHELOR OF SCIENCE

## Neuroscience Major Requirements

(Also see Requirements for a Bachelor's Degree. (https://e-catalogue.jhu.edu/ksas-wse/undergraduate-policies/academic-policies/requirements-bachelors-degree/))

Neuroscience is the study of the nervous system and how it functions. Neuroscientists study the nervous system from all levels, ranging from molecules interacting with cell membranes to brain systems subserving cognitive functions such as language. Dramatic progress has been made at all levels, and the field continues to grow. On the Homewood campus, researchers studying the nervous system are in the departments of Biology, Biomedical Engineering, Biophysics, Cognitive Science, and Psychological and Brain Sciences and in the Krieger Mind/Brain Institute. Their presence provides the opportunity for an innovative, interdepartmental program which offers a broad overview of the neuroscience field, as well as more advanced training in one of four focus areas.

### General Information

- Students are encouraged to complete an optional introductory course in their freshman year, such as AS.200.141 Foundations of Brain, Behavior and Cognition or AS.050.105 Introduction to Cognitive Neuropsychology . Either of these courses will satisfy the prerequisite for AS.080.305 Neuroscience: Cellular and Systems I. Foundations of Brain, Behavior and Cognition will also satisfy the prerequisite for AS.080.250 Neuroscience Laboratory.
- Students interested in attending medical school will need to take a second semester of organic chemistry and its corresponding laboratory and biochemistry to meet medical school admission requirements; however, these courses are not major requirements.
- Students are required to select their advanced neuroscience elective courses from one of four approved focus areas: cellular and molecular neuroscience (NEUR-CM), cognitive neuroscience (NEUR-CG), computational neuroscience (NEUR-CP), or systems neuroscience (NEUR-ST). Approved courses fulfilling this requirement are found on the neuroscience website (http://krieger.jhu.edu/neuroscience/bs-program/courses/) or in the schedule of classes where they can be identified by their POS-Tag.
- To apply towards the major, all courses must be taken for a letter grade and a grade of C- or better is required.
  ***August 28,2023 - Correction to the Neuroscience, BS requirements: Mathematics, Stiatistics, and Sciences Courses, AS.171.113 Subatomic World should be replaced with AS.110.113 Honors Single Variable Calculus.

| Code | Title | Credits |
|---|---|---|
| **Neuroscience Sequence** | | |
| AS.050.203 | Neuroscience: Cognitive (spring) | 3 |
| AS.080.250 | Neuroscience Laboratory (fall/spring) | 3 |
| AS.080.305 | Neuroscience: Cellular and Systems I (fall) | 3 |
| AS.080.306 | Neuroscience: Cellular and Systems II (spring) | 3 |
| **Mathematics, Statistics, and Science Courses** | | |
| EN.553.211 | Probability and Statistics for the Life Sciences | 4 |
| or EN.553.310 | Probability & Statistics for the Physical Sciences & Engineering | |
| or EN.553.311 | Intermediate Probability and Statistics | |
| or EN.553.111 & EN.553.112 | Statistical Analysis I and Statistical Analysis II | |
| or AS.280.345 | Public Health Biostatistics | |
| AS.110.106 | Calculus I (Biology and Social Sciences) | 4 |
| or AS.110.108 | Calculus I (Physical Sciences & Engineering) | |
| AS.110.107 | Calculus II (For Biological and Social Science) | 4 |
| or AS.110.109 | Calculus II (For Physical Sciences and Engineering) | |
| or AS.171.113 | Subatomic World | |
| AS.030.101 & AS.030.105 | Introductory Chemistry I and Introductory Chemistry Laboratory I | 4 |
| AS.030.102 & AS.030.106 | Introductory Chemistry II and Introductory Chemistry Laboratory II | 4 |
| or AS.030.103 | Applied Chemical Equilibrium and Reactivity w/lab | |
| AS.030.205 | Introductory Organic Chemistry I | 4 |
| AS.171.101 | General Physics: Physical Science Major I | 4 |
| or AS.171.103 | General Physics I for Biological Science Majors | |
| or AS.171.107 | General Physics for Physical Sciences Majors (AL) | |
| AS.173.111 | General Physics Laboratory I | 1 |
| AS.171.102 | General Physics: Physical Science Major II | 4 |
| or AS.171.104 | General Physics/Biology Majors II | |
| or AS.171.108 | General Physics for Physical Science Majors (AL) | |
| AS.173.112 | General Physics Laboratory II | 1 |
| **Biology Sequence** [1 and 2] | | |
| Select one biology course with lab of the following: | | 6-8 |
| AS.020.151 & AS.020.153 | General Biology I and General Biology Laboratory I (see footnote about AP Biology credits) [1] | |
| AS.020.152 & AS.020.154 | General Biology II and General Biology Lab II (see footnote about AP Biology credits) [1] | |
| AS.020.303 & AS.250.253 | Genetics and Protein Engineering and Biochemistry Lab (see footnote) [3] | |
| or AS.020.315 | Biochemistry Project lab | |
| AS.020.305 & AS.020.315 | Biochemistry and Biochemistry Project lab | |
| or AS.250.25 | Protein Engineering and Biochemistry Lab | |
| or AS.250.25 | Protein Biochemistry and Engineering Laboratory | |
| AS.020.306 & AS.020.316 | Cell Biology and Cell Biology Lab | |
| AS.020.374 & AS.020.377 | Comparative Physiology and Comparative Physiology Lab | |
| **Advanced Neuroscience Elective Courses and Focus Area** | | |
| Nine credits of 300-level or higher approved courses from one of four focus areas: systems neuroscience, cognitive neuroscience, computational neuroscience, or cellular and molecular neuroscience | | 9 |
| Three credits of 300-level or higher approved course outside of focus area selected above | | 3 |
| If pursuing the Computational Neuroscience focus area, EN.553.291 (or the combo of AS.110.201/212 and AS.110.302) and AS.250.205 are required in addition to the 12 credits in advanced courses required for the focus area. | | 0-11 |

If pursuing the Cellular and Molecular Neuroscience focus area, AS.020.306 and AS.020.316 must be selected as the required biology course with lab

| | | |
|---|---|---|
| **Neuroscience Research and Scientific Communication** [4] | | |
| AS.080.541 | Research Neuroscience – Neuroscience Majors (6 credits total) | 6 |
| or AS.080.544 | Research Neuroscience – Neuroscience Majors | |
| AS.080.499 | Scientific Communication and Mentoring (two semesters) | 2 |
| **Total Credits** | | **72-85** |

1. For students with Biology credit from an exam (AP, IB, GCE), exam credit may not use credits towards this requirement. Therefore, these student must take at least one biology course and its lab at JHU. Students who elect to take General Biology I or II with its lab will lose the corresponding exam credits.
2. Students planning on taking the MCAT should consider whether or not they have a solid biology background coming into JHU. If they are unsure they should consult with the Office of Pre-Professional Advising and consider taking General Biology I and II along with the associated labs.
3. AS.020.340 Developmental Genetics Lab may also be used for this lab requirement and it may have seats during the **fall semester only for Neuroscience majors.** AS.250.253 Protein Engineering and Biochemistry Lab OR AS.020.315 Biochemistry Project Lab can be taken either in the fall or spring semester.
4. Research (AS.080.5xx) must be conducted in one of the neuroscience laboratories participating in the program and can in completed in 1 to 3 credits per term. **Students must register for two semesters** of AS.080.499 Scientific Communication and Mentoring. Students are strongly encouraged to only take Scientific Communication and Mentoring when they are either actively involved in research or have completed at least three credits of research.

## Sample Program

The following course sequence is only a suggestion and is based on the assumption that there are no AP/IB/TR credits applied. Please consult with your academic advisor when selecting and registering for classes, as there are multiple ways to complete the major.

**First Year**

| First Semester | Credits | Second Semester | Credits |
|---|---|---|---|
| AS.030.101 | 3 | AS.030.102 | 3 |
| AS.030.105 | 1 | AS.030.106 | 1 |
| AS.110.106 | 4 | AS.110.107 | 4 |
| Biology Option 1[1] | 3 | | |
| Biology Lab Option 1 | 1 | | |
| | **12** | | **8** |

**Second Year**

| First Semester | Credits | Second Semester | Credits |
|---|---|---|---|
| AS.080.305[2] | 3 | AS.080.306[2] | 3 |
| AS.030.205 | 4 | EN.553.211 | 4 |
| AS.080.499[3] | 1 | AS.080.499[3] | 1 |
| AS.080.541[3] | 1 - 3 | AS.080.544[3] | 1-3 |
| | **9-11** | | **9-11** |

**Third Year**

| First Semester | Credits | Second Semester | Credits |
|---|---|---|---|
| AS.171.103 | 4 | AS.171.104 | 4 |
| AS.173.111 | 1 | AS.173.112 | 1 |
| AS.080.499[3] | 1 | AS.050.203 | 3 |
| AS.080.541[3] | 1 - 3 | AS.080.499[3] | 1 |
| Upper Level Neuroscience Course #1 | 3 | AS.080.544[3] | 1 - 3 |
| | | Upper Level Neuroscience Course #2 | 3 |
| | **10-12** | | **13-15** |

**Fourth Year**

| First Semester | Credits | Second Semester | Credits |
|---|---|---|---|
| AS.080.250[4] | 3 | Upper Level Neuroscience Course #4 | 3 |
| Upper Level Neuroscience Course #3 | 3 | | |
| | **6** | | **3** |

**Total Credits 70-78**

1. The biology course with lab requirement can be taken in any semester. For students who are obtaining a Cellular and Molecular focus area, the biology course with lab requirement must be fulfilled with AS.020.306 Cell Biology and AS.020.316 Cell Biology Lab.
2. AS.080.305 Neuroscience: Cellular and Systems I & AS.080.306 Neuroscience: Cellular and Systems II can be taken sophomore or junior year.
3. Research in Neuroscience (AS.080.5xx) and Scientific Communication & Mentoring (AS.080.499) can be taken at any time.
4. AS.080.250 Neuroscience Laboratory can be taken any time after completing AS.200.141 Foundations of Brain, Behavior and Cognition or AS.080.305 Neuroscience: Cellular and Systems I & AS.080.306 Neuroscience: Cellular and Systems II.

## Honors in the Major

Effective Fall 2023, the honors requirements are changing from prior years. **Students who entered JHU prior to Fall 2023 should refer to their catalogue year of entry to review their honors requirements.**

**For students entering JHU in Fall 2023 and beyond,** the honors requirements are:

- Earn a GPA of **3.8** or better in major requirements
- Earn **6** credits of required research (this overlaps with major requirements)
- Presentation of research findings at the Day of Research in Engineering, Arts, Medicine and Sciences (DREAMS) during the Fall or Spring semester
- Receive a recommendation from research mentor

## Neuroscience Undergraduate Honors Thesis

The Neuroscience Undergraduate Honors Thesis program is designed for students wishing to distinguish themselves via the writing and defense of a thesis. Students wishing to gain more hands-on experience in the construction of a research hypothesis, experimental design, and scientific communication should consider the thesis. In particular, students thinking about pursuing a career in research may find the preparation of an Undergraduate Honors Thesis will provide valuable insight into the

research endeavor.  While this option is new for the 2023-2024 academic year, students who entered in prior years may pursue this opportunity.

### Criteria:

- Design and conduct an experiment in Neuroscience under the direction of mentor
- Submit an application, a recommendation letter from the primary mentor, and a research proposal describing your planned project to the Undergraduate Honors Thesis Director (Dr. Robert Ross) during the Spring semester the year before your planned graduation date
- Earn 9 credits of Independent Research
- Write an Undergraduate Honors Thesis
- Defend the Thesis orally to a committee comprised of members from the Johns Hopkins University Neuroscience community by mid-April of your graduation year
- Present your research at the DREAMS conference Fall or Spring of your final undergraduate year
- Attend a weekly Honors Thesis Seminar during Spring semester of your graduation year focused on assisting with Thesis writing (Neuroscience Honors Thesis Seminar AS.080.589)
- Maintain minimum 3.5 GPA in all required courses for the Neuroscience major