Trinity University

Neuroscience Major

Student Handbook

Fall 2015 - Spring 2016

The following requirements apply to all those graduating according to the requirements of the Course of Study Bulletin 2015-2016. If you graduate according to a different Bulletin, you must fulfill the requirements listed under Neuroscience in that Bulletin. By default, you are assigned the COSB requirements of the year you declare Neuroscience as your major, usually your sophomore year. You can use later COSB rules but not rules of earlier years.

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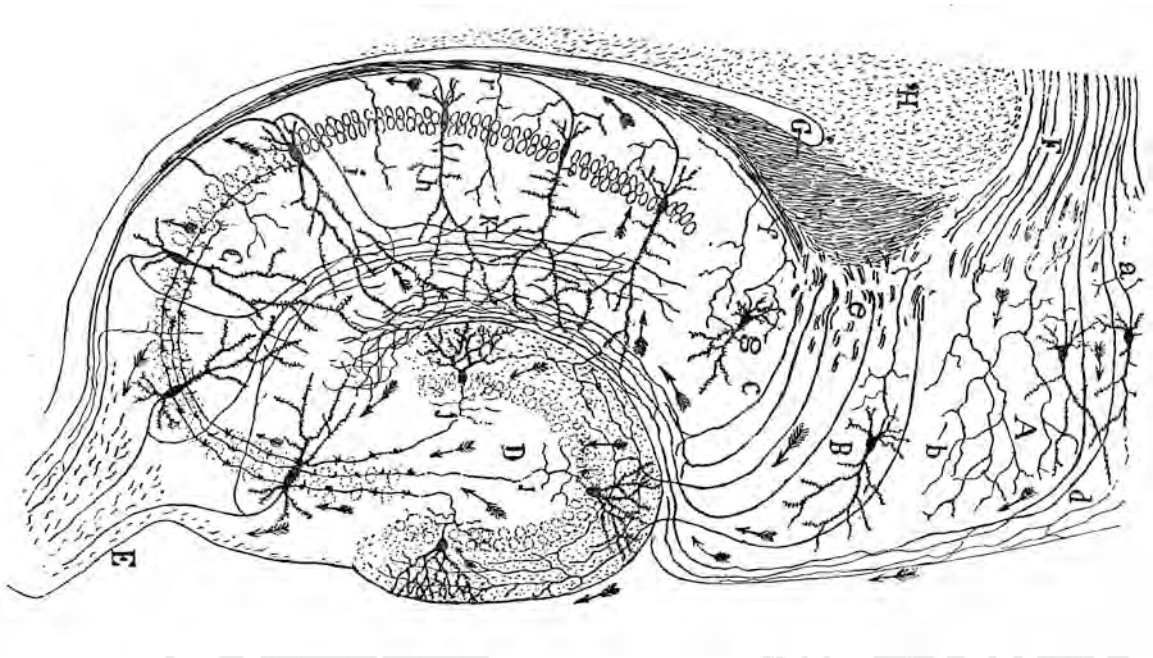


Hippocampal circuits drawn by Santiago Ramón y Cajal at the turn of the 20th century. In order to isolate single cells, Cajal employed a stain developed by Camillo Golgi in 1873. Based on his anatomical studies, Cajal proposed the *neuron doctrine* which indicates that neurons do not form a continuous network but rather communicate through a small gap between their somatic projections. Arrows denote the direction of the "nervous impulse".

The Major in Neuroscience

The Bachelor of Science in Neuroscience is an inter-disciplinary program designed to provide an understanding of the nature and functioning of the nervous system from the molecular to the behavioral level. Courses are taught by faculty from the Biology, Chemistry, Physics/Astronomy and Psychology departments, offering a broad spectrum of topics and approaches to the study of neural systems structure and function.

Neuroscience Advisory Committee:

Faculty	**Department**	**Email address**	**Telephone**
Dr Kimberley Phillips (co-chair)	Psychology	Kimberley.Phillips@Trinity.edu	x7102
Dr. James Roberts (co-chair)	Biology	James.Roberts@Trinity.edu	x7233
Dr. Carol Yoder	Psychology	Carol.Yoder@Trinity.edu	X8385
Dr. Tyisha Williams	Biology	Tyisha.Williams@trinity.edu	X8857
Dr Kelvin Cheng	Physics	Jcheng1@trinity.edu	X8469
Dr. Laura Hunsicker-Wang	Chemistry	lhunsick@trinity.edu	X7895

Requirements for the Degree:

The requirements for the degree of Bachelor of Science with a major in Neuroscience are as follows:

I. The common curriculum

II. Specific degree requirements for the neuroscience major (59 semester hours)

A. Core curriculum in Neuroscience (11 hours):

NEUR 2310 Introduction to Neuroscience
NEUR 2110 Neuroscience Laboratory
NEUR 3447 Neurobiology
NEUR 4000 Neuroscience Seminar (4 semesters)

B. Supporting courses in Biology (12 hours):

BIOL 1311 Integrative Biology I
BIOL 1111 Introductory Biology Laboratory
BIOL 2412 Cell, Systems and their Environment
BIOL 2413 Genes, Phenotypes and Evolutionary Dynamics

C. Supporting courses in Chemistry (8 hours):

CHEM 1318 Chemistry in the Modern World
CHEM 1118 Introduction to Analytical Methods
CHEM 2319 Organic Chemistry
CHEM 2119 Laboratory Methods in Organic Chemistry

D. Supporting courses in Psychology (11 hours)

PSYC 1300 Principles of Psychology
PSYC 2401 Statistics and Methods I
PSYC 2402 Statistics and Methods II

E. Four elective courses from the following set, with two from each discipline (14 hours):

BIOL 3420 Animal Behavior
BIOL 3451 Vertebrate Physiology
BIOL 3453 Developmental Biology
BIOL 3456 Cell Biology
BIOL 3459 Endocrinology
BIOL –91 Selected Topics (3 hours, advisory approval required)
PSYC 3311 Sensation and Perception
PSYC 3331 Memory and Cognition

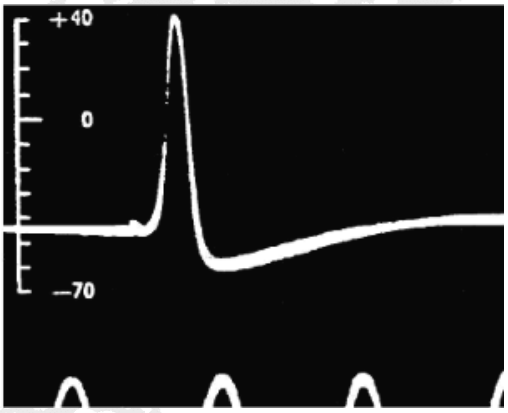
PSYC 3340 Psychopathology
PSYC 3360 Special Topics in Psychology (advisory approval required)
PSYC 4390 Senior Seminar in Psychology (advisory approval required)

A. Neuroscience Integrative Experience (3-6 hours). One course from the following, taken after full acceptance into the Neuroscience program:

NEUR 3360 Special Topics in Neuroscience
NEUR 4-90 Research in Neuroscience
PHYS 2311 An Introduction to Biophysics

III. Electives sufficient to total 124 semester hours (inclusive of common curriculum)

In 1939, Hodgkin and Huxley published the first description of an action potential following membrane depolarization. This figure shows the oscilloscope signal published with their findings. The scale is in millivolts and the peaks at the bottom of the image are a time stamp.
Subsequent studies by the same group would lead to the explanation of the roles of sodium and potassium ions in the generation of action potentials.



Becoming a Major in Neuroscience

Typically, major declaration occurs during the spring semester of the sophomore year. By this time, you should have taken the biology and chemistry requirements for the neuroscience major and the Introduction to Neuroscience and Neuroscience Laboratory. We recommend you take the two statistics courses in your second year as these are common requirements for upper level courses.

If you are interested in the Neuroscience Major, feel free to contact one of the faculty in the advisory committee for more information and advice.

Guidelines for acceptance of majors

Full acceptance in the major is granted if the following requirements are met at the time of application:

Completion of NEUR 2310/2110, BIOL 1311/1111, CHEM 1318/1118, and PSYC 2401 with a grade of C or better.

An overall grade point average of at least 2.0.

Honors Program

To be eligible for graduation with Honors in Neuroscience, students must earn a grade point average of at least 3.33 in all courses taken prior to the semester before graduation, a grade point average in neuroscience courses (core and supporting) of at least 3.50, and "A" in the research portion of their major: either BIOL 4398 and 4399 or PSYC 4395 and 4396 (thesis research in Biology or Psychology) or NEUR 4390.

To apply for graduation with Honors in Neuroscience, students should address a written request for consideration to the Faculty Advisory Committee. The request must be received no later than the first full week of the student's final semester before graduation. The decision to confer or not to confer Honors will be made by the Faculty Advisory Committee and the Research Supervisor and will be based on the quality of the written thesis and its oral presentation in a colloquium.

Research in Neuroscience (NEUR 4390)

A Neuroscience major at Trinity University may choose, for their Integrative Experience, to complete one semester of research in neuroscience for credit by registering for the course NEUR 4390. Students are able to fulfill this research requirement through research on- and off-campus as long as it fulfills the following expectations:

(1) students develop a meaningful research project for which it is reasonable to expect completed results no later than the end of the semester in which you are enrolled in 4390,
(2) students will work an average of 10 hours/week on the project during the semester (or 30 hours/week in the summer)
(3) the research mentor/project sponsor will provide feedback to the student in preparing a written report and a presentation based on the research results

Requirements for research proposal:

All materials are due to be submitted electronically to the Neuroscience Steering Committee Co-Chairs. To graduate with a major in Neuroscience in May, you must submit the proposal ***no later than September 1, 5:00 pm during your senior year for projects completed during the academic year; no later than January 20, 5:00pm for those graduating in December; and no later than May 1, 5:00 pm for summer research experiences.***

All proposals must have the following sections:

Abstract. This should be a concise summary of your proposed project. Do not exceed 200 words. You and your Trinity sponsor must sign and date the Abstract page. You must use the cover sheet on page 13.

Introduction to the project. You should discuss the general problem to be addressed, the theoretical context of the work, and the most relevant literature to the problem. You must also state the hypothesis to be tested in your project.

Methodology. Describe the techniques and methods to be used to test the hypothesis. Discuss why these methods were chosen. Identify the materials and supplies you will need to conduct this research. Indicate any potential pitfalls and how you are prepared to address them.

Data analysis. Indicate how you will analyze and interpret your data. Justify your analysis.

Significance. Indicate the contribution of the work to the published literature/field. If this project is a portion of a larger project in the laboratory, state how this project fits into the whole.

Location. Indicate precisely where the research will be conducted. If the research is to be conducted off-campus, the off-campus sponsor must provide a separate letter of support for project, indicating that he/she has read the proposal and agrees to supervise the proposed research.

References. Citations should follow APA style (6th ed).

Formatting. Number all pages on the bottom center of the document. Use Times New Roman, 11 point font; double-space throughout. The entire proposal can be no longer than 5 pages.

Requirements for research report:

The student must submit a written report to the Neuroscience advisory committee by the first day of finals for the semester the student is enrolled in NEUR 4390. The report must be written in the style and format of a scientific research article (Abstract, Introduction, Methods, Results, Discussion, References, Tables, Figures) and written in APA style. Before submission to the advisory committee, the report must first be submitted to the project sponsor, and the version the student will hand in by the due date will be a revision that is responsive to comments made by the project sponsor.

Requirements for research presentation:

In the same semester in which the student is registered for NEUR 4390, the student must publicly present the research. The presentation should be 15 minutes, with time for questions. The research mentor/project sponsor is expected to provide feedback to the student in preparing the presentation.

Neuroscience 4390 – Research Proposal Cover Sheet and Contract

Name of Trinity student: _____
Name and location of research sponsor: _____
Title of research proposal: _____
Approximate cost of materials and supplies: _____
Funding source(s) and amount: _____
Semester of data collection: _____

Attach to this form your research proposal, including your introduction, methodology, data analysis, significance, location (with letter of support if off-campus), and references.

By signing this contract, the Trinity student and non-Trinity research mentor or Trinity project sponsor named below agree to fulfill the above-stated expectations for an independent research project as part of the requirements of the Neuroscience major.

Signature of Trinity student: _____ Date: _____

Signature of off-campus research mentor: _____Date: _____
(Required for off-campus research only)

Signature of on-campus faculty advisor: _____ Date: _____
(Required for off-campus research only)

Signature of on-campus research project sponsor: _____ Date: _____
(Required for on-campus research only)

ABSTRACT

Neuroscience Research Opportunities

On-Campus Opportunities

Becker
The focus of the lab is on body image, eating disorders, dissemination and implementation of evidence-based interventions, and PTSD. Neuroscience students typically piggyback a study that involves collection of biological data onto existing psychological studies and are supervised by biology faculty in analysis of that data. Neuroscience students also review relevant literature and relate findings associated with biological data back to psychological data collected for the same study.

Cheng
Projects involve the use of computational and single-molecule spectroscopy tools to explore the roles of lipid composition, domain structure and membrane potential in the interactions of beta amyloid protein with neuronal membranes. We are particularly interested in the molecular mechanisms of protein insertion into membranes as well as protein-misfolding and self-aggregation on lipid membrane surface and their association with the pathogenesis of Alzheimer's.

Childers
Projects typically test hypotheses concerning how children deduce the meaning of a new verb. Neuroscience students would review what is known about brain areas involved in the acquisition of words (nouns or verbs) in adults or children.

Cooley
My lab is focused in part on the development of new therapeutic approaches to treat and prevent neurodegenerative diseases such as Alzheimer’s Disease. I am particularly interested in a broad therapeutic strategy to treat a spectrum of protein misfolding diseases by the activation of stress-responsive signaling pathways which can remedy protein misfolding and neurodegeneration only under conditions of disease onset and progression. This project involves the chemical synthesis and biological evaluation of small molecule prodrugs designed to release free drug under specific conditions of cellular stress associated with neurodegenerative disease such as oxidative stress.

Hertel
Projects typically concern the effects of attentional focus on performance on other cognitive tasks, such as memory or interpretation. We examine performance differences associated with depressed and anxious states. Neuroscience students would review literature on cortical activation associated with the relevant cognitive processes in depressed or anxious states, in addition to the usual activities of design, data collection, and analysis.

Johnson
Projects examine the mechanisms of lizard social behavior and the ecological contexts in which these behaviors occur. We're particularly interested in the neural, muscular, and hormonal traits that underlie reproductive behaviors, and how variation in these traits produces variation in behavior within and among species. Research in the Johnson lab involves field work (both locally and in the Caribbean) to determine how the environment influences neuroendocrine traits and behavior; histological and biochemical techniques to analyze tissues associated with these traits; and laboratory experiments on captive animals to allow careful, systematic manipulation of the animals and their environment.

King
Projects involve understanding how cells interact with their neighbors. Neuroscience projects would be broadly related to investigating the blood-brain barrier. Cellular models of glia-neural interactions may be investigated using confocal imaging and/or gene expression studies. Experience in Cell Biology and/or Physiology is desired.

Murphy
Projects investigate visual communication signals in birds and fish to study the adaptive function and the underlying honesty enforcing mechanisms that regulate signal intensity. For example, neuroethological research can focus on effects of testosterone and corticosterone in signal design and regulation, and how the physiological costs of testosterone, or the costs of stress — as indicated by corticosterone, vary with an individual's phenotypic quality, and how this translates into the amount of resources available to invest in signaling. Most research in the lab is on wild Goldfinches in Canada, Orioles in Mexico, and local Titmice in the hill-country, as well as on captive female Betta fish (and some captive birds). Neuroscience students would review the literature on the endocrine and neural mechanisms involved in the maintenance of communication signals and/or the sensory reception and processing of these signals.

Phillips
Current research in the lab focuses on the neuroprotective and neurotherapuetic effects of exercise. We investigate these questions using animal models (nonhuman primates and mice). We are interested in the degree to which exercise results in long-lasting behavioral, cognitive and neurological change. A related research area concerns the structural and functional brain changes associated with motor learning.

Roberts
The major research area in the Roberts' lab focuses on the role of the sex steroids, estrogens and androgens, in mediating protection/recovery of the brain from damage due to oxidative stress, focusing on the nigro-striatal pathway and its degeneration in Parkinson's disease. This whole system is characterized from the perspective of the changes which occur as the animal's age progresses. Astrocytes, the largest cell population in the brain regulate neuronal homeostasis and have been implicated in affecting the viability and functioning of surrounding neurons under stressed conditions. We study estrogen signaling in astrocytes to evaluate the mechanism of estrogens indirect neuroprotective effects on DA neurons. A new project characterizes the role that neuronal plasma membrane lipid content plays in a neuron's toxicity to ß-amyloid, a hypothesized confound in Alzheimer's disease.

Wallace
Projects investigate mechanisms of performance under pressure. Specifically, our lab examines the relationship between measures of approach and avoidance orientations (e.g., behavioral activation and inhibition systems) and performance outcomes in different social situations. Neuroscience students would review literature on the physiological and neurological roots of the performance mechanisms they study.

Yoder
Projects explore developmental changes in reasoning and learning about emotionally-laden topics during college years. Work here is associated with identifying behavioral evidence of prefrontal cortical changes associated with late adolescence and early young adulthood.

Off-campus Research Opportunities

Students may wish to pursue research opportunities with scientists at other institutions. We strongly encourage you to talk with your faculty advisor and the Co-Chairs of the Neuroscience Committee before committing to an off-campus experience. Should a student wish for this experience to fulfill the NEUR 4390 Research Requirement, he/she still needs to follow the previously stated procedures. Please note that research experiences off-campus will not automatically be approved as satisfying the NEUR 4390 requirement. You must submit your proposal to the Neuroscience Committee by May 1 for summer research experiences, and September 1 for academic year experiences.

Looking Towards the Future

Assuming that you are not considering attending medical school (in which case by now you already know what your next steps should be), what can you expect once you graduate with a B.S. in Neuroscience? By the time you need to answer this question you will know a good deal about the different applications of neuroscientific knowledge and will also know to some extent which field(s) attracts you the most. Regardless of the answer to that question, success in Neuroscience will most likely require you to attend graduate school. Another useful site regarding this information is maintained by the Society for Neuroscience.
http://www.sfn.org/index.aspx?pagename=ProfessionalDevelopment_ChoosingaProgram

At the moment the most sought after degree in Neuroscience is a Doctor of Philosophy (Ph.D.) degree. There are a few programs that offer Masters of Science (M.S.) programs but they are quickly disappearing due to the requirements of most entry-level positions both in academia and in industry.

A Ph.D. program on average lasts around 5 years. Many programs will tell you that the range is from 4-7 years, but it is rather uncommon to have people graduate in less than 5 years. In a typical program you will spend the first year (sometimes into the second) taking a few core courses and a few electives. During the first year, students are required to do "lab rotations" which means that you will spend a few months in 2-4 different laboratories doing research aiding in your decision of a laboratory to perform your thesis research. The final two to three years emphasize research and the writing of the Ph.D. dissertation. After your second year you will typically take a "qualifying" or "comprehensive" evaluation that is meant to gauge your preparedness to continue with the program to thesis research. The work done during your Ph. D. dissertation will generally produce 1-3 publications in peer-reviewed journals and thus set a basis for your future career.

Applying to graduate school

The next step in your career is obtaining an advanced degree in an area of your interest. Some people decide to apply to graduate school fresh out of Trinity, while others may decide to take one or two years to gain some more experience before committing fully to a research career. You could decide to gain more experience by working in a lab as a research assistant. This type of work may facilitate your admission in to some graduate programs. You should discuss with members of the neuroscience steering committee for guidance.

Once you are ready to tackle graduate-school applications, you should do a search for suitable institutions. Most major universities have a Neuroscience Program. An internet search with the name of the institution and the word "neuroscience" will usually produce the appropriate link to the departmental homepage. The Neuroscience Departments and Programs subcommittee of the Society for Neuroscience maintains an updated database on all neuroscience graduate training programs [http://www.sfn.org/ndp/search.aspx]. In choosing which institutions to look at, you could also ask your advisor or other faculty members. You can also look at the board on the first/fourth floor of CLS where a number of posters from different programs are located. You could also do a search based on a specific researcher whose work is particularly interesting to you.

Applications to graduate school typically include four elements: an official undergraduate transcript, GRE scores, letters of recommendation and a personal statement, and are generally due between December and February (to start the following fall).

The Graduate Record Examination (GRE)

The GRE has gone through many changes in the last few years, but the basic idea is to test for Quantitative reasoning, Verbal reasoning and Analytical skills. The highest score you can obtain is 800 on each of the three segments. For most institutions, the Quantitative and Verbal segments are the most carefully looked at. You should always aim to obtain the highest scores possible, but scores above 600 are desirable on each of the Quantitative and Verbal sections. **We highly recommended that you study carefully for your GRE.** You can either take a course or follow a study guide (available online or at major bookstores) at your own pace. If you are unsatisfied with your GRE scores, you may take the GRE over again. However, you should know that the GRE retains a cumulative record of your scores for 5 years, and all of these scores are submitted to Universities. More information on the GRE can be found at http://www.ets.org.

Recommendation letters

An application for admission to graduate school typically requires three recommendation letters from people who know your academic abilities and your personal qualities. These are generally faculty at Trinity or research advisors at other institutions where you may have carried out research. Make sure you provide them with all the necessary information (transcript and Personal Statement – see below) as well as an addressed stamped envelope, and allow plenty of time (at least a couple of weeks) for them to write the letters before the applications are due. A list of the institutions with deadlines is very useful when you are applying to a large number of universities. Increasingly, institutions are moving toward online applications. If the institution to which you are applying has an online recommendation process, be sure to speak with your prospective letter writers before submitting their names to the institution.

Personal Statement

It is what it sounds like. Usually a two-three page essay explaining the reasons why you want to attend graduate school in the specific program to which you are applying. You don't need to be verbose, but you do need to be articulate. Importantly, this is the only portion of your application in which you do the talking. So make sure your enthusiasm and commitment come through clearly. You may insert a bit of personal history regarding your basic motivation, but the most important information is what you have accomplished thus far, whether in scientific research or academically. So don't leave it to the last minute. Prepare a few drafts and have other people read it to make sure you are communicating your ideas succinctly. Ask your academic advisor to read a polished draft. We recommend making this document available to the people that you are asking for letters of recommendation.

Financial support during graduate school

By now you are probably wondering: how am I going to afford 5 more years of school? The good news is: you don't have to worry about that! Most neuroscience graduate programs will provide you with tuition remission (you don't pay for your courses) and a modest stipend (by modest we mean "about as much as you need to survive"… about $20-28K these days…. Such that you DO NOT have to work to participate in graduate school). In some institutions you may need to do some teaching in return for your education.

The Society for Neuroscience

If you have not joined as an undergraduate student, once in graduate school you should join the Society for Neuroscience (http://www.sfn.org).

From their website:

SfN provides professional development activities, information, and educational resources for neuroscientists at all stages of their careers, including undergraduates, graduates, and post doctoral fellows. The Society also provides programs to increase participation of scientists from a diversity of cultural and ethnic backgrounds.

As the largest organization of researchers studying the nervous system, the Society for Neuroscience remains committed to directing national efforts to increase the diversity among individuals participating in neuroscience research.

Currently, SfN, the American Psychological Association, the Texas Consortium, and Vanderbilt University maintain the fellowship programs listed below, which provide minority students in the neurosciences with professional opportunities to develop and enhance their career paths.

Minority Neuroscience Fellowship Program

The SfN Minority Neuroscience Fellowship Program is an extramural training program supported by NIMH and NINDS that is designed to increase the diversity of the pool of individuals participating in mental health-related neuroscience research and teaching programs. This program offers pre- and postdoctoral training stipends, travel, mentoring, SfN member resources, and enrichment programs.

Neuroscience Scholars Program

This three-year fellowship for underrepresented minorities is coordinated by the Society's Committee on Diversity in Neuroscience and provides travel assistance to the Society's annual meeting along with mentoring, enrichment opportunities, and SfN membership benefits. During their tenure, fellows will increase their number of professional contacts, develop a network of lifelong contacts, acquire the necessary skills to present their work, and be better equipped to advance their scientific careers.

APA Diversity Fellowship Program in Neuroscience

The goal of the MFP in Neuroscience is to increase the number of ethnic minorities who complete the doctorate in neuroscience and who conduct research in areas of importance to the NIMH. The APA does this by providing financial support and professional guidance to individuals pursuing doctoral degrees in neuroscience.

Meharry/Vanderbilt Alliance for Training in Neuroscience

This joint venture between Meharry Medical College and Vanderbilt University brings together a research-intensive institution and an institution that has a historic focus on training African American minorities. A training grant, jointly sponsored by NIMH, NINDS, and NIDA, supports predoctoral and postdoctoral trainees and provides the foundation for advancement and career development. The vision of the Meharry/Vanderbilt Alliance in Neuroscience includes programs that affect all aspects of neuroscience graduate education from summer undergraduate research internships to postgraduate training. These linked activities create a vibrant center for diversity training in neuroscience that will serve as a model for an innovative program which addresses the national need to optimize the development of the nation's human resource pool.

Texas Consortium in Behavioral Neuroscience

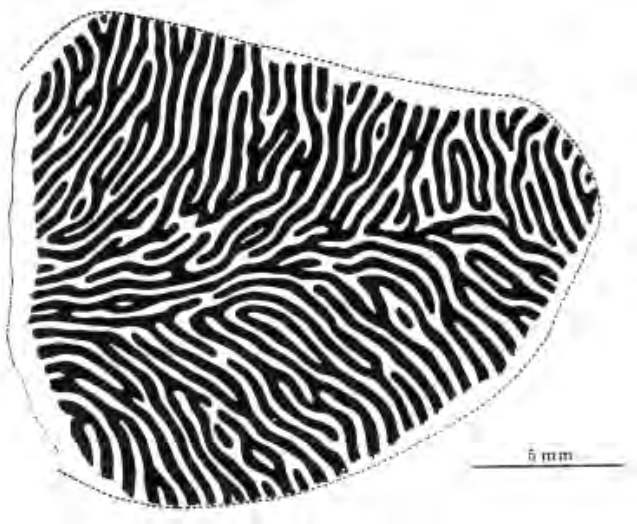
The Texas Consortium in Behavioral Neuroscience is the first regional training program designed to increase the number of behavioral neuroscientists from underrepresented populations. Ten pre-doctoral and five postdoctoral students will be intensively trained in conducting high quality research in behavioral neuroscience relevant to the missions of NIMH, NIDA, and NINDS. Hispanic and African American leaders with demonstrated knowledge of successful neuroscience training programs for underrepresented populations provide direction for this program.

Specialized Neuroscience Research Programs (SNRP)

The Specialized Neuroscience Research Programs was designed to assist in infrastructure development leading to well-established, state-of-the-art neuroscience research programs. This program also fosters innovative and effective partnerships and collaborations between minority institutions and established neuroscience laboratories, at federal and non-federal research institutions, and creates, supports, and maintains a stimulating academic and intellectual milieu to inspire and prepare students and fellows to pursue research centers in neuroscience. The SNRP program provides support to develop and sustain competitively funded neuroscience research projects and programs.

Committee on Women in Neuroscience

The **Committee on Women in Neuroscience (C-WIN)** is charged with implementing initiatives to increase the awareness of women's issues in the field, advance the interests of women in neuroscience, and to foster networking and mentoring opportunities for young women pursuing a career in neuroscience.



By the early 1970s, Hubel and Wiesel had described the single-cell activity of the mammalian visual cortex as well as its functional architecture. The figure shows the arrangement of retino-cortical projections from the eyes (one in black, the other in white) to the primary visual cortex of juvenile primates. The image was produced by the injection of a radioactive substance to one of the pathways followed by the exposure of a sensitive film to the cortical tissue.