The Departments of Psychology and Biology offer a course major and an honors major in Neuroscience. Each Neuroscience major will be assigned a faculty advisor from whichever of the two departments best reflects the focus of that student's plan of study.

**A. Entry Requirements for the Neuroscience Course Major and Honors Major**

The study of Neuroscience involves advanced coursework with the following prerequisites. For admission to the Neuroscience special major, students must

a. complete (or otherwise satisfy) the following required courses (up to two credits of these taken at Swarthmore may be counted as Group B electives for the major), and
b. obtain a minimum GPA of 3.0 (B) for these courses overall, as well as within all Biology courses and within all Psychology courses.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Name</th>
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<tbody>
<tr>
<td>Biology</td>
<td>BIOL 001: Cellular and Molecular Biology</td>
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<tr>
<td></td>
<td>BIOL 002: Organismal and Population Biology</td>
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<tr>
<td>Chemistry</td>
<td>CHEM 010: General Chemistry</td>
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<td>CHEM 022: Organic Chemistry I</td>
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<tr>
<td>Math/Stat</td>
<td>MATH 015: Elementary Single-Variable Calculus</td>
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<td>STAT 011: Statistical Methods</td>
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<tr>
<td>Psychology</td>
<td>PSYC 001: Introduction to Psychology</td>
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<tr>
<td></td>
<td>PSYC 025: Research Design and Analysis</td>
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</tbody>
</table>

- The requirement for BIOL 001 and/or BIOL 002 may be satisfied by credit from the Biology AP exam (score of 5) if at least one credit in Biology has been completed at Swarthmore.
- The requirement for CHEM 010 will be satisfied if the student has placed out of it and completed CHEM 022.
- The requirements for MATH 015 and STAT 011 may be satisfied by placement out of these courses, as determined by the Department of Mathematics and Statistics.
- The requirement for PSYC 001 may be satisfied with a Psychology AP exam score of 5.
- Provisional admission to the special major will normally be granted based on substantial progress in satisfying these entry requirements at the time of application.

**B. Neuroscience Course Major Requirements**

A special major at Swarthmore must include at least 10 credits and no more than 12 credits. A Neuroscience major will normally include two (2) Entry Requirement Courses (i.e., any two that have been taken at Swarthmore) and eight (8) Elective credits as specified below, including fulfilling the comprehensive requirement. Up to twelve credits may be included in the major, but only ten are required.

1. **Electives**

Majors will complete at least **eight (8) elective credits** from the following lists, to include at least one seminar. At least five (5) elective credits must be from Group A including at least one Foundation course and at least one course from each of Psychology and Biology. The remaining three (3) elective credits can be from either Group A, Group B, or Group C (see restrictions below). It is possible to substitute or add electives from other universities (e.g., Systems Neuroscience at UPenn), including abroad, but students should seek Swarthmore faculty approval for such courses in advance.
Group A: Neuroscience Electives

- PSYC 030 Behavioral Neuroscience [Foundation Course*]
- BIOL 022 Neurobiology [Foundation Course*]
- BIOL 020 Animal Physiology
- BIOL 029 Developmental Neurobiology
- BIOL 030 Animal Behavior
- BIOL 1XX Developmental Neurotoxicology (2 credits)
- BIOL 121 Neural Systems and Behavior seminar (2 credits)
- BIOL 123 Learning and Memory seminar (2 credits)
- BIOL 124 Hormones and Behavior seminar (2 credits)
- BIOL 131 Animal Communication seminar (2 credits)
- BIOL 134 Evolution of Social Behavior (2 credits)
- PSYC 031 Cognitive Neuroscience
- PSYC 031A Social, Cognitive, and Affective Neuroscience
- PSYC 032 Perception
- PSYC 091 Advanced Topics in Behavioral Neuroscience
- PSYC 130 Seminar in Behavioral Neuroscience (1 credit)
- PSYC 131 Seminar in Cognitive Neuroscience (1 credit seminar)
- PSYC 131A Seminar in Psychol and Neuroscience: The Social Brain (1 credit)
- PSYC 132 Perception, Cognition, and Embodiment seminar (1 credit)

*At least one Foundation Course must be included. Both are recommended.

Group B: Course Electives in Related/Overlapping Scientific Areas

- BIOL 010 Genetics
- BIOL 014 Cell Biology
- BIOL 019 Omics
- BIOL 024 Developmental Biology
- BIOL 026 Invertebrate Biology
- BIOL 027 Systems Biology
- BIOL 034 Evolution
- BIOL/CPSC 068 Bioinformatics
- BIOL 111 Genome Regulation by Noncoding RNA seminar (2 credits)
- BIOL 112 From Cells to Organs (2 credits)
- BIOL 115 Plant Molecular Genetics
- BIOL 119 Genomics and Systems Biology seminar (2 credits)
- BIOL 125 Cellular Basis of Embryonic Development & Cancer seminar (2 credits)
- BIOL 126 Biomechanics seminar (2 credits)
- BIOL 136 Molecular Ecology and Evolution seminar (2 credits)
- CHEM 038 Biological Chemistry
- COGS 001 Introduction to Cognitive Science
- CPSC 021 Introduction to Computer Science
- MATH 056 Modeling
- PSYC 028 Stereotypes, Prejudice, and Discrimination
- PSYC 033 Cognitive Psychology
- PSYC 034 Psychology of Language
- PSYC 035 Social Psychology
- PSYC 038 Clinical Psychology
- PSYC 039 Developmental Psychology
- PSYC 133 Metaphor and Mind seminar (1 credit)
PSYC 134    Seminar in Psycholinguistics (1 credit)
PSYC 138    Seminar in Clinical Psychology (1 credit)
PSYC 139    Seminar in Developmental Psychology (1 credit)

**Group C: Research Electives**

One unit of research (of up to 2 credits) in neuroscience from the following may be counted toward the minimum required 10 credits of the major. Additional research units may be counted for optional credits up to 12. Research electives are one way of fulfilling the comprehensive requirement (see below) for the Neuroscience major.

- BIOL 098    Neuroscience Thesis Research
- PSYC 099    Senior Neuroscience Thesis
- PSYC 096/097 Senior Thesis (2 credits)
- PSYC 102    Research Practicum in Perception and Cognition
- PSYC 103    Research Practicum in Behavioral Neuropharmacology
- PSYC 104    Research Practicum in Language and Mind
- PSYC 105    Research Practicum in Psychology and Neuroscience: Social Imitation
- PSYC 110    Research Practicum in Cognitive Neuroscience

2. **Comprehensive Requirement for Course Majors**

The comprehensive requirement is a Neuroscience Research Thesis, a complete scientific paper based on a research project conducted in Biology or Psychology or some other area related to neuroscience. Each Neuroscience major must identify their faculty thesis mentor before the end of the junior year. Students will normally submit a *thesis proposal* to their faculty advisor in advance of their advising meeting in the spring of junior year, and will discuss the proposal with the advisor prior to enrolling for fall courses.

The *thesis proposal* will:

1. Be submitted to the student’s faculty advisor prior to their advising meeting in the spring of junior year, and will be discussed with the advisor at this meeting, prior to enrolling for fall courses.
2. Indicate which thesis option (below) the student intends to pursue.
3. Identify their faculty thesis mentor, a faculty member in either Biology or Psychology who has agreed to oversee their thesis.
4. Specify where and when the research will be conducted.
5. Provide a concise statement of their research topic and aims.

**Thesis options.** Each Neuroscience major must write their own Thesis, from one of the following options:

1. The thesis may be based on an individual research project directly supported by a faculty member as a Group C elective in either Biology or Psychology.
2. Students in Biology seminars and Psychology Research Practica often work on group projects and sometimes produce multi-authored research papers. Such a project may serve as the basis of a Neuroscience Research Thesis, but the paper must be a unique product of the student who submits it as their Thesis and should be undertaken under the guidance of the faculty member who taught the seminar or research practicum.
3. The thesis may be based on a separate research project, such as might occur during a summer (either at Swarthmore or at another institution). In this case, a student must secure the preliminary consent of a faculty mentor in either Biology or Psychology (whichever is more appropriate for the project) before
beginning work on the project (i.e., before the summer research experience). The student must provide a one-page summary of the research project to both the faculty mentor and their academic advisor at the beginning of the fall semester of the senior year (no later than Friday of the first week of classes). If the faculty mentor approves the project for a Neuroscience Thesis, and consents to mentor the student through the process of writing the thesis, then the student will register for a 0.5 credit unit of Neuroscience Thesis during either (but not both) semester of the senior year.

Neuroscience Research Thesis: Guidelines for content and organization.

- The thesis should be organized in the format of a formal scientific paper, including the following sections: abstract, introduction, materials and methods, results, discussion, acknowledgments, and literature cited.
- The thesis should report new empirical data on a research project that was conducted by the student.
- As the comprehensive exercise for an interdisciplinary special major, students should endeavor to explain their scientific question(s) and how their work is related to larger themes in neuroscience in the thesis introduction and/or discussion.
- The length of the thesis is to be no more than 20 pages, double-spaced (exclusive of figures, tables, and references).
- The deadline for submitting the complete draft of the thesis will be set by the faculty research mentor, and will be no later than the last day of classes of the student’s final semester.


- A 0.5- or 1-credit thesis will be evaluated by the Swarthmore faculty thesis mentor.
- A 2-credit thesis will be evaluated by two faculty members, typically one from Biology and one from Psychology. One of these will normally be the faculty thesis mentor, and the second will be determined by the student in consultation with the thesis mentor.
- For a 2-credit thesis, it is the responsibility of the student to invite two faculty members to serve as thesis examiners, and to negotiate with them a time and place for the oral exam, normally to be held during the week after the last day of classes.

3. Sample Neuroscience Course Majors

The Neuroscience Major is demanding, but can be very flexible. It is important to receive advising from a faculty member in planning your program. Here we show several different possible programs. These are intended to be illustrative, and they should not take the place of advising.

ENTRY REQUIREMENTS (including 2 credits toward major)

- AP in BIOL 001 plus BIOL 002 (1 credit counted toward major credits)
- AP in PSYC (no credit) plus PSYC 025 (1 credit counted toward major credits)
- AP in Calculus, STAT 011, CHEM 010, CHEM 022

SAMPLE PLANS FOR COMPLETING COURSE MAJOR REQUIREMENTS

- “Minimalist” Neuroscience Major (fewest credits, minimum in Group A). A total of 8 Elective credits = 5 from Group A (including 1 Foundation) + 3 from Groups B/C: PSYC 030 (Group A, Foundation)
BIOL 030 (Group A elective)
PSYC 031 (Group A elective)
PSYC 032 (Group A elective)
PSYC 130 (Group A elective/seminar)
BIOL 014 (Group B elective)
COGS 001 (Group B elective)
PSYC 105 (Research Elective/Comprehensive)

• **“Core Emphasis” Neuroscience Major** – A total of 9-10 Elective credits =
  8 credits from Group A (including 2 Foundation courses) + 1 or 2 Research credits:
  BIOL 022 (Group A, Foundation)
  PSYC 030 (Group A, Foundation)
  PSYC 130 (Group A, seminar)
  BIOL 123 (2-credit Group A seminar)
  PSYC 031/131A (2-credit Group A electives)
  PSYC 032 (Group A elective)
  PSYC 105 or PSYC 096/097 (1- or 2-credit Research Elective/Comprehensive)

• **“Cognitive Neuroscience Emphasis” Neuroscience Major** – A total of 8 Elective credits =
  7 credits from Group A (including 1-2 Foundation courses) + 1 Research credit:
  PSYC 030/130 (Group A Foundation + Group A elective)
  BIOL 022 or BIOL 030 (Group A elective)
  PSYC 031A/131A (2-credit Group A electives)
  PSYC 032/132 (Group A electives)
  PSYC 102, 104 or 105 (1-credit Research Elective/Comprehensive)

• **“Biology Emphasis” Neuroscience Major** - A total of 9 Elective credits =
  7 from Group A (including 1-2 Foundation courses) + 1 from Group B + 1 Research credit:
  BIOL 022 (Group A Foundation)
  PSYC 030, 031, or 032 (Group A)
  BIOL 030 (Group A)
  BIOL 123 (2-credit Group A seminar)
  BIOL 131 (2-credit Group A seminar)
  BIOL 010 (Group B)
  BIOL 098 (1-credit Research Elective/Comprehensive)

C. Honors Neuroscience Major Requirements

Entry Requirements for admission to the Neuroscience Honors major are the same as those for
admission to the Course major (see section A above).

The Neuroscience Honors major comprises two (2) Entry Requirement courses, at least one (1) of the
two Foundation Courses, three (3) Honors Seminar preparations, and an Honors Research Thesis.

1. **Neuroscience Foundation Courses**: Majors will complete at least one of:
   PSYC 030 Behavioral Neuroscience
   BIOL 022 Neurobiology

2. **Honors Seminar Preparations**
Majors will complete three (3) seminar preparations from the following groups, with at least two from Group A and no more than two in one department.

**Group A: Neuroscience Honors Preparations (Seminars)**

- BIOL 1XX  Developmental Neurotoxicology (2 credits)
- BIOL 121  Neural Systems and Behavior seminar (2 credits)
- BIOL 123  Learning and Memory seminar (2 credits)
- BIOL 124  Hormones and Behavior seminar (2 credits)
- BIOL 131  Animal Communication seminar (2 credits)
- BIOL 134  Evolution of Social Behavior (2 credits)
- PSYC 030/130  Behavioral Neuroscience course and seminar (1 credit each)
- PSYC 031/131  Cognitive Neuroscience course and seminar (1 credit each)
- PSYC 131A +1  Social Brain seminar (plus a pre-req; 1 credit each)
  Pre-req: Either PSYC 031 or PSYC 031A
- PSYC 132 +1  Perception and Embodiment seminar (plus a pre-req; 1 credit each)
  Pre-req: Either PSYC 032, PSYC 033, or COGS 001

**Group B: Honors Preparations (Seminars) in Related Scientific Areas**

- BIOL 111  Genome Regulation by Noncoding RNA seminar (2 credits)
- BIOL 119  Genomics and Systems Biology seminar (2 credits)
- BIOL 125  Cellular Basis of Embryonic Development & Cancer seminar (2 credits)
- BIOL 136  Molecular Ecology and Evolution seminar (2 credits)
- PSYC 133 +1  Metaphor and Mind seminar (plus a pre-req; 1 credit each)
  Pre-req: Either PSYC 033, PSYC 034 or COGS 001
- PSYC 134 +1  Psycholinguistics seminar (plus a pre-req; 1 credit each)
  Pre-req: Either PSYC 033, PSYC 034 or COGS 001
- PSYC 038/138  Clinical Psychology course and seminar (1 credit each)
- PSYC 039/139  Developmental Psychology course and seminar (1 credit each)

### 3. Honors Research Thesis (2 credits)

The Neuroscience Honors Thesis is a complete scientific paper based on a substantial research project that, according to the practices of the host department, may be completed in two semesters of research OR in one or two summers plus one semester of research. The project will be taken for one or two credits (of PSYC 180 or BIOL 180) and will be graded by an External Examiner. The Honors thesis normally has a page limit of 20 pages, not counting references, figures, figure legends or tables.

An Honors thesis requires a significant investment of thought and time. This begins with careful advance planning. A Neuroscience Honors major will normally identify a faculty member in either Psychology or Biology who consents to be their thesis mentor no later than the middle of the junior year. Each Honors student will submit an Honors thesis proposal to their Neuroscience faculty advisor in advance of their advising meeting in November of junior year, and will discuss the proposal with the advisor prior to enrolling for junior spring courses.

The Honors thesis proposal will:

1. Be submitted to the student’s faculty advisor prior to their advising meeting in November of junior year, and will be discussed with the advisor at this meeting, prior to enrolling for spring courses.
2. Identify their faculty thesis mentor, a faculty member in either Biology or Psychology who has agreed to oversee the thesis.
3. Specify where and when the research will be conducted.
4. Provide a concise statement of the thesis research aims.

A Neuroscience Honors thesis will normally be based on a substantial research project directly supported by a Swarthmore faculty member as either BIOL 180 or PSYC 180 (Honors Research). Students who are interested in pursuing a thesis project with a research mentor who is not a Swarthmore faculty member must (1) discuss their interests and plans with their Neuroscience faculty advisor in either the Biology or Psychology Department no later than the fall of their junior year, and (2) obtain the consent of a faculty thesis mentor at Swarthmore who is willing to oversee the thesis. This may include different levels of involvement, which will be determined through conversations between the thesis student, the Swarthmore faculty mentor, and the external research advisor. Finally, a student who proposes to conduct an Honors thesis project with a research mentor who is not a Swarthmore faculty member must obtain approval from the Neuroscience coordinators in both Biology and Psychology no later than Spring Break of their junior year.