# Neuroscience PhD Program Progress through Degree

March 2022

The Neuroscience Graduate Program is a Ph.D. program with a standard completion time of 5.0 to 5.5 years. The program offers broad-based neuroscience training with an emphasis on research. *We do not admit students who wish to pursue a Master's degree*. However, when a student experiences a significant change in career orientation, after successful completion of the qualifying exam, a Master's degree may be awarded.

| Standard Course of Study, By Year | | | | | | |
|---|---|---|---|---|---|---|
| | First | Second | Third | Fourth | Fifth | Final |
| Neuroscience Boot Camp | * | | | | | |
| 290A/B Methods & Career Skills Courses<br>(Fall: Methods & initial career skills.<br>Spring: Rotation talks & other advising) | * | | | | | |
| 291A/B Lab Rotations<br>(3 rotations, 10 weeks each; 4th if needed) | * | | | | | |
| Ethics in Research<br>(MCELLBI 293C) | Spring | | | | | |
| Foundational Neuroscience Courses<br>(3 courses across breadth of neuroscience) | * | * | | | | |
| 294 Brain Lunch seminar<br>(Formal research presentation in Y4) | * | * | | * | | |
| Statistics or Quantitative Methods<br>(1 course or demonstrated expertise) | * | * | * | * | | |
| Teaching (GSIships, 2 semesters total) | | * | * | | | |
| Qualifying Examination | | Spring | | | | |
| Elective Course<br>(1 course, neuroscience related topic) | | * | * | * | * | |
| Thesis Research | | * | * | * | * | * |
| Dissertation writing, exit seminar and filing | | | | | * | * |

The program provides flexibility for students as they cultivate their scientific interests. Individual curricula and research are arranged in consultation with the student's Thesis Mentor and Graduate Advisers. Most formal coursework is completed during the first two academic years. The primary focus thereafter is on thesis research. Mentoring on scientific and career development is integrated throughout the program.

# I. Neuroscience Boot Camp

The program begins with an intensive 10-day course that includes lectures on foundational topics in cellular, systems, and cognitive neuroscience, and hands-on laboratory exercises using a wide range of modern neuroscience techniques. These include whole-cell patch clamp recording, synaptic physiology, genetics, extracellular spike recording, calcium imaging, microscopy and immunohistochemistry, animal behavioral methods, computational methods, analysis of functional MRI data, and human psychophysics. The course also includes research presentations on current projects in faculty laboratories. All Neuroscience PhD students must attend Boot Camp.

# II. Coursework

The program has a flexible curriculum of graduate coursework in neuroscience and related disciplines. The curriculum balances a requirement for broad training in all areas of neuroscience (cellular/molecular, circuits/systems, computational, and cognitive), with flexibility to focus more deeply within each student's primary research area. Within each area, students choose appropriate classes that match their interests and prior background. Broad training in neuroscience is a central feature of the program.

**Course requirements**

**1. NEUROSC 290A/B Methods & Career Skills Classes.** These short courses introduce a broad range of modern neuroscience research methods in didactic lectures, and provide advising in initial career skills. They are taken in Year 1. NEUROSC 290A (Fall) includes a survey of cutting-edge research methods, advising on how to choose a thesis mentor, training in scientific rigor and reproducibility, and an introduction to the use and misuse of statistics in neuroscience research. NEUROSC 290B (Spring) includes in-depth training on how to give a top-notch scientific talk, advising on how to write effective research papers, and on scientific project management.

**2. NEUROSC 291A/B Lab Rotations and Presentations.** Year 1 students perform three 10-week research rotations in different faculty laboratories. The goal is to expose students to varied techniques and approaches in neuroscience and to provide training in experimental design, critical analysis of data, and presentation of research findings. Rotations also allow students to identify the laboratory in which their thesis research will be performed. During the Spring semester, students formally present results from their laboratory rotations in the NEUROSC 290B course.

Rotation research is graded and receives academic credit. This is accomplished by enrolling in NEUROSC 291A-B, a year-long course, during the rotation year. Grades and evaluations are collected from rotation mentors and are used to assign an overall grade in the course at the end of the Spring semester.

Detailed rules and guidelines for laboratory rotations:

1. Rotation placements are made by the student in consultation with the faculty member they wish to rotation with. Students and faculty are encouraged to discuss rotation availability and potential rotation projects, and the student should confirm with the faculty member their agreement for the student to rotate in the lab. Students will be asked to submit their rotation placements to the Graduate Advisor. It is the student's responsibility to discuss and confirm rotation placement within faculty labs prior to submitting the rotation placement form.
2. Students may perform an early rotation starting in July of the entering year. This must be pre-approved by both the rotation faculty mentor and the head graduate adviser. At the beginning of the fall semester the student can request either to continue in the same laboratory through the first rotation, or alternatively to rotate in another laboratory. Regardless of summer rotations, all students are required to rotate in 3 different laboratories during the regular school year.
3. Students who were undergraduate or research assistants in a Berkeley faculty laboratory cannot rotate in that faculty lab. The aim of this rule is to maximize exposure to new scientific opportunities during rotations. However, a student in this situation is free to choose to join this laboratory for thesis dissertation research after rotations are complete.
4. A student may elect to perform a 4th laboratory rotation if the first 3 rotations do not result in a suitable laboratory for his/her thesis dissertation research.

Research in the thesis laboratory begins at the end of Year 1, immediately after rotations are complete.

**3. MCELLBI 293C (Ethics in Research)** is required in Spring of Year 1 for all students. This is a 10- meeting lecture-and-discussion based course that reviews important guidelines on ethical behavior in research, from honesty in data analysis and presentation to sharing reagents to authorship disputes.

**4. Foundational courses (Years 1-2).** Students must take 3 foundational courses distributed among three broad areas: (A) Cellular, Molecular & Developmental Neuroscience; (B) Circuits, Systems and Computational Neuroscience; and (C) Cognition, Brain and Behavior. Students can either take one graduate level course from each category, or three graduate level courses chosen from two areas, plus a selected advanced undergraduate course from the third area. These are taken in Years 1-2.

For the list of courses that satisfy the foundational course requirement, please see the "Neuroscience Course Curriculum" document. There are 3-7 approved course choices in each category. These are all 200-level graduate classes. You can choose the courses that best complement your interests and your prior academic background. At least one choice in each category is a broad survey class.

**5. Training in statistics and quantitative methods.** Beginning with the entering class of 2014, all students must complete a one semester course on statistical analysis or quantitative methods. This course is chosen from a large number of appropriate classes at Berkeley, and can be completed at any time prior to the semester of graduation. Students with prior appropriate coursework or whose thesis research uses substantial quantitative methods can use that prior experience to fulfill this requirement, subject to approval by the Head Graduate Adviser.

**6. Additional elective courses.** In addition, students must take one additional elective course. This can be either a graduate-level seminar or graduate-level lecture course and can be 1 unit or more. It is usually taken after passing the qualifying examination, typically in Years 3 and 4. Electives can be chosen from any relevant graduate-level class in any department. These courses promote deeper expertise in chosen areas of neuroscience. You can also take any of the Foundation Courses as an elective.

**7. NEUROSC 294 seminar (Brain Lunch)**. This is an ongoing student-led seminar class, offered every semester, that includes student presentations of ongoing thesis research, journal club paper discussions related to visiting speakers, and periodic faculty-led advising on career topics. All students are required to take Brain lunch for 1 semester in each of Years 1 and 2. In addition, during Year 4, students must enroll in NEUROSC 294 and give a **formal fourth-year research seminar** on their ongoing thesis research. You can take this course any number of times for a satisfactory/unsatisfactory (S/U) grade. You should enroll for a letter grade in the semester of your fourth-year research seminar.

Coursework Notes:

1. All required courses must be taken for a letter grade and passed with a grade of B or higher, except where noted explicitly above.

2. You should have finished, or be close to finishing, your Foundational Courses prior to the Qualifying Examination in Spring of Year 2. These will provide you with the general knowledge in Neuroscience needed for the Qualifying Exam.

3. NEUROSC 290A/B, 294, and MCELLBI 293C do not satisfy the elective course requirement.

## III. Scientific research seminars and Neuroscience Retreat

UC Berkeley hosts a wide array of research seminar series, in which national and international scientists present current research results. These include the MCB/HWNI Neuroscience Seminar Series, Psychology Colloquia, Redwood Center for Theoretical Neuroscience Weekly Seminars, Oxyopia Vision Science Seminars, and more. These are an

invaluable resource for students to gain depth of knowledge in their specific field and broad knowledge of modern research problems across neuroscience. There is no formal requirement to attend seminars. However, students are strongly encouraged to attend relevant seminar series, to the extent that their research allows.

Students are required to attend the yearly UC Berkeley Neuroscience Retreat.

## V. Training in Teaching

Neuroscience students are required to serve as Graduate Student Instructors (GSIs) for two semesters. GSI is the UC Berkeley term for teaching assistants. Teaching typically occurs during Fall semester of the second year and Spring semester of the third year. (One GSIship can be delayed to Year 4 if necessary to meet requirements of outside fellowships.) Teaching affords students supervised experience in a variety of educational situations, including labs, discussion sections, and demonstrations. GSIs also participate in record-keeping, grading, advising, and student consultations.

GSIs are matched to courses using an application process. Whenever possible, students are assigned to courses related to research interests. GSIs are evaluated by both supervising faculty and the students they teach. These evaluations become a permanent part of the student file. Top-performing GSIs are nominated for the Outstanding Graduate Student Instructor Award, which has been won by many Neuroscience PhD Program students. No more than 2 GSIships are allowed, so that students are able to focus primarily on research.

## VI. Qualifying Examination

All students must take a Qualifying Examination during the Spring semester of Year 2. The QE is an oral exam, designed to ensure that students have in-depth knowledge within their thesis research area and in closely related, complementary research areas; that students can design and interpret experiments, can propose research in a written grant format, and can reason scientifically at a high level. In addition, the exam is used to confirm that within the overall field of Neuroscience, students have a basic graduate-level understanding of important concepts.

The exam is administered by a committee of four faculty members: three from within the Neuroscience Graduate Program, and a fourth from an outside department.

The examination has three parts: Thesis Proposal, Related Research Areas, and Foundational Questions in Neuroscience. The thesis proposal is in the form of a written, NIH-style grant proposal, which is turned in to the committee, and then defended orally. Related Research Areas are identified cooperatively by the student and his/her committee prior to the exam, and are chosen to be complementary to the main thesis research subject. These areas are examined orally. The Foundational Questions in Neuroscience are designed to test broad

knowledge in Neuroscience. These are a published list of questions, the same for all students, that are available upon entry to the program. These questions are designed to test basic common knowledge of neuroscience facts and principles, and a subset of them are examined orally during the qualifying exam.

During the exam, students must demonstrate the ability to recognize fundamentally important research problems, propose relevant experimental approaches, and display comprehensive knowledge of appropriate disciplinary areas and related subjects. All students are required to pass the qualifying examination before advancing to doctoral candidacy.

Please see the Qualifying Exam Student Guide for important details regarding Qualifying Examination preparation, timeline, and format.

## VII. Thesis Committee, Thesis Research, and the Dissertation

After passing the Qualifying Examination, students establish a Thesis Committee and advance to Doctoral Candidacy.

Thesis committees are comprised of four faculty members: the thesis mentor, two additional Neuroscience Graduate Program faculty, and "Academic Senate Representative" who can either be from outside of Neuroscience, or from a special list of Neuroscience faculty members. Students assemble their committees in consultation with their thesis mentor(s) and the Graduate Adviser.

Once students have advanced to Doctoral Candidacy, they are required to meet with the thesis committee at least once yearly. The annual Thesis Committee Meeting is a time to discuss dissertation progress, review experimental results, set goals, and ensure students are adhering to appropriate timelines to completion.

Years 3-5 are spent primarily on dissertation research. At this stage, students are encouraged to present posters or speak at scientific meetings and conferences whenever possible. During the Year 5, students are advised to start arranging postdoctoral training. In addition to help from the thesis mentor, the thesis committee members and other neuroscience faculty members, students can also consult with counselors at the Career Center to aid them in searches, portfolios, and more.

The written PhD dissertation must comprise one or more complete research projects that are determined to be publication quality by the PhD thesis committee. The written dissertation must be completed according to UC Berkeley campus rules. The thesis committee must sign the finished dissertation.

## VIII. Academic and Professional Mentoring

Academic mentoring is provided in the first two years of the program by a group of 1st and 2nd year faculty advisers. These advisers provide input on course selection, choice of rotation labs, and preparation for the Qualifying Exam. Students also receive mentoring from their rotation advisers, PhD thesis adviser, and qualifying exam committee members. After joining a thesis lab, the primary scientific and academic mentors are the thesis adviser and the PhD thesis committee.

Mentoring on professional development is provided to all students periodically by the Head Graduate Adviser and the faculty advising committee. Topics include grant writing, information on academic and non-academic careers, how to select a postdoctoral laboratory, how to manage research groups, etc. At the end of Year 2, students conduct a formal individual development plan (IDP) to help self-evaluate career goals and directions for professional growth.

## IX. Exit Seminar

In lieu of a thesis defense, students must present a thesis seminar to the neuroscience community during the semester they file their dissertation. UC Berkeley does not conduct thesis defenses with committee examination.