

## THE SENIOR EXERCISE IN NEUROSCIENCE

In completing the Neuroscience Senior Exercise, students are expected to:

- use primary literature as the foundation for understanding and developing ideas and arguments.
- understand and think critically about experimental design and data.
- identify important questions and design new experiments.
- integrate material from several courses or subdisciplines.
- consolidate and synthesize basic neuroscience information.

This document contains information regarding the formation of the Neuroscience Senior Exercise committee, the selection of the senior exercise topic, the preparation of the proposal abstract, and the due dates associated with this process. It also contains a detailed description of the writing format and the expected contents of the various sections of the final proposal. Consistent with NIH research grants, these sections include: (a) specific aims, (b) background and significance, (c) research design, methods, and analysis, (d) ethical treatment of human/vertebrate animal subjects, and (e) literature cited. This information is available from the Chair of the Neuroscience Program and also from the Neuroscience website.

### **The Original Research Proposal**

As stated in the Kenyon College Course of Study and the Neuroscience website, the Senior Exercise for majors in Neuroscience consists of writing an original research proposal, using the somewhat unique format that is appropriate for a scientific grant (e.g., National Institutes for Health). The proposed research does not have to be a project that the student is actually expected to conduct, so it may involve subjects (e.g., primates, hospitalized patients) and sophisticated experimental or clinical equipment (e.g., MRI or PET imaging methods) that are not available at Kenyon.

**The final draft of your original research proposal is due at 12 noon November 20, 2015.**

### **Choosing a Senior Exercise Advisor and Senior Exercise Committee**

Your Senior Exercise Advisor can be any faculty member affiliated with the Neuroscience major. In choosing a faculty mentor who will advise you on the senior exercise, you should select a faculty member whose field of expertise or interest is reasonably related to the area you expect to research. *Note: Due to the amount of time that can be involved with advising, each faculty member can only accept a few seniors, so you may need to contact several professors.*

**You must have found a Senior Exercise Advisor by September 9<sup>th</sup>, 2015**, however you may initiate discussions and choose your mentor as early as April 2015, which may enable you to more fully engage your topic over the summer. You may begin discussions with your Senior Exercise Advisor regarding potential research topics as soon as the mentor has signed the Senior Exercise Faculty Advisor Form.

**The Senior Exercise Faculty Advisor Form must be signed by your selected mentor and submitted to the Department Office by September 9<sup>th</sup>, 2015.**

The final draft of the Senior Exercise research proposal will be evaluated by a two-member committee, which is comprised of the Senior Exercise Advisor and another faculty member affiliated with the Neuroscience major. Decisions about the additional member of each student's Senior Exercise Committee are initiated by the student and discussed with the student's Senior Exercise Advisor and finalized by September 23<sup>rd</sup>, 2015. (On special occasions, if your advisor recognizes that a faculty member without Neuroscience affiliation has appropriate expertise in your proposal area, you may petition to the Chair of the Neuroscience department to have this professor as the second member of your committee.)

### **The Senior Exercise Topic and Proposal Abstract**

By September 23, 2015 the student must submit a 300-word abstract, or summary, of the topic of the proposal to his or her Senior Exercise committee. This abstract is also used by the faculty to determine if the hypothesis(es) is sufficiently different from previous assignments that have been, or are being, done by the student. Unanimous approval of the abstract of the proposal by the members of the committee must be confirmed, in writing, on the "Neuroscience Senior Exercise Topic Approval Form." This form can be obtained from the Neuroscience website <http://www.kenyon.edu/academics/departments-programs/neuroscience/academic-program-requirements/senior-exercise/> or the Neuroscience Senior Exercise Moodle site and should be turned in to the department Administrative Assistant, Ms. Hashman.

### **The Original Research Grant Proposal**

The purpose of the original research grant proposal is to demonstrate your ability read and understand the current literature, to identify important open questions, and to understand and think critically about both experimental design and data. Once you have decided on an open question to investigate, your overall objective is to describe future work that needs to be done to address that question.

The original research grant proposal must describe your proposed future work in detail. Present a research question and a hypothesis, then describe the experimental system(s) and specific techniques and methods that will be used to test the hypothesis. Where appropriate, describe the control groups and the data analysis that will be employed. State what results would support or contradict the hypothesis. Indicate potential problems that might arise during the experiments and suggest alternative strategies where possible. Where possible, you should support your proposed research questions and experiments through references to relevant literature.

Within the original research grant proposal you should describe at minimum one, but up to three original and **well thought out** hypothetical experiment(s). Since the most influential publications in Neuroscience require multiple experiments for submission criteria, having designed a research project with several experiments is highly encouraged for the senior exercise. Having a multi-experiment proposal is an indicator that the author has spent considerable thought on the research agenda. In order to think ahead for multiple experimental exploration, you must consider the

potential outcomes of the first experiment, and then design follow-up studies that could assess validity issues (e.g., theoretically, what should happen; or be related/not related to a variable), or rule out potential confounds so that your expected finding could be strengthened.

Although it is possible for the topic or hypothesis(es) to be somewhat related to your previous work (ex. the research proposal for other courses, topics under investigation in an Honors or independent research project, term papers, etc.) the major theme or hypothesis(es) of the original research proposal must be clearly different from these other assignments in terms of the involvement of unique subject populations, methods, measures, and/or analyses. Additionally, you may not describe experiments and results that have already been published; it is your responsibility to know the literature well enough to avoid previously published experiments. When you sign the “Neuroscience Senior Exercise Topic Approval Form” you are confirming that you are going to abide by these principles. At any point during this exercise, if you have any questions about the originality of your work, make sure to talk to your Senior Exercise Advisor.

Technical and logistical questions about the format, style, etc. of the actual proposal should be directed to the Senior Exercise Advisor.

### **The Format of the Senior Exercise Original Research Grant Proposal**

The student should use the scientific-writing style of the *Journal of Neuroscience* and avoid the use of the first person as much as possible. All sections of the proposal should be in Times or Times New Roman, 12-point font, and single-spaced, with 1 inch margins on all sides of the page, and one blank line between paragraphs. Section headings should be centered and in bold face. Thus, the layout of the proposal should be similar to the remaining sections of this document. The NIH sectional format to be used for this research grant proposal is described below:

#### **Face Page**

The following information should appear on this cover page: the student’s full name, Neuroscience Senior Exercise, Kenyon College, the date, the names of the Senior Exercise Advisor and committee members, and the title of the proposal. The title should not exceed 56 characters, including spaces between words and punctuation. Choose a title that is specifically descriptive, rather than general. It should be centered in the middle of the cover page and typed in boldface.

#### **Abstract (final version)**

On a separate page, using the present and future tenses, state the specific aims and possible broad, long-term objectives of the proposed research, making reference (without citing specific textbooks or articles) to the health or mental health relevance of the project. Concisely describe the research design and methods for achieving these goals. Avoid long summaries of past studies and the use of the first person. This description is meant to serve as a succinct and

accurate description of the proposed work, and it should not depend on the presentation of specific information found in the remaining sections. It is probably easier to write a good abstract after you have completed the other sections of your proposal. Above the abstract have the title of your proposal. *[Limit the final version of your abstract to 350 words. This should be a revised and slightly expanded version of the abstract stated in the Topic Approval Form.]*

## **Research Proposal**

Number the pages of all the remaining sections, starting with Page 3, and do not begin each section on a separate page. Use the writing style appropriate for your discipline, and avoid the use of the first person in all sections. However, always cite references by the last name of the first author (using et al. for multiple authors) followed by the year of the publication in parentheses: e.g, Brown, et al. (1997) or (Brown, et al., 1997; Jackson, et al., 1991; Smith & Thomas, 1994). Later, in the Literature Cited section, you should provide the list of complete references, in alphabetical order, using the standard style of your discipline.

### ***I. Specific Aims***

Use the present or future tenses in this section, and begin with a short paragraph that provides some of the theoretical and empirical background of the proposed research project. Then, present the broad, long-term objectives and what the specific research is intended to accomplish. That is, list each of your major aims or objectives in terms of specific hypotheses. Each of these listed aims should be explained in some detail, and they should be a logical extension of the literature review that will be presented in the following section. Be sure that you have operationally defined the specific variable(s) that you are manipulating (independent variable) and the variable(s) that you are measuring (dependent variables). In many neuroscience studies, there are one or two manipulated or predictor variables that are examined in terms of several behavioral, physiological, or biochemical measurements. Note: You should not give a complete description of all of your methodological or procedural details in this section. Rather, focus on what do you intend to do in broad terms and what questions you hope to answer. *[One or two pages are recommended.]*

### ***II. Background and Significance***

Using the past tense, review the theoretical and empirical literature that provides a logical background leading to the purpose(s) of your proposed study. Critically evaluate the existing knowledge in the scientific literature and indicate the specific gaps that the proposed research is intended to fill, using the present or future tense. Be sure to state concisely the importance and health relevance of the research, described later in terms of your methodology, by relating what you stated as your specific aims to broad, long-term objectives. In summary, this section should reflect your knowledge of what other scientists have done and why your proposed project is important in terms of its theoretical implications or practical applications. *[Two to three pages are recommended.]*

### ***III. Research Design and Methods***

Using the future tense, give a detailed description of the research design (or strategy) that will be used to accomplish the specific aims of the proposed project. Include how the data will be collected (subjects, equipment, and materials or supplies), analyzed, and interpreted. Be sure that you give precise operational definitions of the specific methods you intend to use to manipulate your independent variables and record or measure your dependent variables. Describe any new approach or methodology (or combination of methods) and explicitly state the advantages over existing methodologies. Discuss the potential difficulties and limitations of the proposed procedures and alternative approaches to achieve your stated aims. As a part of this section, provide a hypothetical sequence of events and timetable for the project. Point out any procedures, situations, or materials that may be hazardous and the precautions to be exercised. In summary, this section should indicate the subjects, equipment and supplies, design and procedure, statistical analyses, and other considerations that are involved in conducting the proposed research. *[Three to four pages are recommended.]*

### ***IV. Ethical Treatment of Human/Vertebrate Animal Subjects***

If you are using human or other vertebrate animals as subjects, use the future tense in providing sufficient information to show that the proposed research is in compliance with the ethical issues stated in the “Guidelines for the Treatment of Human and Animal Research Subjects.” Some of these issues may have been addressed briefly in your methodology section where you described specific procedures and measures. A copy of these guidelines was distributed in the Research Methods courses (PSYC 401, 403, 406) and can be found at the Neuroscience Senior Exercise Moodle site. *[One-half to one page is recommended.]*

### ***V. Literature Cited***

List all references in alphabetical order, according to the last name of the first author. Each reference must include the names of the author(s), year of publication, title of the article or book chapter, name of journal or title of book, volume number of journal, and page numbers. Use the referencing style from the Journal of Neuroscience, which can be found on the following website, [www.jneurosci.org/site/misc/ifa\\_organization.xhtml#References](http://www.jneurosci.org/site/misc/ifa_organization.xhtml#References) *[Although there is no page limit for this section, there should be at least 12 primary (i.e., journal) references, with at least 4 from the last five years.]*

**Ultimately, your Research Proposal should be at least 10 single-spaced pages and should not exceed 17 single-spaced pages (including the Face Page, Abstract, Ethical Treatment of Subjects, and Literature Cited sections).**

## **The Evaluation of the Senior Exercise Original Research Grant Proposal**

Evaluation of the Senior Exercise is based solely on the student's research proposal as there is no oral examination. Likewise, the student's grade point average is not a factor in evaluating the Exercise. Each original research proposal will be read by at least the student's Senior Exercise Committee and the faculty affiliated with the Neuroscience major will approve the final evaluation. The members of the student's committee will meet to discuss the strengths and weakness of the proposal, after which time the Senior Exercise Advisor will prepare a written summary of the major points that were discussed. Decisions will be made by the end of the first semester.

The grading of the senior exercise consists of the following categories: "Rewrite," "Pass," "High Pass," or "Distinction." Original research proposals receiving "Distinction" are usually marked by originality, outstanding scientific writing, analysis and organization. Additionally, the flow of the discussion and the use of primary literature should be exceptional. If a "Rewrite" is required, the student will be required to submit a revision of the original proposal using the faculty's feedback. The evaluation of the revised version will determine the official grade category that is to be entered on the student's transcript. (However, a student who is required to do a "Rewrite" cannot receive "Distinction.") If you are required to do a rewrite, the deadlines, will be scheduled by the Chair and your Senior Exercise Advisor. **Should you not satisfactorily complete any part of the senior exercise in Neuroscience you cannot graduate.**

### **Plagiarism**

You must write in your own words and avoid close paraphrasing. Ask your mentor about paraphrasing if you have any questions. Never use quotes, but rather describe things as you understand them. Always remember to insert citations where appropriate.

***The electronic submission of your work at the Neuroscience Senior Exercise Moodle site automatically checks for plagiarism through turnitin.com.***

*If a prospective or current Neuroscience major has questions about any aspect of the previously described Senior Exercise in Neuroscience, please feel free to contact their Senior Exercise Advisor or the department Chair.*

## **Due Dates and Logistics**

**Moodle** will be used to submit work electronically. See the Neuroscience Moodle site for updated instructions on uploading work. (Be aware that your original written work submitted to Moodle will be automatically submitted to **turnitin.com**.)

All submissions are due by **12 noon** on the due date. See specific submission instructions below for each deadline.

**Sept. 9**      **[Wednesday]** Final date for commitment to a mentor. Faculty mentor form submitted to Mrs. Hashman in her office (Tomsich 110, 8:30<sub>am</sub> – noon & Sam Mather 303, 1-4:30pm).

**Sept. 23**      **[Wednesday]** The senior exercise topic and proposal abstract should be submitted to Mrs. Hashman in her office (Tomsich 110, 8:30<sub>am</sub> – noon & Sam Mather 303, 1-4:30pm). Note that mentors may also require paper copies at their discretion.

**Nov. 20**      **[Friday]** Final manuscript in electronic form as a single document to the **Neuroscience Senior Exercise Moodle** site. Also submit the **most pertinent primary literature cited** (5-10 primary sources) as PDF documents via **Moodle**. Note that mentors may also require paper copies at their discretion.

***Due dates are non-negotiable.*** If any deadline is not met, the Dean for Academic Advising will be notified, and you may be required to begin the written portion of the senior exercise over with a new journal article. Comments by your faculty mentor will generally be returned within one week following each deadline.

- Failure to meet a deadline automatically results in loss of eligibility for distinction.
- Time stamps on Moodle define on-time submission for electronic documents.
- Without successful and timely completion of the senior exercise you cannot graduate.

**All drafts submitted must show professional English style and usage throughout, including page numbers and proper reference format.** If deficiencies appear, you will be required to work with a scientifically literate tutor at the Writing Center or your faculty mentor before submitting the revised manuscript. Revised manuscripts that still show serious deficiencies in style will not satisfy the senior exercise.