

Neuroscience Senior Project Guide (2019/2020 school year)

A) Students completing a senior project in Neuroscience should be able to:

- show a solid understanding of the subject area and be aware of problems and/or limitations of the particular study.
- understand the methods used in the study and their relevance to the overall project.
- communicate the limits of their ability to interpret and extrapolate from the results.
- discuss the most important literature references related to the project. In other words, the student must be intellectually involved with the work.
- demonstrate their ability to work independently and exhibit critical thinking and troubleshooting skills during the project.

B) Observable behaviors students should demonstrate during the senior project

The initial design of a neuroscience senior project and experiments often involves collaborative thinking between the student, the advisor, and the other members of the student's Senior Seminar. However, once an appropriate topic has been chosen, the student will be expected to work independently. Although students will certainly have questions, they should not rely heavily on the advisor or other faculty members for guidance at every turn of events. We expect students to show initiative in getting started and completing the project and written thesis, to attend and contribute to the Senior Seminar, to meet deadlines, and to clean up after the work is complete.

As stated under section "A" students should be able to demonstrate a solid understanding of 1) the subject area and be aware of problems and/or limitations of the particular study, 2) the methods used and their relevance to the overall project, and 3) the most important literature references related to the project. In general, what we are looking for is that the student has a solid understanding of the material. The student should be aware of the problems and limitations of their study (all studies have some), the ramifications of the study, and other research which could be undertaken to deal with the problems or ramifications. In other words, the student must be intellectually involved with the work. Simple reporting of the data or reorganization of some published information is considered a serious weakness. Students should be ready to discuss and make their own interpretation of the ideas in their study based upon fundamental concepts and ideas in Neuroscience.

C) Appropriate topics for Neuroscience senior projects

The Society for Neuroscience defines the discipline of Neuroscience as "the study of brain development, sensation and perception, learning and memory, movement, sleep, stress, aging and neurological and psychiatric disorders. It also includes the molecules, cells and genes responsible for nervous system functioning." Because Neuroscience covers such a wide range of topics, any project relating to the brain, nervous system, or animal/human behavior is considered appropriate for a senior project.

All projects in Neuroscience must be experimental in nature and should be hypothesis driven or have clearly stated objectives. Projects typically use animal models (e.g. insects, snails, amphibians, reptiles, mice or rats) to test specific questions relating to neurophysiology or behavior. Human subjects may also be used in cases where non-invasive experiments are designed to test human neurophysiology and/or behavior.

D) Approval of topics and selection of senior project advisors

All Neuroscience senior project proposals should be initiated in the context of a discussion with a potential senior project advisor and will normally be closely related to the advisor's research area or research experience that the student has gained during a summer internship. Students who will be conducting projects that were proposed during the junior seminar should consult with the appropriate faculty member about that project when requesting a signature for Neuro 600 during the spring of the junior year. Students who are proposing new projects will consult with one or more potential advisors to agree on an acceptable topic before being permitted to register for a section of Neuro 600. Registration for Neuro 600 is contingent upon proposing a project that is acceptable to the senior project advisor.

E) Selection of 2nd readers

The senior project committee is made up of the senior project advisor and at least one additional faculty member in the Neuroscience Program. Students are expected to contact prospective 2nd readers and discuss the proposed project. Generally, the 2nd reader will have some expertise or interest in the proposed research area. If the faculty member agrees to serve on the senior project committee then it is up to the student to communicate this to the senior project advisor.

F) Context and frequency in which students are expected to meet with the project supervisor and/or additional readers and goals of such meetings

Senior projects in the Neuroscience Program are year-long projects that break down into two one-semester courses carrying a total of 6 credits (2 credits the first semester and 4 credits the second semester). During both semesters, students normally meet once per week with the senior project advisor and the other students doing senior projects with the advisor. In these meetings (the "Senior Seminar") the students are expected to discuss pertinent literature in their general area of research in order to identify proper experimental approaches, designs, techniques, and

method of data analysis. The students will also, as the senior project progresses, discuss any problems that they might be having with their research projects, as well as data analysis and interpretation, and modes of presentation of research findings. There is no expectation that there will be formal meeting times with 2nd readers but students are expected to keep the other members on their senior project committee informed of the project progress.

G) Use of vertebrate animals, human subjects, or radioisotopes in research projects

Students planning to use vertebrate animals in any part of their research project must prepare and submit an approval form to the Animal Review Committee (ARC). Students planning to use humans in any part of their project must submit a proposal to the Institutional Review Board (IRB). No work on the project can proceed until approval(s) by the appropriate committee(s) have been received. As this approval process often takes a few weeks, it is important that students submit their proposal for approval as soon as possible.

Neglect of animal care responsibilities

The Neuroscience Program takes the care of all research animals seriously. They are living creatures, and as such, must be treated with care and dignity. The use of animals in student research is not a right, but a privilege. Students are responsible for the maintenance and care of their research animals during all stages of their research. Prior to starting a research project, each student is required to attend a meeting with the animal care staff and discuss the appropriate animal husbandry protocol with their research advisor.

In the event that a student does not tend to his/her research animals appropriately, defined below as “neglect”, the Neuroscience Program will follow this general system of three “strikes” as necessary:

1. The first time neglect is discovered, an e-mail will be sent to the student in question, the Animal Review Committee (ARC) chair, and the research advisor alerting them to the problem.
2. If the problem is not corrected, or if a new problem arises, a second e-mail to the above parties will be sent, and there will be an automatic 1 letter grade penalty for the semester.
3. Should problems continue after the above warnings, a third e-mail will be sent. In addition, the animals will be taken away, ARC will terminate research approval, and the student will fail for the semester.

The Neuroscience Program defines “neglect” as being remiss in the care or treatment of research animals, regardless of intention. Neglect includes, but is not limited to:

- Not feeding or watering animals to the satisfaction of the Neuroscience Program
- Not providing clean living spaces for animals, including water or bedding changes
- Allowing animals to become ill or diseased*
- Allowing animals to die*
- Not checking on the health and well-being of the animals
- Not logging feedings, health, etc. in logbooks
- Falsifying records or reports of care

ARC and the Neuroscience Program reserve the right to intervene and terminate the research at any stage, skipping strikes and proceeding directly to consequence 3. Decisions to skip strikes or modify the consequences for animal neglect are made on a case-by-case basis, and the outcome is based on the degree of neglect. Students that reach consequence 3 will not be able to use animals in research for the remainder of their time at Allegheny College.

* unless stated explicitly as an experimental outcome in the approved ARC protocol

H) Materials that students are required to turn in and relevant due dates

The first (normally fall) semester's work is worth 2 credits and involves writing a research proposal, discussing the proposed research with the senior project committee, learning experimental techniques, and beginning the actual process of data collection and analysis.

Quick Reference for Due Dates

Research Proposal	Friday, October 4, 2019 @ 5:00 pm
Proposal Meeting with Committee	by Friday, October 25, 2019
Progress Report or Intro and Methods	December 10, 2019 @ 5:00 pm
Final Draft of Senior Project	March 30, 2020 @ 5:00 pm
Oral Defense	by April 17, 2020
Final Corrected Senior Project	by April 28, 2020
Complete Neuroscience Abstract Form .	by April 28, 2020

Research Proposal

The research proposal is based on a current review of the primary literature relevant to the hypothesis proposed. This review should place the proposed research in context, and demonstrate that the student understands this context. We expect the proposal to be well organized, with good syntax and grammar. The proposal should contain 1) an introduction to the topic that includes a literature review of background information, 2) a statement of the hypothesis(es) to be tested or the objectives of the project, 3) methods including a detailed experimental design that can adequately test the proposed hypotheses or address the project objectives, 4) a description of the statistical tests that will be used, 5) a budget, and 6) a timetable for completing the project. The experimental design is expected to be complete, with appropriate controls and replications (if necessary), and statistical analyses (if appropriate) to be used. An exhaustive treatment of methods will not compensate for a poor review and vice versa. The timetable should include a list of expectations for the work that will be completed during the first semester.

Students are to provide each committee member with a copy of the proposal by the first Friday in October. Students are expected to schedule a meeting with their committee, to be held by Friday, October 26, 2018. The committee will formally evaluate and approve the proposal at this meeting and agree upon a list of expectations for progress during the first semester. After the proposal meeting, the committee will assign a grade to the written proposal (based on the average of each committee member's evaluation).

Progress Report or Introduction and Methods Section

Students submit a progress report or the Introduction and Methods sections to their senior project advisor by the last day of class in the Fall Semester. Check with your senior project advisor to determine what materials they want you to turn in. A progress report should contain a description of the work done on the project during the first semester, including a summary of any relevant data collected, a discussion of problems and/or modifications of the proposed experimental design suggested by the preliminary experiments, and revised timetables, expectations, and "plan of action" for the spring semester.

This document, along with informal observations of the student's progress, will be used to assign a grade for the first semester of the senior project. The progress report will be graded by the student's senior project advisor (subject to approval by the committee) against the list of expectations agreed to at the proposal meeting. Extenuating circumstances will be considered and lack of progress on some expectations might be traded for progress beyond expectations in other areas.

Final Written Report

The second (normally spring) semester's work is worth 4 credits and continues the experiments and data analyses begun in the first semester. Students must submit a final written report on the research project by the second Monday after Spring Break. Shortly after the written report has been submitted the student should arrange for an oral defense of the report, to be held within three weeks. In this oral defense, the students will be expected to present their findings and answer questions from the senior project committee about the project.

General guidelines for how the final project is prepared

1. The report should be well written in proper English and of a style consistent with the literature in the specific field.
2. The report must be typed, double spaced, with 1 inch margins, except 1.25 inch on left side.
3. Quotes are generally not used in scientific writing. Their content can generally be incorporated without direct quotes.
4. Properly reference outside sources using the APA format.
5. Metric units should be used.
6. Assume that the reader has a basic understanding of the area of the subject matter.

The written thesis must include the following sections:

1. Abstract

The abstract should be a brief (< 200 words) paragraph that highlights the salient points of the research.

2. Introduction

The *Introduction* should contain: 1) an introduction to the topic addressed in the project, 2) a summary of background information that demonstrates knowledge of what is already known in this field and how the current project will add to that knowledge, and 3) a clear statement of the hypothesis(es) being tested or the objective(s) of the project.

3. Materials and Methods

The *Methods* section should: 1) include a description of the methods, materials, and protocol used to conduct the study, 2) be detailed enough for someone else to reproduce the study but not include extraneous and unnecessary details, and 3) include an experimental design appropriate to the questions being asked (i.e., adequate replication and controls)

4. Results

The *Results* section should be a clear exposition of the actual findings with some assistance to the reader to show which results and relationships should be specifically considered. Explanations of the results should be presented in this section while the interpretations of the findings and their significance should be left for the *Discussion* section. Appropriate statistical analyses must be used to aid in evaluating the data. The style of tables and figures should follow accepted styles in the discipline. Tables and figures should be well labeled so that they are clear enough for the reader to understand the data in them without referring to the text. Lengthy tables of raw data should be placed in appendices.

5. Discussion

In the *Discussion* section the results should be discussed with regard to the hypothesis or objectives posed in the *Introduction*. The discussion should not include a reiteration of the results, but rather should be an interpretation of the findings and their relationship to previously published information on the topic. The student should use appropriate supporting or contradictory literature to put the results in perspective. However, this is not a review of everything that is known about the subject. Weaknesses or limitations of the study should be discussed in this section. Finally, further research to clarify some of the unanswered issues related to the project should be discussed.

6. References

All references cited in the text of the thesis should be listed in an order consistent with the published literature in the field and the APA format.

How the final written report is turned in:

During the spring semester the senior project advisor will indicate the particular deadline schedule she/he will use for the completion of rough drafts of parts of or all of the written senior thesis. The final draft of the written thesis must be turned in to each committee member by the second Monday after Spring Break (Monday, March 30, 2020). This is the copy that will be graded and failure to meet this deadline will result in one letter grade penalty, plus an additional 2/3 letter grade penalty for each additional week past this date. The copies submitted at this time should not be bound because the committee might require revisions after the oral examination.

Students are to submit one copy of the corrected, bound, and signed copy of the thesis to the senior project advisor no later than the last day of classes. Failure to meet this deadline will result in 1/3 letter grade penalty, and failure to submit the bound thesis by 4 pm on the last day of Finals will result in an incomplete (and no graduation).

In order to insure that students properly clean up the cultures, organisms, equipment, etc., which they have used in their senior project, we require that all clean-up be completed and that all keys have been returned before the final grade will be submitted to the registrar.

I) Arrangement and format of the senior project oral defense

Students will organize the time, date, and location of the final oral examination. The oral defense is generally scheduled for 45-60 minutes. For the first 10-15 minutes the student gives a presentation of their project. Thereafter the members of the committee ask the student questions. The oral defense is intended to test the depth and breadth of knowledge relevant to the topic. The student should be able to demonstrate a solid understanding of 1) the subject area and be aware of problems and/or limitations of the particular study, 2) the methods used and their relevance to the overall project, and 3) the most important literature references related to the project. Students should demonstrate during the oral defense that they are intellectually involved with the work. Students should be ready to discuss and make their own interpretation of the ideas in their study based upon fundamental concepts in Neuroscience. Students conducting research with neuroscience faculty in the Biology department will participate in the Biology Senior Project Symposium. Details on the format of this symposium are provided on the Biology Home Page.

At the oral defense, the committee may ask students to make changes in the written thesis. Those changes must be made in order for students to receive their grade.

J) Determination of senior project grade

Grading of the Neuroscience Senior Project will be determined as follows:

Fall Semester (2 credits)

30% of the grade is based on the quality of the written research proposal.

70% of the grade is based on the extent and quality of the progress made on the project as shown primarily in the written progress report, as well as attendance and quality of participation in Senior Seminar.

Spring Semester (4 credits)

33% of the grade is based on the quality of the written final project.

33% of the grade is based on the level of scientific scholarship that the student displayed during the research. (The Neuroscience Faculty considers intellectual curiosity, independence, distance traveled from the start of college and/or start of the project, persistence, flexibility, and participation in Senior Seminar, as evidence for scientific scholarship).

33% of the grade is based on the quality of the oral defense of the project and presentation of the project.

The grading procedure at the end of spring semester for the senior project is as follows:

Immediately following the senior project oral defense, the committee will tell the student whether or not any revisions are required in the written manuscript. When these corrections have been made to the satisfaction of the committee, the student can submit a bound copy to his or her advisor. The senior project advisor will submit the senior project grade to the registrar after the student has: 1) submitted the corrected and bound thesis, 2) given the oral defense and oral presentation, 3) cleaned the work space and returned all materials used during the project, and 4) submitted an electronic version of their abstract using the [Neuroscience Abstract Submission Form](#).