

Section 1 Description of Neuroscience Program

1.1. Mission, Vision and Goals

The Neuroscience minor started in 2005 and currently has approximately 40 students in the program and we anticipate at least that many in 2010. The program is clearly growing, in 2007 there were 5 graduating students in the neuroscience capstone seminar and in 2009 there are 15. The minor is served by two faculty members, one each from the Departments of Biology and Psychology with the possibility of occasional contributions from others in the same departments. Both faculty members also maintain departmental commitments beyond the Neuroscience Program (such as Comparative Physiology, FTS, Natural World CII, Research Methods and Statistics, Brain & Behavior).

Mission

The neuroscience revolution was triggered by the realization that the best hope for understanding the workings of the brain would come from an interdisciplinary approach. Students are encouraged to understand and appreciate all levels of study of the nervous system from molecules to behavior and thought. The curriculum emphasizes mechanistic explanations of mental activity and aims to show the links to other sciences as well as arts and philosophy. Neuroscience by its nature epitomizes liberal arts education by breaching the walls of traditional disciplines. The participating faculty members are from two departments and the program is designed to attract and to be accessible to students from across the campus. The neuroscience faculty envisions a program that promotes a broad view of neuroscience with students participating in discussion of ideas and actively involved in laboratory research.

Goals

1. To build a sustainable neuroscience program that can accommodate growing student interest.
2. To provide a program of excellence
3. To provide a range of courses which showcase the breadth and the technical changes in the field.
4. To increase the depth of understanding of students by providing more opportunities for independent research both on and off campus.

Future

The program has grown as much as it can with the current faculty and resource commitment and it is clear that the future of the program depends largely on the amount of support provided. If there are no changes, the program is likely to collapse under its own weight but if relatively small additional commitments are made then the program can continue in its current form. If the college identifies this program for growth then Neuroscience could have a significantly larger profile and develop into an interdisciplinary major between the two departments. It is apparent that student interest would support this growth.

1.2 Programs

Students are offered the opportunity to complete a minor in Neuroscience. There is no required specific major to be taken in conjunction with the minor, but most of our students complete Biology or Psychology majors, with others completing Biochemistry, Physics and HES majors. The courses in the neuroscience minor count towards the Psychology (PSY260, PSY345) and Biology (PSY260, BIO384) majors with one of the courses (BIO384) fulfilling a WRITD requirement.

1.3 Support Relationships

The Neuroscience minor requires introductory courses in Biology and Psychology (BIO101 and BIO102 or BIO101 and PSY100). These courses are taken by many students across campus and should be offered every year.

Laboratory classes utilize the services of the Biology Stockroom for animal orders and care. The administrative assistants in both Psychology and Biology maintain budget and spending reports for the Program.

Section 2: Strategic Review

2.1.1 Internal Strengths

Neuroscience is a field of enormous interest to many people and the minor is clearly in heavy demand. The students choosing this minor are some of the most engaged and dedicated students on campus and their enthusiasm is evident in all the courses. The program has been successful in attracting a wide range of students, including under-represented students.

The faculty members participating in the Neuroscience program are also passionate and dedicated to the topic and teach as broadly as possible across the field. Neuroscience is strongly interdisciplinary and makes obvious to students the connections to different disciplines including other natural sciences as well as arts and humanities. The direct connections to physics and mathematics let students apply analytic skills to demanding conceptual problems. The connections to philosophy and science policy questions allow students to explore ethical questions in science.

The laboratory classes in the minor use highly technical equipment, complex analyses and students develop hands-on skills. This helps to fulfill the needs of the Psychology program which is currently unable to provide strong classroom laboratory experiences due to high enrollment and poor facilities. The labs also enhance the skill-set of biology students beyond what is offered in the Biology program.

2.1.2 Internal Weaknesses

The success in attracting students has revealed that the primary threats to the program are inadequate resources and insufficient faculty time devoted to the minor. There are more students trying to enter the program than can be accommodated in classes but there are not enough faculty members or resources to add extra classes. Currently the program can only operate if faculty members are able to work with an overload, officially unrecognized by the College. Clearly in this configuration the program is unsustainable in the long term and unable to grow. Although the program tries to cover a wide range of topics within

Neuroscience it is obvious that it is limited by having only two faculty perspectives and no course releases for administrative and lab preparation tasks. The pressure put on the Neuroscience faculty is currently untenable.

The program is jointly run and staffed from two departments and is dependent on the willingness and interest of the respective chairs and on the stresses placed on these departments. The needs and cultures of the two departments differ and the ability to free faculty time also varies.

The administrative structure of the program is ambiguous. Although there is a Director of Neuroscience it is not clear what roles and responsibilities pertain to this position. The lines of communication and decision making are unclear. For example, hiring decisions which greatly affect the program can be made with little or no input by the program. This is a critical weakness and nothing can be changed until this is addressed. It is not clear who has the power to make important decisions which could impact both the program and the departments. The Neuroscience program would benefit from clearer delineation of responsibilities and accountability that is supported by the academic dean's office.

There is also no defined budget for the program. Despite successful grant writing (NSF CCLI) for equipment funds, there has been little capital investment in laboratory and pedagogical equipment. Each department has contributed funds for the running of the program but do not have the resources to buy needed equipment which can be expensive and require consistent updates to work effectively.

The time taken to administer the program has also grown with the number of students and this now absorbs considerable faculty time. Administrative items includes such things as additional advising time for courses, careers and summer internships, letters of reference, tracking expense and managing websites, email lists and resources. As a consequence faculty members have insufficient time to devote to scholarly activities and this limits the opportunities for both students and faculty to conduct meaningful research.

The current course pre-requisites for the minor although generally useful do not fill the needs of the minor. Students are not introduced to important concepts, such as, signal transduction or membrane biophysics, in the 100 level courses and this adds pressure onto the 200 level course in the minor (PSY260). In addition, students in psychology have very little exposure to laboratory techniques; if labs could be offered in PSY100 then this would provide much stronger base for students entering as psychology majors. Currently, the students have quite diverse academic backgrounds and this makes it harder to teach the upper level neurobiology course (BIO384). Students in the early courses have very little exposure to neuroscience topics and yet the demand for the minor is strong. One can only assume that if the departments intentionally set out to recruit students for the minor the demand would be overwhelming

2.1.3 External Opportunities

The neuroscience faculty has made connections with other Neuroscience programs at liberal arts colleges in Minnesota to form the Midbrains Group and this has allowed us to apply for external funds for summer research as a consortium. Although no funds have yet been

forthcoming we believe that this will ultimately be a successful pathway for realizing this goal. The Midbrain Group now organizes an annual undergraduate conference of neuroscience which is a great forum for our students to present their work and learn about current research within the Midwest. Over the past two years approximately 25 Gustavus students have attended, most of whom have also presented research.

As part of our Capstone Seminar students are involved with the local intermediate school to take part in Brain Awareness Week (Society for Neuroscience) and teach the children about the brain. The neuroscience faculty members have conducted this outreach program for 3 years and it is warmly welcomed by the teachers and students. Faculty members are also asked to come to regional high schools to talk about the brain. One purpose of this program is to raise early awareness of science for boys and girls.

2.1.4 External Challenges

As student interest in our field is increasing it is easy to see that other schools are taking advantage of their greater facilities and resources in recruiting talented students. The neuroscience faculty members are in the difficult position of attracting students without being certain that their needs can be met. It is clear that other institutions in our region, such as St Olaf, Carleton and Macalester Colleges, have recognized the enormous potential in this field and have made a stronger commitment of money, facilities and faculty, to supporting their neuroscience programs.

2. 2 Barriers

The equipment used in our teaching laboratories is heavily utilized and frequently in need of repair or replacement. The initial equipment was purchased by obtaining external funds (NSF) and was a good starting point for the labs. The program does not have the funds to buy replacement equipment or to purchase new equipment that would enable us to significantly improve the laboratory experiences. Modern neuroscience is an emerging technical field and in order to move to the next level more sophisticated equipment is needed. For example, a patch clamp apparatus would enable students to use visualization techniques, such as fluorescent dyes, at the same time that they record bioelectrical events.

The technical nature of the equipment and the complexity of the experiments, usually with live tissue or animals, require a large time investment in the maintenance and set up of experiments. The neuroscience faculty members do not have any technical support for these tasks.

The laboratory facilities provided for our classes are not designed for the needs of the program. These facilities are multi-purpose and require quick changes of equipment configurations between classes. Many of the objects are extremely heavy and difficult to move easily. The pieces of equipment are linked together with cables and are intended to be isolated from electrical interference and vibration; repetitive construction and deconstruction takes time and causes problems such as ground loops. Behavioral labs, such as the water maze, that could be used for students in other classes or for ongoing research projects need to be disassembled because there is no room. Ideally the labs need their own dedicated space. A new academic building has been proposed, and neuroscience would be at least partially housed there, but it is not clear when ground will be broken for this facility.

The geographical location of the college makes it difficult to take full advantage of the many new and exciting opportunities available in the city or in research hospital settings. Our students can do off-campus research or internships effectively only during the summer months.

Section 3: Strategic Initiatives and Recommendations

Some initiatives impact multiple goals. The addition of extra faculty to the program would serve all four goals.

Goal 1: To build a sustainable neuroscience program that can accommodate growing student interest.

Strategic Initiative 3.1.1 Hire additional faculty.

In order to maintain the program it is imperative that new faculty be hired to contribute to Neuroscience. This would let us offer extra sections of our basic classes allowing more students into the program. With more faculty and classes it would also be possible to adopt a two track system with common courses at the introductory level and capstone level but with branches giving a Biology or Psychology focus. This would allow more options for students to follow their interests and would alleviate the difficulty of trying to fit Psychology students into an upper level Biology course with little preparation.

Strategic Initiative 3.1.2 Focus faculty FTE on the program.

The current faculty members have widely spread teaching commitments and if more time were dedicated to the program it would alleviate many of the identified problems of time debt.

Strategic Initiative 3.1.3 Provide administrative time for the program

The program has grown and requires considerable administrative time. One faculty member needs to be given course release time each semester which can be devoted to administrative duties.

Strategic Initiative 3.1.4 Simplify line of communication and reporting structure

The program director needs to have primary responsibility for the Neuroscience program and a reporting structure that provides a clear line to a single academic dean.

Strategic Initiative 3.1.5 Develop an interdisciplinary major in Neuroscience.

The major would integrate existing courses in the two primary departments, Biology and Psychology and create parallel tracks with common bridge points by offering specific neuroscience courses. A wider range of courses would be included, with at least one course from a humanities department to show the connections of studying the brain to topics such as Philosophy, Art or Music. To build greater quantitative skills the major would also require at least one course in Physics and in Mathematics and Computer Science. A Neuroscience major structured in this fashion would provide greater opportunities for students across campus while still preserving the option of a Neuroscience minor.

This initiative would serve to clearly define the structure of the program and its relationships to other programs and departments.

Goal 2: To provide a program of excellence

Strategic Initiative 3.2.1 Invest in new instrumentation

Investment in equipment and buying new instruments would transform the possible laboratory experiences that could be provided. This would allow us to enhance the level of technical sophistication to reflect the modern face of neuroscience.

Strategic Initiative 3.2.2 Hire a laboratory technician.

The labs require extensive set-up and equipment preparation and hiring a laboratory technician would significantly improve the lab experience. Science courses typically rely on labs to teach significant portions of the curriculum and support staff would allow us to expand our lab offerings and free time for more interactive lab experiences. This lab instructor could be shared with the Psychology department as this is in line with the department's strategic plan.

Strategic Initiative 3.2.3 New facilities in the new academic building

Our current facilities are inadequate but when the new building is built, the facilities provided for neuroscience will allow us to significantly improve the laboratory experiences.

Strategic Initiative 3.2.4 Improve library access to academic journal publications

Our library needs more resources. It would improve the courses in our field if there was greater access to original peer-reviewed literature in the field. Electronic access to more journal publications would help students to conduct meaningful literature searches in a timely fashion.

Strategic Initiative 3.3.5 Speaker program

The neuroscience faculty would like to have the funds to invite and pay outside speakers to participate in an interdisciplinary visiting speakers program. This would allow students to broaden their perspective in the field of neuroscience and encourage students from multiple disciplines to come together.

Goal 3: To provide a range of courses which showcase the breadth and the technical changes in the field.

Strategic Initiative 3.3.1 Hire new additional faculty to contribute to the program.

More faculty members would enable us to expand our course offerings and rotate the individual members through different courses. Ideally faculty with expertise in areas such as Cognitive Neuroscience or Molecular Neuroscience would be hired.

Strategic Initiative 3.3.2 Improve links to other interdisciplinary programs

The hiring of additional faculty could be coordinated with other programs (such as Biochemistry) to form links between the programs. This individual would also be well poised

to improve communication with other departments and programs and so identify challenges that prevent students participating in both programs such as class times which conflict.

Strategic Initiative 3.3.3 Implement a visiting professor rotation

The program could increase the breadth of offerings if visiting faculty who would stay for a short time and teach classes in his/her specialty were added.

Goal 4: To increase the depth of understanding of students by providing more opportunities for independent research both on and off campus.

Strategic Initiative 3.4.1 Provide more time for faculty research.

Faculty members would have more time for research if strategic initiatives 3.1.1, 3.1.2, 3.1.3 and 3.2.2 were implemented. Ideally a five-course load for all faculty members would allow for greater time to spend on research.

Strategic Initiative 3.4.2 Hire new faculty

An additional faculty member would offer an additional line of research and open up new opportunities for students and free time for other Neuroscience faculty to conduct additional research.

Strategic Initiative 3.4.3 Improve off-campus links

There are a number of organizations (e.g. Faculty for Undergraduate Neuroscience) which foster collaborations in neuroscience and provide opportunities for students to seek research at other institutions. Gustavus faculty members need to be able to participate in these groups and attend national and regional meetings of these organizations in addition to research meetings.

Strategic Initiative 3.4.4 Student research funds

Additional funds to provide stipends for students conducting summer research and travel money to allow students to attend meetings is necessary if students are to benefit from these research experiences. For example, when faculty members travel to present research at national meetings, there is no funding for students who have worked on the research to also attend.

Section 4 Assessment

The goals are all related to providing an ongoing program of academic and research excellence, it is likely that some proposed tools of assessment will evaluate more than one goal. These extra administrative tasks will require personnel time dedicated to record keeping.

Goal 1: To build a sustainable neuroscience program that can accommodate growing student interest

The number of students registering for classes and graduating with a minor in neuroscience will be recorded. Our ability to support growth will be indicated by these numbers and by how many students remain on waiting lists to get into courses.

Goal 2: To provide a program of excellence

Student outcomes are the best measure of excellence. If administrative time were provided for assessment then it would be possible to track the outcomes of our graduates. Already many of our students have gone to prestigious medical school and graduate school programs around the country.

Goal 3: To provide a range of courses which showcase the breadth and the technical changes in the field.

Graduating seniors will be canvassed to ascertain how well the curriculum served their interests and needs.

Goal 4: To increase the depth of understanding of students by providing more opportunities for independent research both on and off campus.

Records of student research outcomes in the form of presentations and publications would indicate the participation rate of students in research. Applications for off-campus experiences could be tracked.