

Academic Program Review – Neuroscience Program (2015)

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This review of the administration, education, training and professional development offered in the graduate and undergraduate programs is being undertaken for the first time in the history of the Neuroscience Program (NSP). The self-study, covering the period from 2004-2014, assesses the quality of the programs and identifies action points for continued success and improvement. This review is organized around key program issues identified through (i) faculty discussions, (ii) surveys of faculty members, postdoctoral associates, graduate students and program administrators and (iii) discussions of the APR committee. Analytics from various sources were used to assess program quality including but not limited to (i) student and faculty demographics, (ii) graduation rates, (iii) time to degree, (iv) student and faculty scholarly output, (v) extramural funding, (vi) student grade point average and (vii) student placement.

The Neuroscience Program also commissioned an external review of the program. Drs. Sved, Herman (University of Cincinnati) and Keefe (University of Utah) are senior neuroscientists who direct interdisciplinary neuroscience Ph.D. training programs at their home institutions. Dr. Sved is also Chair of the Department of Neuroscience at the University of Pittsburgh which supports an undergraduate program in neuroscience. These reviewers also sit on NIH study sections charged with reviewing T32 neuroscience training grant applications.

The program review is organized as follows:

- I. Program Overview and Faculty Member Analytics
- II. Administrative Functions
- III. Graduate Program
- IV. Undergraduate Program
- V. APPENDIX: External Review

In accordance with the University's *Boldness by Design* roadmap, our academic program at both the graduate and undergraduate levels is focused on excellence and innovation in the following areas:

- Enhancing the student experience.
- Enriching the community, the economy and family life.
- Expanding our international reach.
- Increasing research opportunities.
- Strengthening stewardship.

I. Program Overview and Faculty Member Analytics

The Neuroscience Program (NSP) at MSU became a Ph.D.-granting program in 1998. The NSP is an interdepartmental and intercollegiate graduate program (M.S. and Ph.D.), not a department, and a College of Natural Science-based Bachelors of Science undergraduate degree granting program. *The general mission of the NSP is to prepare students through education, research and professional development for careers in neuroscience or neuroscience-related fields.*

The interdisciplinary program is comprised of 71 faculty members with appointments in 18 departments and 5 colleges including the 3 medical schools. Four faculty have full-time appointments in neuroscience, 5 faculty have split appointments with the departments of Physiology or Zoology. There are 13 postdoctoral associates, 32 graduate students and 461 undergraduate students (328, College of Natural Science; 133 Lyman Briggs College). The faculty resides in 17 home departments. The program conducts research at the campuses in East Lansing (EL) and Grand Rapids (GR). The majority of the faculty associated with in the program (87%) holds no appointment directly in NEU. There are two categories of faculty membership in the program: Regular faculty (37) and Training faculty (34). Regular faculty are those who contribute to the success of the program through teaching, research, service and outreach activities. Training faculty have the same responsibilities and rights of Regular faculty but, in addition, they have the financial resources (extramural funding) to support Ph.D. students as graduate research assistants (GRAs). Regular faculty can change their status to Training faculty when financial and other resources needed to support a GRA become available.

Comparing our graduate program with other programs (n=97) around the country, one finds that ours is average in size in both numbers of faculty members and graduate students. According to a 2011 Society of Neuroscience survey of Neuroscience Training Programs (http://www.sfn.org/~media/SfN/Documents/Professional%20Development/NDP/SurveyReport_AY20102011.ashx), the number of faculty members per program across the country ranges from 10-90 with a median of 32 and an average of 42. The number of graduate student trainees per program ranges from 10 to more than 100 with a median of 33 and an average of 39. Recall our graduate program includes 71 faculty members, with 34 of these categorized as training faculty, and 32 graduate students.

Teaching and research in our program is clustered in three areas: (i) Behavior and Systems (understanding how individual neurons assemble and interact in complex neuronal systems to control behavior), (ii) Cellular and Molecular (studies of individual neurons and their support cells in the nervous system, the signaling molecules they utilize and how these signaling processes control nervous system development and function), and (iii) Cognitive (the synergistic interactions between individual parts that produce the higher order functions of the human brain

including attention, perception, executive processes, language, memory, categorization, planning and decision making).

Faculty Analytics (data for all 71 affiliated members)

Year in the Program	5.5 ± 3.7 (a young faculty)
M.S. and Ph.D. students mentored (mean)	4
NSP Ph.D. students mentored (mean)	1
NSP graduate student guidance committees (mean)	3
Undergraduate students mentored (lab research, mean)	11
Publications (mean)	23
Books and Book Chapters written/edited (mean)	1
Editorial Board membership (mean)	1
Professional Society memberships (mean)	3

These analytics were generated from data over the 2004-2014 period provided by 75% of the affiliated faculty members. Strength of the program is the commitment of the faculty to supporting undergraduate research. Another strength is the interdisciplinary training offered by the diverse group of faculty member affiliates. *It should be noted that at least 25% of the faculty members have been affiliated with the program for three years or less.* This young faculty has brought energy and, most importantly, expertise to the program that has filled gaps in the training portfolio. As a measure of scholarly output, one can take the average number of publications by all the members and divide by the average time in the program. This turns out to be ~4 peer-reviewed papers published per year. This output metric is lowered somewhat by the fact that not all of the faculty members are actively engaged in research. This is because for some, their appointments call for primarily teaching and administrative duties. In other cases, the faculty member is nearing the end of his/her career and is no longer research active.

The current NSP faculty member breakdown in ranking is as follows: Professor (48%), Associate Professor (30%) and Assistant Professor (22%).

Many Neuroscience faculty from multiple departments contribute to teaching in the graduate program. Typically, faculty will give several lectures in one of the core courses and the topics are most often related to the faculty member's research expertise. Indeed, all of the graduate courses are team taught. Undergraduate teaching is done nearly exclusively by NEU appointed faculty. This is based on a strategic goal of building a relationship between program faculty and the students in the undergraduate major. In addition, team teaching (at least with many different teachers) is not as effective with undergraduate students as faculty have different teaching styles and testing styles. The greater commitment required to teach undergraduate also limits non-NEU faculty willingness to participate in undergraduate teaching.

As mentioned, the NSP faculty members are quite interdisciplinary in expertise and gender diverse. The members come from multiple departments across campus as reflected in the data below.

Interdisciplinary Faculty Members (Training and Regular): Rank and Gender

<u>Department</u>	<u>NSP Faculty Members</u>	<u>Prof.</u>	<u>Assoc. Prof.</u>	<u>Assist Prof.</u>	<u>Male</u>	<u>Female</u>
Psychology	17	10	4	3	47%	53%
Physiology	10	5	1	4	70%	30%
Pharm./Tox.	11	6	5	0	73%	27%
Trans. Sci./Mol. Med.	10	4	3	3	70%	30%
Zoology	4	1	2	1	50%	50%
Kinesology	3	0	0	3	100%	0%
Elec. Comp. Engr.	3	0	2	1	67%	33%
Neurology Ophthal.	2	1	1	0	50%	50%
Radiology	2	0	2	0	100%	0%
Chemistry	1	1	0	0	100%	0%
Computer Science	1	1	0	0	100%	0%
Entomology	1	1	0	0	0%	100%
Fish. Wildlife	1	1	0	0	100%	0%
Human Medicine	1	1	0	0	0%	100%
Osteo. Medicine	1	1	0	0	0%	100%
Psychiatry	1	0	1	0	0%	100%
	69	33	21	15	58%	42%

Two of the faculty in Psychology have primary appointments in NEU. Recall also that there are two additional faculty members with full appointments in NEU.

Of the 34 members of the graduate training faculty, 21 are male and 13 are female. By rank, there are 17 Professors, 8 Associate Professors, and 9 Assistant Professors. By breakdown, 14 of the training faculty are in the Department of Psychology (41%), 6 are in the Department of Physiology (18%), 6 are in the Department of Translational Science and Molecular Medicine (18%), 5 are in the Department of Pharmacology and Toxicology (14%) and 3 are in other departments across campus (9%).

II. Administrative Functions

The Graduate and Undergraduate programs are overseen by the Program Director (James Galligan, PhD) and the Associate Program Director (Cynthia Jordan, PhD).

The Program Director (PD) is the chief administrator, responsible for the overall operation and management of the NSP. The continued appointment of the PD is evaluated every five years by the Provost. The PD is advised by the Associate Program Director, Faculty Advisory Committee (FAC), any relevant standing and ad-hoc committees, and the Neuroscience faculty and students as a whole. The primary responsibilities of the PD include (i) long range planning involving matters of undergraduate education, graduate student training and budget, (ii) serving as administrative liaison between the NSP and the departments, colleges and other graduate and undergraduate programs of MSU, (iii) overseeing faculty hiring and facilitating partnerships with departments to provide laboratory space and tenure homes for these faculty, (iv) providing

annual performance reviews for faculty jointly hired by NEU and partner departments and (v) providing annual performance reviews for all NSP graduate students.

The Associate Program Director (APD) serves a three-year term and with a maximum of two consecutive terms. The primary duty of the APD is to advise the PD on program matters. Other duties are assigned at the discretion of the PD. Additional responsibilities include (i) coordinating and administering the standardized component of the comprehensive exam for the NSP Ph.D. students and (ii) coordinating outreach activities. The APD is an “ex officio” member of the Faculty Advisory Committee (FAC).

Graduate Program (32 current students, 13 postdoctoral associates)

Director of Graduate Admissions (Peter Cobbett, PhD)
Graduate Affairs, Seminars, Recruiting (Jim Stockmeyer)
Human Resources and Budgets (Shari Stockmeyer)

Undergraduate Program (540 students)

Program Director (Laura Symonds, PhD)
Academic Advisor (Kanchan Pavangadkar, PhD)
Undergraduate Neuroscience Lab Course Coordinator, Academic Specialist (Jenny Taylor, PhD)
Administrative Assistant (Mary Millar)

The Undergraduate Program Director (UPD) is appointed on a recurring basis by the PD after consultation with the FAC. The UPD is responsible for overseeing all aspects of the undergraduate degree program. This extensive list of responsibilities include teaching, curriculum development and innovation, engaging in recruiting activities, seeking funding for research and professional development activities for undergraduate students, and supervising the undergraduate secretary, academic advisor and the laboratory manager. The UPD reports to the PD. The UPD is also an “ex officio” member of the FAC.

The NSP has several standing committees, primarily for the graduate program.

1. Comprehensive Exam Committee. Exam writing/grading committees will have 3 members, one of whom will serve as chair, each appointed for a 2-year term with one position rotating on/off each year. Faculty cannot serve consecutive terms. Faculty can volunteer or can be asked to serve by the Comprehensive Exam Coordinator (Cynthia Jordan). The Comprehensive Exam Coordinator will serve a 2-year term and will be chosen by the FAC. Students are informed about who is on the exam writing/grading committees and receive guidance from committee members about performance expectations on the exam.

2. Faculty Advisory Committee (FAC). This committee represents the faculty members by providing advice to the PD on appointment and reviews of faculty and other policy and curriculum matters relating to the program.

3. Graduate Affairs Committee (GAC). The Graduate Affairs Committee reviews applications for graduate study and recommends admission of the applicant. This Committee also plans and coordinates the annual recruiting weekend (January of each year), which brings prospective graduates students (typically 10-12) to the EL and GR campuses for visits and interviews with

faculty. The Committee consists of six NSP faculty members, and seeks to recruit the best qualified applicants for graduate study. In its recommendation, the committee considers the following: academic performance, course preparation in the basic sciences, direct knowledge of and experience in neuroscience research, letters of recommendation, statement of research interest, competence in the English language, GRE scores and recommendations by individuals in the applicant's field of interest. The GAC also makes recommendations on requests for course waivers and other issues related to an individual student's graduate training. Students with grievances may take them to a member of the GAC or to the PD or the faculty liaison of the NeuroBuddy Program.

4. Graduate Student Council (GSC). The GSC assumes several duties including, but not limited to, organization of the annual retreat, administration of faculty awards, and organization of social activities. Additionally, several committee members serve as graduate student representatives on NSP committees including the GAC, the hiring committee, the Dean's student advisory committee (DSAC), and the FAC. This committee also coordinates the biannual Cross-Campus Research Day and other events that serve to facilitate the cohesion between the EL and GR campuses

III. Graduate Program

The graduate program in Neuroscience has been in existence since 1998 when it started granting Ph.D. degrees. There are presently 32 graduate students enrolled in the program. The average GRE scores of the cohort of students entering the program between 2009-2014 were 541 (Verbal) and 688 (Quantitative). In the new scoring format, data are only available for 2012-2013 and 2013-2014. For these two entering classes, the mean Verbal and Quantitative scores were both 157.

For the period from 2004-2014, the number of offers made each year ranged from 6-12 and the number of acceptances ranged from 2-6. Mechanisms of financial support for the graduate students include (i) an NIH training grant (4 students max.), (ii) fellowships through the college (none presently held by students), (iii) teaching assistantships (the number will be increasing in the future as new undergraduate laboratory courses are introduced, currently 4 TAs funded annually), (iv) extramural graduate fellowships (*e.g.*, American Heart Association, NSF Graduate Fellowship, NIH NRSA, etc. – currently 4 funded fellowships and 1 pending) and (v) support as a research assistant from individual PI grants. The number of offers made in any year depends primarily on the number of faculty with interest and funding to support new students. In other words, financial support of our graduate students at present rests heavily on individual PI grant support.

The graduate program is diverse in gender and ethnicity. For the period from 2009-2014, 68% of the admitted students (37 total) were female and 32% were male. Of these, 89% were U.S. citizens or permanent residents and 11% were non-residents. The entering cohort of Ph.D. students (33) was 70% Caucasian, 3% Black/African American, 15% Hispanic, 6% Asian and 6% other. These two sets of data were provided by the Information on Graduate Programs (MSU).

In developing this internal review of our graduate program, input was solicited from the faculty members, postdoctoral associates and graduate students on what the key issues are. The following major points were raised:

1. Review of our required courses is needed. The program should generate a list of concepts and core topics that should be taught. Better course descriptions with updating and revision are needed. Be current in the methodologies being taught. The routine of textbooks, lectures, sit-down exams is dated and more effort should be devoted to updating teaching approaches.
2. There is a lack of a defined group of NSP faculty. Over 70 faculty members are listed as participants. How many are active and have a vested interest in the program?
3. Continue to find ways to improve cohesion of the program and student experience across the split campus (East Lansing and Grand Rapids).
4. Recruiting - Incoming graduate student rotations often seem to be decided before the students arrive, which leaves faculty little opportunity to interact with new students and potentially recruit them. There is interest in seeing a return of the faculty/student interviews back in the faculty laboratories. This would give the prospective students a better look at the facilities and feel for the environment. More follow-up is needed with the prospective students after the recruiting weekend. We do not follow up and continue with the recruiting process as much as we should after the recruiting weekend in January.
5. Every NSP student should prepare a NSF or NRSA style training grant proposal. This could be incorporated into the prelims. This perhaps could be accomplished by having the prelim composed of writing the grant application with the help of a mentor and a shorter student-only prepared proposal. This would serve the student-mentor well by helping them prepare for their research and would increase the NSP's "appearance" in vying for training grant applications.

1. *What do we do?*

Graduate Program and Instruction. The NSP offers graduate students and postdoctoral associates world-class research opportunities and unparalleled education in a highly collaborative atmosphere. Outstanding mentoring and strong professional development in a highly interdisciplinary environment are attributes of the program. A wide range of research opportunities are available for students given the diverse research portfolios of the multiple faculty members. Teaching and research are conducted at both the EL and GR campuses, which presents some logistic challenges for our students and faculty. These are addressed below.

To facilitate the comprehensive and interdisciplinary training of the doctoral students, a core component of the program is an NIH-funded predoctoral training grant (Michigan State University Jointly Sponsored Predoctoral Training Program in the Neurosciences, NS T32044928-11A1). The Training grant, which is currently funded through 2017, is predicated on the conviction that the best and most successful neuroscientists (i) have a strong foundation in the operation of the nervous system at all major levels of analysis, (ii) are well-versed in scientific method and hypothesis testing and (iii) have acquired the professional skills that facilitate interdisciplinary research collaborations and the integration and dissemination of knowledge. To provide students with these essential tools, the Training Program includes a broad-based curriculum in the fundamentals of nervous system function and disease, specialized research training with faculty, and professional mentoring. The 34 training faculty (a subset of

the 71 program members) come primarily from the Departments of Psychology, Pharmacology and Toxicology, Physiology, and Translational Science and Molecular Medicine.

Of the 32 current graduate students (2014-2015), 2 new students are presently doing rotations. The remaining 30 students are distributed as follows: 12 mentored by faculty in the Department of Psychology (38%), 5 by faculty in the Department of Physiology (16%), 5 by faculty in the Department of Translational Science and Molecular Medicine (16%), 5 in the Department of Pharmacology and Toxicology (16%), 2 by faculty in the Department of Neurology and Ophthalmology (6%) and 1 by faculty in the Department of Zoology (3%)

The graduate training is comprehensive in teaching, research, professional development and outreach. In terms of the coursework, the following list shows the required courses as well as and some of the common elective courses that are part of the typical degree plan.

Required Core Courses for All Students (typically taken in Years One and Two)

- Physiology and Pharmacology of Excitable Cells (NEU 827)
- Systems Neuroscience (NEU 839)
- Advanced Behavioral Neuroscience (NEU 811)
- Molecular and Developmental Neurobiology (NEU 804)
- Statistics for the Biological Sciences (PHM 830 or PSY 815)
- Research Forum (NEU 800)

Students will also choose some elective courses in consultation with their faculty advisor and guidance committee.

Common Electives (typically taken in Years Two and Three)

- Vertebrate Neural Systems (ANT 885)
- Synaptic Transmission (PHM 810)
- Developmental Psychobiology (PSY 809)
- Neuropsychology (PSY 851)
- Principles of Drug-Tissue Interaction (PHM 819)
- Confocal Microscopy (NSC 837)
- Writing and Manuscript Preparation in the Neural and Behavioral Sciences (PSY 992)

First-year graduate students typically do not register for Research Forum (NEU 800) but do attend the weekly sessions. This course is a venue for students to develop their professional skills and to address other important topics in graduate training that will further enhance their career. Specific topics vary from year to year but generally include (i) oral presentation skills using a variety of media, (ii) strategies for efficiently writing an effective grant application, (iii) development of a course's curriculum and effective lesson plans for those interested in a teaching career and (iv) resume writing, interviewing skills, etc. for post-graduate placement.

In addition to the coursework, NSP graduate students are required over their tenure in the program to attend a number workshops offered by the Graduate School. Multiple workshops are in the "Responsible Conduct of Research" series and one is from the "Conflict Resolution" series.

The timeline for the typical training of a doctoral graduate student is as follows:

First Year

- Two laboratory rotations are completed (selected by the student), each one semester in duration.
- Completion of three core classes: Physiology and Pharmacology of Excitable Cells, Systems Neuroscience, and Methods in Neuroscience Laboratory.
- Selection of a dissertation advisor after the second rotation.

Second Year

- Students begin work in their selected laboratory.
- Completion of core classes: Advanced Behavioral Neuroscience, Molecular & Developmental Neurobiology, and Statistics for the Biological Sciences.
- Fulfill a teaching requirement (customized for each student and their long-term goals).
- Form a dissertation guidance committee.
- Completion of the standardized or comprehensive exam, which consists of three areas of emphasis: (i) a current controversy in neuroscience, (ii) a translational application and (iii) an NRSA-type research plan (emphasis on hypothesis formulation and testing). Students research and write on these topics over a three-week period (take home). The exams are prepared by separate three-member Comprehensive Exam Committees. The problems are designed to assess the student's ability to integrate knowledge and concepts from the core and elective courses, weekly seminars and the literature. This exam is taken in May. Ideally, by December of the calendar year in which the written component is taken but no later than May of the following year, the student should complete the oral component of the comprehensive exam. The oral or specialized exam consists of a defense of a research proposal that is presented to the student's dissertation guidance committee.

Third Year

- Dissertation proposal is approved by the guidance committee and is presented by the student to the program faculty and students. The presentation to the program members typically coincides with the presentation to the guidance committee.
- Dissertation research work.

Fourth and Fifth Years

- Continue dissertation research work.
- Dissertation defense.

Professional development is something the program working to improve. It is recognized that not all graduates will pursue careers in academia. Therefore, our professional development activities need to reflect the different career paths future graduates will follow: industry, education and public policy. The GR campus has taken the lead on this by establishing a structured individual development plan (IDP) for their graduate students and postdoctoral associates. This comprehensive plan integrates research discipline-specific and professional development components for each individual. This IDP also in line with new NIH requirements for supported graduate student and postdoctoral associates.

The University also has a number of programs in place for the professional development of graduate students and postdoctoral associates. These include **CareerSuccess** (an interactive web

site for evaluating skills, identifying a career path, developing a training plan and creating tools for success), **NSF CAFFE** (Center for Academic and Future Faculty Excellence – an interactive web site for creating individual development plans for graduate students and postdoctoral associates preparing for academic careers), and **FAST** (a fellowship program for future academic scholars in teaching offering mentored teaching opportunities and materials on teaching and assessment techniques).

Research and Scholarship. All students are expected to take ownership of their research projects and to become critical and independently-thinking scientists. They are expected to be proactive in presenting their work at meetings and conferences and publishing their work in peer-reviewed journals.

Our students regularly present their research results at international meetings such as the Society for Neuroscience and Experimental Biology.

There is a semi-annual Cross-Campus Research Day in the program when graduate students present their work (some oral but mostly poster presentations) to the faculty and student members at the EL and GR campuses. The location of the Research Day alternates between campuses. This helps to improve cohesion of the program and student experiences across the spilt campus.

In terms of publication numbers for the graduate students, which is the most important analytic of research activity and scholarship, the average number of total MSU-based publications is 4.3 and the average number of 1st authored publications is 2.5 for the cohort of students who both entered the program in or before 2006 and completed training in or before 2012 (n=83). The average total publications is 3.3 and the average number of 1st authored publications is 2.5 for the cohort of student who both entered the program in or after 2007 and earned the PhD in or before 2012 (n=6).

Data indicate that of the 32 current graduate students (2 of these are doing rotations), half have published papers so far from their graduate work at MSU. For these students, the average number of papers is 1.7 and the average number of 1st author papers is 1.0.

Diversity initiatives. Dr. William Atchison, a long standing member of the Neuroscience Program and previous Program Director, is leading an active and successful effort to strengthen diversity in our graduate student population. While his programs focus on graduate neuroscience training, they have also strengthened diversity in the graduate programs based in departments associated with the Neuroscience Program (Pharmacology & Toxicology, Physiology, Translational Science and Molecular Medicine, Psychology). Dr. Atchison has built a strong relationship with the faculty and students in the University of Puerto Rico system. This relationship was initially formalized between the University of Puerto Rico Cayey (UPR-C) campus in 2009 through establishment of a bridging program backed by institutional support (\$64,000) and a R25 award from NINDS (R25 NS065777; \$1,605,131, 4/1/09- 3/31/14; PD: Dr. Atchison). The goal of this program was to increase the number of Neuroscience Hispanic PhDs. UPR-C students in the program spent the summers between their sophomore and junior year and between their junior and senior year at MSU involved in laboratory research projects with faculty mentor most of whom were Neuroscience Program faculty. After the second summer, the students enroll at MSU for the fall semester of the senior undergraduate year. They will take 9 credits of undergraduate courses, complete their research project and prepare

applications for graduate school. This program was very successful and resulted in admission of 7 Puerto Rican students into our Ph.D. program (3 have completed their training and 4 are current students). Dr. Atchison has built on the initial success of the R25 program with 3 new federally funded programs (Bridge to the PhD in Neuroscience, 1R25NS090989 from NIH; Research Experience in Structural and Functional Neural Biology for Undergraduates from NIH; and DBI-1359302 First Time Summer Research Experience in Environmental Health Sciences from NSF).

It is noteworthy that 3 Ph.D. students who are trainees in departments associated with our Pharmacological Sciences Training program (Eileen Rodriguez, Alexandra Colon and Chelsea Tiernan) received the Society for Neuroscience Next Generation Award for their innovative and effective outreach program for high school students in Puerto Rico. This is another tangible indicator of our commitment and effectiveness in recruiting and training young Hispanic neuroscientists.

Outreach, Engagement and Mentoring. The NSP faculty and graduate students have an impressive record of participation in outreach and engagement activities. There are at least three major events each year that are generally organized by the Graduate Student Council (GSC).

- i. Brain Bee at MSU: The Brain Bee at MSU is a live Q&A competition that challenges high school students on their knowledge of neuroscience facts.
- ii. Neuroscience Fair: Teachers, students, and parents gain exposure to the field of neuroscience through hands-on experimental demonstrations, talks by experts, arts and crafts, etc.
- iii. Brain Awareness Week: This activity occurs in March, and NSP graduate student volunteers visit local elementary, middle, and high schools to promote neuroscience education to young students. Activities range from presentations to mini-experiments to seeing (and touching) real animal and human brains.
- iv. NeuroBuddy Program: This is a mentoring program where an advanced graduate student is assigned to mentor a new graduate student.

The above-listed activities are organized and largely participated in by students and faculty from the EL campus. The GR campus also participates in an extensive number of outreach activities.

- i. During the past five years, the Grand Rapids NSP faculty have made 70 educational presentations to the public and organized over a dozen large-scale events. Grand Rapids NSP faculty regularly travel throughout Michigan to all of MSU's statewide campus locations, other colleges and universities, as well as elementary and secondary schools to give presentations on general neuroscience, Parkinson's disease (PD) and Alzheimer's disease (AD).
- ii. In addition, led by GR NSP Faculty Member, Dr. Kathy Steece-Collier and in collaboration with community partners, Brain Awareness Week Events were organized in West Michigan that were attended by over 2,000 visitors. Additionally, in collaboration with the Davis Phinney Foundation for Parkinson's we brought their signature event, a Victory Summit, to Grand Rapids. This day-long event provides "education and inspiration" for patients, families and caregivers alike. The Grand Rapids Victory Summit was the largest and most successful in the Foundation's history with over 850 attendees, many drawn from over 1,000 miles away.

2. *Why do we do it?*

The NSP provides comprehensive interdisciplinary education, research training and professional development leading to the Ph.D. degree. The Program's mission is to prepare students for successful neuroscience-related careers in academia, industry or government.

3. *How well do we do it and who thinks so?*

Retention, Graduation Rates and Time to Degree. Over the period from 2004-2014, there were 7 entering graduate students (3 male, 4 female) pursuing a M.S. degree. Of these, 6 completed their degree in 1 year (86% retention) and 1 student left without a degree. There is a question regarding the listed M.S. students as the NSP does not offer a terminal M.S. degree.

Over the same period, there were 57 entering graduate students (20 male, 37 female) pursuing a Ph.D. degree. Of these, 21 graduated with a Ph.D. degree, 5 graduated with a M.S degree, 3 left the program without a degree and 28 students remain in the program (95% retention). Therefore, there are 28 remaining students plus the 4 new students who entered in the FS 2014 (32 total). The time to degree for the 21 Ph.D. students was 6.3 ± 0.8 years. However, considering data over only the past three years, the average time to completion of the Ph.D. has decreased to 5.5 years. Based on these data, we are recruiting a cohort of intelligent and capable students and the retention of these students in the program has been excellent. Programmatic changes have recently been instituted that have resulted in this decrease in the time to completion. These two sets of data were provided by the Information on Graduate Programs (MSU).

According to a 2011 Society of Neuroscience survey of Neuroscience Training Programs (<http://www.sfn.org/~media/SfN/Documents/Professional%20Development/NDP/SurveyReportAY20102011.ashx>), the national average is also 5.5 years. Efforts are being made within the program to be better than the national average and a goal has been set of reducing this number by 0.5 years.

Scholarly Output of Faculty Members and Graduate Students. As presented in the faculty metrics table above, the mean publication number of the affiliated faculty members is 23 over the ten year reporting period or ~4 peer-reviewed publications per year (based on the average number of years in the program, 5.5 years). In addition to the reasons given above, this number is lower than it otherwise might be because 25% of the faculty members have been in the program for three years or less. This number will clearly increase as the new faculty members establish their laboratories, train more students and get their projects further developed.

The following table of data is reflective of the scholarly output of all the affiliated faculty members. The data were obtained from the Web of Science and includes articles, proceedings publications, abstracts, book chapters, etc. These analytics cover the entire career of the members (93% of the listed faculty members for which data were available), not just the 2004-2014 period.

Average number of publications (items)	47 (range = 6-360)
Average h-index	12 (range = 3-49)
Average number of citations per item	14 (range = 3-60)
Total citing articles (excludes self-citations)	590 (range = 19-6700)

Submitted proposals and awarded extramural funding has been steady over the 2004-2014 period with total award amounts generally increasing over this period. The proposal activity is shown in the following table.

Funding Data for Neuroscience Program Faculty Members (2004-2014)				
<u>Year</u>	<u>Submitted</u>	<u>Funded</u>	<u>Percent Funded</u>	<u>Total Award Amount</u>
2004-05	67	25	37	\$7.66M
2005-06	72	30	42	\$8.95M
2006-07	63	21	33	\$9.82M
2007-08	75	28	37	\$11.9M
2008-09	84	18	21	\$11.8M
2009-10	125	43	34	\$11.3M
2010-11	84	28	33	\$15.4M
2011-12	102	35	34	\$15.7M
2012-13	116	40	35	\$12.1M
2013-14	128	31	24	\$13.4M

Data provided by the Office of Sponsored Projects, Michigan State University

Our students have been active submitting predoctoral fellowships. For the period from 2004-2014, 19 fellowship proposals were submitted, mainly to the American Heart Association (AHA) and NIH (NRSA), with 4 of these being funded and 1 pending. This past fall, graduate students submitted 1 AHA and 4 NRSA applications.

Faculty research training accomplishments. It is also noteworthy that Neuroscience Program Faculty (GD Fink, Program Director, JJ Galligan, Project Leader, G. Swain and A. Dorrance, co-investigators) are investigators on 1 of only 2 NIH funded program project grants on campus. The PPG has recently been refunded for years 11-15. In addition, Neuroscience Program Faculty are Program Directors on 3 NIH T32 training grants (Galligan, Pharmacological Sciences; Breedlove, Integrative Neurobiology of Social Processes; Sisk, Interdisciplinary training in Neuroscience). The application process for T32 grants is extremely competitive and assembling the application is a major undertaking. These large impact awards are tangible indicators of the research success of our faculty.

Satisfaction Surveys. In surveys of our graduate students and postdoctoral associates, it is clear that the program is viewed as strong and comprehensive. The following two comments from a recent survey reflect these positive views.

“The NSP is incredibly supportive of its students and allows much flexibility when it comes to students pursuing goals. For example: allowing (and actually helping) students to take courses outside the "core" NSP canon with no fuss. Also, the ease of attaining funding for travel to conferences, etc., has been very helpful. The program also gives us ample opportunity to develop things like lecture/presentation skills through Research Forum and various NSP get-togethers (such as our retreats and cross-campus research days).”

“The Program has excellent opportunities for collaboration across many disciplines and areas of expertise. It’s almost always possible to find someone willing to collaborate in the Program with

the expertise you need. Also, the financial support for conference attendance is very important to allow and encourage students to attend at least one conference each year.”

Exit surveys are used by the Graduate School to assess the graduate’s satisfaction with their education and training. During the survey period (2004-2014), 19 doctoral students from the NSP completed the survey. The scoring ranges from 1 (strongly agree) to 5 (strongly disagree). The following summarizes the survey data.

General Department/Program. Items 1 to 5 described how graduate students feel about various aspects of their department/program (Mean=1.67, SD=.90). The majority of respondents agreed or strongly agreed with positive statements regarding the department. For example, 90% of respondents agreed or strongly agreed with the statement that “The Department/Program has provided me with satisfactory preparation from my future professional work” (item 1).

Department/Program Atmosphere. Items 6 to 9 gauged the atmosphere of the department/program (Mean=1.64, SD=.52). The majority of students agreed or strongly agreed with most statements. For example, 84% of respondents agreed or strongly agreed that “there has been satisfactory communication between faculty and doctoral students regarding our needs, concerns, and suggestions” (item 6).

Department/Program Support. Items 10 to 11 assessed department support (Mean=1.50; SD=.80). On all items, a majority of respondents agreed or strongly agreed with positive statements regarding department support. For example, 90% of students agreed that they never unfairly passed over for teaching or research assistantships (item 11).

Department/Program Faculty. Items 12 to 14 assessed students’ attitudes and feelings toward department/program faculty (Mean=1.32; SD=.51). On all items, a majority of respondents agreed or strongly agreed with positive statements regarding faculty. For example, 100% of respondents agreed or strongly agreed that “faculty assigned to graduate courses have been highly qualified” (item 12).

Department/Program Delays. Item 15 examined department delays (Mean=1.42; SD=.61). In particular, 95% of the respondents expressed that they had *not* experienced “delay when guidance committee members were unavailable or unprepared.”

Department/Program Procedures. Items 16 to 17 assessed satisfaction with department/program procedures (Mean=1.21; SD=.42). In particular, 95% of the respondents agreed with the statement that the “guidelines and requirements in my program have been clearly conveyed to me in writing” (item 16). Another 100% agreed that “the degree requirements and work expectations were made clear when I began my program” (item 17).

Department/Program Teaching Experience. Items 18 to 20 assessed department/program teaching experience (Mean=2.00; SD=.75). Respondents tended to indicate agreement with these items. For example, 58% felt that their teaching experience at MSU was adequate to prepare for the teaching component of an academic career (item 18).

Dissertation Advisor/Major Professor. Items 21 to 25 assessed satisfaction with dissertation advisor or major professor (Mean=1.66; SD=.77). On all items a majority of respondents agreed or strongly agreed with positive statements regarding their advisor. For example, 95% of respondents agreed or strongly agreed that “my major professor could be relied upon to give constructive criticism on my work” (item 24).

University. Items 26 to 28 assessed satisfaction with various aspects of the university (Mean=1.87; SD=.66). On all items, a majority of respondents agreed or strongly agreed with positive statements regarding the university. For example, 68% of respondents agreed or strongly agreed that they were “satisfied with the interdisciplinary opportunities” (item 27).

Placement. For 43 graduates in the period of 2004-2014, we have placement data for 22 of these. These individuals have pursued positions (i) as a postdoctoral associate at institutions such as Harvard, University of Texas, University of Michigan and MSU, (ii) in academia as a lecturer or tenure-track faculty at Central Michigan University, Mercer, Georgia Southern, University of Colorado at Denver and City College of New York, and (iii) in industry at companies such as Merck and Novartis.

4. *What changes do we think are needed in order for use to advance?*

(i.) The committee favorably views the efforts being made in the program to lower the time to graduation toward the 5.0 year mark. To this end, the program has implemented several structural changes. First, beginning with students entering the program in the fall semester 2014, they will be encouraged to begin their Ph.D. training during the preceding summer term. This will allow students to complete their two required lab rotations by the end of the first fall term, which will enable them to progress into their Ph.D. research project in the spring term of Year One (one semester earlier than in the past). This change has the added advantage of providing a subset of our students the opportunity to apply for National Science Foundation predoctoral fellowships during their first year (NSF fellowships require that students have less than 12 months of graduate education at the time of the application). This structural change will help reduce time to completion and also help to increase student productivity. Second, the time to the dissertation proposal defense is positively correlated with time to degree completion. Therefore, all students are now required to complete their proposal defense (specialized component of the comprehensive examination) no later than May of their third year. Third, we have found that many students delay formation of their dissertation advisory committee until after they have completed the written, standardized component of our comprehensive exam (end of the spring term, second year). Input from a student’s committee is critical for the development of the dissertation research project and students should begin these consultations soon after selecting a home laboratory. Students are now required to form their dissertation advisory committee and hold their first committee meeting before December of their second year. The faculty advisor and student would work together to create an Individual Development Plan. This new requirement will result in more focused research earlier in the student’s training.

(ii.) The committee views continued efforts to improve program cohesiveness between the EL and GR campuses as critical for the success of the NSP. Recently, several program changes have been instituted to this end. These include the newly initiated semi-annual Cross-Campus Neuroscience Day (fall and spring semesters each year alternating sites), use of state-of-the-art two-way HD video conference-enabled classrooms for seminars and meetings, subsidizing the inter-campus travel costs of both students and faculty to commute back and forth, and the appointment of two cross-campus facilitators on the Student Council.

With regard to the travel costs of commuting between the two campuses, the MSU Neuroscience Road Fellowship program has been established with funds provided by the Graduate School. The purpose of this fellowship program is to defray costs for NSP graduate students commuting

to/from East Lansing (required for NSP coursework) to/from Grand Rapids CHM (required for NSP laboratory rotations). Students receive \$750 per semester and they can receive the fellowship for two semesters.

Additional activities designed to improve the cohesion of the two campuses are:

- A GR-based NSP faculty member has served on the Graduate Advisory Committee (GAC) since 2011.
- In 2012, a few GR NSP faculty travelled to EL to participate in the applicant luncheon and poster session as part of the recruiting weekend. GR faculty conducted phone interviews with the applicants interested in GR NSP labs, and some applicants returned to GR to tour the facilities and meet GR NSP faculty. Three NSP recruits joined GR NSP labs from this class. In the 2012-2013 school year, approximately half of all first- and second-year required courses could be video conferenced from GR, allowing the students to commute less and conduct more research. The Road Fellowship was initiated.
- In 2013, a few more GR NSP faculty travelled to EL to participate in the applicant luncheon and poster session as part of the recruiting weekend. Then, on the second day of the recruitment visit, applicants interested in NSP GR labs travelled to GR to spend the morning in interviews and touring the facility. 8 of 9 GR NSP faculty participated in the interviews. One NSP recruit joined a GR NSP lab from this class. In the 2013-2014 school year, all required courses but one could be video conferenced from GR.
- In 2014, similar activities were conducted as in 2013. It is anticipated that one NSP student (of two total recruited) will be joining a GR NSP lab. 9 of 10 GR NSP faculty participated in interviews. In the 2014-2015 school year, all required courses will be video conferenced from GR.
- In 2015, there will be increased student exposure to GR NSP further. Instead of some prospective applicants opting to visit GR NSP labs as part of the recruiting weekend, *all* hosted applicants will spend 6 hours in GR on the second day of the visit. Applicants will be interviewed by all 11 GR NSP faculty, activities in GR will include a separate poster session, luncheon, and lab tours. This represents a change in the structure of the recruiting weekend that was suggested by some faculty members.

(iii). Given the current state of biomedical research with regard to the large numbers of graduates produced relative to the limited number of job openings (see PNAS 111 (2014) 5773-5777), infusing more diversified training into the graduate program to prepare our students and postdoctoral trainees for careers beyond academia (*e.g.*, science policy, foundations, industry, science writers, staff scientists, etc.) would be prudent. Success as a program will ultimately depend on whether our graduates can be gainfully employed using the PhD training they received. The NIH's Biomedical Research Workforce Innovation Award: Broadening Experiences in Scientific Training (BEST) (<http://grants.nih.gov/grants/guide/rfa-files/RFA-RM-12-022.html>) is one program that might be pursued for funding to support new and innovative approaches to broaden graduate and postdoctoral training. The developed training should reflect the range of career options that trainees ultimately may pursue and that are required for a robust biomedical, behavioral, social and clinical research enterprise. Changes in this direction are already in motion with the Individual Development Plans that are now starting to be created for the graduate students and postdoctoral associates.

High level research productivity of our graduate students has been and will continue to be a core principle of our Ph.D. program. Program administration and faculty recognize the changing landscape of post Ph.D. careers for our students. We provide ample teaching opportunities through our program directly and also encourage our students to take advantage of campus-wide teaching training and certificate programs for students who wish to pursue postgraduate teaching positions. We also have an active outreach program that provides students opportunities to develop communications skills for interacting with the lay public about the value of neuroscience research and education. One of our current students (Nicole Polinski) is a Society for Neuroscience Early Career Policy Fellow. We encourage students to explore many career options but emphasize that regardless of the long-term career pathway, research productivity while a graduate student be a key factor in determining the student's long-term success.

(iv). Efforts should continue to promote more timely scholarly output from the faculty members and the graduate and postdoctoral trainees. Efforts should also continue to encourage and support the graduate student and postdoctoral trainees to prepare and submit fellowship applications. This is in line with the recommendation that the graduate student support progressively shift from individual P.I. grants toward more fellowship and training grant support.

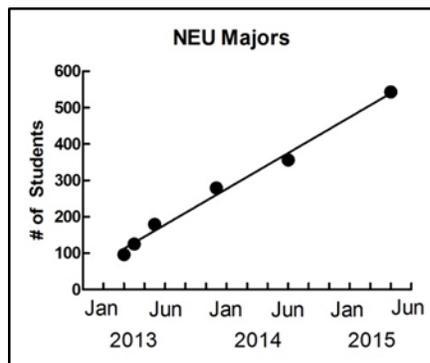
(v). The Graduate Affairs Committee (GAC) or perhaps an ad hoc curriculum committee should spend time evaluating the current core and elective courses in order to recommend updates to the content or the manner in which the content is presented and to decide on what new courses might need to be taught to fill curriculum gaps.

5. How will we evaluate our future progress and success?

We will evaluate our future progress and success by (i) annually evaluating the scholarly output from the graduate students, postdoctoral associates and faculty members with an eye toward reducing the time to publication of the work and increasing the number of 1st author publications by the graduate students, (ii) reducing the time to graduation to near the 5.0 year mark, (iii) annually evaluating the percentage of graduate and postdoctoral trainees who submit fellowship/grant applications and the success rate for these applications, (iv) exit interviews and trainee surveys that probe the program's effectiveness at education, research training, professional development and outreach, and (v) the placement of graduate students after receiving degrees and postdoctoral associates after completing their tenure in the program.

III. Undergraduate Program

The undergraduate program is only in its third year. Even so, the program has seen unprecedented growth. The following numbers show the declared majors in each semester the program has been in existence: FS 2012 (80), SS2012 (184), FS2013 (288), SS2014 (373), FS2014 (411) and SS2015 (547)(Figure at right). It is anticipated that the number of majors will reach 600 over the next two years. This rapid growth has created some strains on the program teaching load, particularly with teaching additional sections of the core courses (NEU 301 and 302) and the introduction of new courses, timely advising, and having an adequate number



undergraduate laboratory research experience opportunities.

At present, the following program courses are offered:

NEU 301	Introduction to Neuroscience I (Fall Semester, 3 h)
NEU 302	Introduction to Neuroscience II (Spring Semester, 3 h)
NEU 311	Neuroscience Laboratory (Fall and Spring Semesters, 2 h)
NEU 420	Neurobiology of Disease (new course, Spring Semester, 3 h)
NEU 492/ECE 491	Neural Signaling/Engineering (Special Topics, Spring Semester, 3 h)
NEU 310/ZOL 301	Human Sexuality (online course, Summer, 2 h)

New courses available beginning fall, 2015:

NEU 215	Neuroscience and Society (Summer 3 h)
NEU 410	Instrumental Methods of Analysis in Neuroscience (Fall, 3 h)
NEU 416	Development of the Nervous System Across the Lifespan (Fall, 3 h)
NEU/PHM 422	Fundamentals of Neuropharmacology (Spring, 3 h)
NEU 425	Computational Modeling in Neuroscience (Spring, 3 h)
NEU 430	Genomics of Brain and Behavior (Summer 3 h)
NEU 435	Ion Channels of Excitable Membranes (Fall, 3 h)
NEU 440	Synaptic Transmission (Spring, 3 h)
NEU 445	Analysis of Functional Neuroscience Data (Fall, 3 h)
NEU/ECE 4XX	Introduction to Neural Engineering (Fall, 2016, 3 h)

NEU 301 and 302 enrollment is now nearing the level that will soon necessitate the addition of a second section in each semester. Faculty will be needed to teach these additional sections. For example, in SS2014 NEU 302 had 70 students and in FS2014 NEU301 had 143 students. NEU302 in spring semester, 2015 has 132 students. These are the introductory core courses and given the fact that the number of majors will reach 600 in the next two years, these two courses will see a doubling of the current enrollment.

In developing this internal review of our undergraduate program, input was solicited from the faculty members, postdoctoral associates and graduate students on what the key issues are. The following major points were raised:

1. Given the rapid growth of the program, additional sections of NEU 301 and 302 are needed now and new courses are needed that cover critical topics in the subject. Mechanisms are needed to incentivize non-NEU faculty to contribute to the teaching load. These could include financial compensation or receiving credit in their home departments for developing and teaching these courses. Faculty willingness to participate in program teaching varies widely across faculty home departments.
2. Related to point 1, the program needs more involvement of faculty members from multiple departments (*e.g.*, Pharmacology/Toxicology, Physiology, Psychology, etc.) for teaching in order to offer a more diverse set of interdisciplinary courses.
3. Research experience for each undergraduate is an overarching goal of the program. More undergraduate research opportunities are needed for the majors. Independent laboratory research experience is a vital component of the students' undergraduate education. The limiting factor at the moment is the number of funded faculty members willing to mentor these students.

4. With the rapidly growing size of NEU 301 and NEU302, there is an ever increasing need for access to an interactive classroom.
5. Implement new activity-based approaches for learning, departing from the traditional passive watching and listening approach.
6. Increased enrollment will require the addition of at least 1 new 311L laboratory section of 24 student per section to meet the needs of our students. Initial planning of the program envisioned that 100 student per year would need the laboratory course (2 sections per semester of 25 students). Current demands are for 150 laboratory slots each year requiring the addition of 1 section per semester.

Summary and Committee Recommendations

The administrative functions for the graduate program are appropriate and satisfactorily met by the current structure. No changes or additions are recommended.

However, the rapid growth of the undergraduate program has presented both administrative and financial challenges. The program has only been in existence for two years but has grown from 25 to 411 students during that time. Continued program growth is expected over the next two years to near 600 majors.

Therefore, there is a need in the undergraduate program is for additional administrative assistance. It is the opinion of the committee that a teaching laboratory manager (part-time) and an academic advisor (part-time) are needed.

(i) A Laboratory manager (part-time) is needed. This would be a new position. Currently, graduate student teaching and laboratory assistants along with the Laboratory Course Director (Jennifer Taylor, PhD) handle duties that are more commonly handled by a laboratory manager, in addition to their teaching and instruction responsibilities. Examples include setting up laboratories, ordering supplies, seeing to equipment maintenance, and maintaining colonies of drosophilae and crayfish. As present, there is one undergraduate laboratory course (multiple sections), NEU 311 (Neuroscience Laboratory), taught each semester. This laboratory course provides an overview of neuroscience research methodology, including experimental design, data analysis, and presentation of results. The course is also an MSU Tier II writing course (“writing in the discipline”) and it is important that the Course Director and TAs have sufficient time to grade and provide feedback on the multiple writing assignments. In the fall semester 2014, there were three sections taught to 40 students and in the spring semester of 2015, three sections will be taught to 50 students. Finally, new laboratory courses are planned as the undergraduate curriculum continues to develop and expand. A part-time laboratory manager would be extremely helpful.

(ii) An Academic advisor (part-time) is needed. The current undergraduate academic advisor (Kanchan Pavangadkar, PhD) now meets with each first-year student at least twice per year, and with all other students at least once per year. Meeting with the number of students currently enrolled in the NEU major already exceeds the 350-student guideline recommended by the College of Natural Science, and is very close to the limit of available hours in a full-time position. Given the other demands of the job, including approving academic plans, working with probation students, and staffing academic orientation programs during the summer, there is too much work for one individual to perform. Dr. Pavangadkar also been working with the UPD to

develop expanded research opportunities and summer internships at MSU, in Ann Arbor (Backyard Brains), and in Grand Rapids (Translational Science & Molecular Medicine). A part-time academic advisor would help with more of the routine advising efforts, allowing Dr. Pavangadkar more time to continue the above-listed efforts as well as to assist with advising students in their pursuit of prestigious national and international scholarships and fellowships, and helping to recruit high-achieving undergraduates.

(iii) Additional teaching and learning assistant positions to support the increased number of needed sections of NEU 301, 302 and 311L (laboratory course).

Position	Cost
Laboratory manager	\$33,238
Academic Advisor (½ time)	\$26,000
4 TA positions	\$153,320
4 LA positions	\$39,128
Total request for recurring support	\$251,686

1. *What do we do?*

The Bachelor of Science degree in Neuroscience is designed for students who wish to pursue a career in which a broad-based knowledge of the structure and function of the nervous system is necessary. This includes careers in research, education, healthcare or business. It is also intended for those students who seek admission to graduate programs in neuroscience or health-related professional schools. In addition to the core requirements, students can concentrate their studies in cellular and developmental neuroscience; behavioral and systems neuroscience; or cognitive neuroscience.

2. *Why do we do it?*

There is an ever increasing demand for training in neuroscience as evidenced by the past and expected growth of the program. A degree in Neuroscience is a cornerstone for careers in the biomedical sciences and for postgraduate studies in a variety of fields including psychology, pharmacology and toxicology, physiology, biochemistry, molecular biology, medicine and veterinary science. Neuroscience majors find jobs in the medical, educational, research and government sciences communities. Neuroscience degree holders work in the pharmaceutical industry as well as in the areas of biotechnology and biomedical research.

3. *How well do we do it and who thinks so?*

The program is relatively new. As a consequence, there have not yet been enough graduates to develop many useful performance metrics. However, one key metric that clearly indicates we are teaching the students well and that they are learning the theoretical and practical aspects of the discipline is the grade point average (G.P.A.) of our majors in comparison with the G.P.A. of all majors in the College of Natural Science. In the Spring Semester of 2014 there were 10 graduates with a nominal G.P.A. of 3.59 ± 0.37 and in the Summer Term of 2014 there were 8 graduates with a nominal G.P.A. of 3.49 ± 0.27 . Both G.P.A.s are considerably higher than the average G.P.A. of all College of Natural Science graduates over the period from 2005-2013, which is 2.95 ± 0.03 . The mean G.P.A. of our NEU graduates is also greater than the mean G.P.A. for all university graduates between 2004-2014 is 3.23 ± 0.03 (~57,000 students).

It is also clear that our students are being prepared well in terms of their training in the theoretical and experimental aspects of neuroscience, and they are being stimulated to pursue advanced degrees. Of the 24 graduates in 2013-2014, 14 of the 24 were accepted and are enrolled in postgraduate degree programs (Ph.D., D.O. or M.D.); 2 of the 24 are currently engaged in academic research and 8 of the 24 are in a gap year waiting for acceptance to graduate, medical or veterinary school.

4. *What changes do we think are needed in order for use to advance?*

(i). More sections of the core courses (NEU 301 and 302) and perhaps new course offerings are needed covering special topics in neuroscience (300 and 400 level). With the ever growing number of majors, there is an emerging need to add new sections and even new courses, especially upper division courses at the 300 and 400 level. The undergraduate majors need a greater selection of advanced courses on selected special topics in the field. Currently, the Undergraduate Program Director (UPD) is responsible for curriculum development. The UPD would be greatly assisted if a standing Undergraduate Curriculum Committee were to be established. This committee could be formed with current NSP faculty members and should be tasked with creating a diverse and interdisciplinary curriculum. Courses should be developed with an eye toward combined training in science with the teaching of leadership skills, creativity, teamwork and communication skills.

A difficulty with adding additional sections of NEU 301 and 302 is the fact that there is a limited number of partially or fully-appointed NEU faculty members, and the ones who do have an appointment are carrying a full teaching load. Recruiting faculty from other departments is complicated because the PD has no authority to assign these faculty classes to teach. Furthermore, the faculty would have to take on the teaching as an “extra” workload. This is a limitation of being a program rather than a department. A solution to this teaching problem as well as other issues is to convert from a program to a department. Efforts have begun for this transition as a proposal is presently under consideration with the upper administration.

(ii). More independent research opportunities are needed for the majors. The research can be performed for academic credit (NEU 490, no pay) or for pay. Undergraduate students should be doing independent work on their own research projects. The theoretical and practical aspects of the discipline are best learned through mentored research. Students should be given the opportunity and expected to apply their classroom and laboratory knowledge to an independent project. The faculty research mentor and his/her group should be there to help the student with any questions or concerns they may have when working in the lab, but the expectation should be that the student conduct the work on their own. The students should be encouraged to start engaging in research early in their academic careers rather than waiting until their senior year as is often the case. Programs are in place at MSU to facilitate this such as the **Professorial Assistant** program. The limiting factor at present is the number of laboratories and research mentors willing to host the many undergraduate students. The placement of students in laboratories is now being coordinated by the academic advisor (Kanchan Pavangadkar, PhD). Faculty members should be strongly encouraged to serve as research mentors. If possible, mechanisms should be put into place to provide hosting laboratories with a small compensation. This might be a small amount of money that could be used for materials and supplies in support

of the project. Another possibility is a joint funding mechanism between the program and the mentoring PI. Mechanisms should be put into place, if possible, to offer some research fellowships for qualified and selected students that would support full-time work in the laboratory during the summer with opportunities at both the EL and GR campuses. Finally, efforts should be made to develop an internship program with regional industries to give students opportunities to learn about working in industries where their skills and education can be applied (*e.g.*, clinical laboratories, pharmaceutical companies, biotech firms, etc.).

The GR campus is starting to be more active in providing undergraduate research opportunities. In summer of 2014, 4 MSU Undergraduate NSP students participated in summer research internships in the Manfredsson, Sortwell, Collier, Steece-Collier and laboratories. These internships were primarily supported by the NSP with an additional contribution from TSMM. The MSU NSP Undergrad program coordinated the application and selection process. This program will continue in 2015.

In support of undergraduate research, the Neuroscience Club organized the first Undergraduate Neuroscience Research Forum in the spring of 2014. Students made poster presentation on their projects to other student, graduate students, postdoctoral associates and faculty in the NSP. This will become an annual event.

(iii). Develop more modern and cutting-edge upper-level courses and recruit faculty to teach these. This point is directly related to (I) above. Cross listing new neuroscience courses with existing relevant courses in other departments would be a mechanism to increase the course offerings to the students. A potential problem with developing new courses to fill curriculum gaps is that most of the NSP faculty members have neither full nor partial appointment with the program. Their primary appointments are in other departments. This means, at least for newly developed courses, that faculty would have to volunteer to take on an extra teaching load. Mechanisms should be sought within the college and between the NSP and the faculty member's home department to give the faculty member credit for teaching a course outside their home department and in addition to their normal course load. For most research-active faculty, a normal course load would be one course (3 h) per semester. The credit could be some financial compensation for the additional workload and or a reduced departmental teaching load the semester the faculty member is teaching the neuroscience course.

(IV). Develop a more diverse set of courses that better represents the interdisciplinary make-up of the neuroscience program faculty members. Strength of the NSP is the interdisciplinary diversity of the faculty members. This means opportunities exist for developing a broad-based, interdisciplinary curriculum for the undergraduates. Currently our course offerings are rather limited. As mentioned above, faculty members need to be recruited to teach special topics courses at the 300 and 400 levels and mechanisms need to be put into place to credit this faculty for the extra workload.

(v). Create courses that enhance human learning using activity exploration and innovation rather than passive watching or listening. Today's students learn differently than their predecessors. Course offerings in the program should be more problem-based and interactive rather than the traditional passive learning. New courses should be developed with an eye toward combined

training in science with the teaching of leadership skills, creativity, teamwork and communication skills.

5. How will we evaluate our future progress and success?

We will evaluate our future progress and success by (i) comparing the G.P.A. of our graduates with the average for all students in the College of Natural Science, (ii) following our graduates through exit interviews and post graduation follow-ups to see what percentage are employed or are placed in advanced degree programs, (iii) monitoring the numbers of our students/graduates in each year who engaged in independent research that results in co-authorship on papers and or presentations by the student at conferences, and (iv) determining the number of our students/graduates that apply for and receive awards and fellowships.

Summary Statement from the Committee

In summary, the NSP offers exceptional education, research and professional development opportunities to undergraduate and graduate students as well as postdoctoral associates. The health of the undergraduate and graduate programs is strong. Strong collaborative and interdisciplinary training is made available by the research- and gender-diverse faculty. The program provides a high quality and nurturing environment for the student. The NSP is highly regarded across MSU, and our distinguished faculty and students infiltrate many departments, programs, and colleges to present a good face of the neuroscience community to the institution as a whole. Departmental and college administrative units have consistently partnered over the years to promote and support neuroscience research and education through collaborative faculty hiring initiatives, and most recently, the creation of an undergraduate neuroscience major that is administered by the NSP. We enjoy this institutional support not only because of the credibility that comes with T32 funding (graduate program), but also our effective stewardship of both extramural and intramural support to provide a rich and vibrant education and research training program that is launching our trainees into successful careers.

Future Directions: Department of Neuroscience. The dynamics of the Neuroscience Program have changed dramatically with the addition of the undergraduate neuroscience major while still supporting a large and successful interdisciplinary Ph.D. program. Addition of the undergraduate major presents exciting opportunities to develop an outstanding program where students are provided state of the art education in neuroscience and preparation for a variety of neuroscience-related careers. Part of this career preparation is to offer research opportunities for all undergraduate neuroscience students. However, providing high quality instruction in neuroscience requires faculty who are successful researchers and are also committed to excellence in undergraduate neuroscience education and are willing and able to devote the time needed to accomplish these goals. In 2011, the Neuroscience Program hired 1 full time fixed Assistant Professor and 4 tenure track Assistant Professors to provide undergraduate teaching. In addition, there are two tenured Professors with 100% appointments in the Neuroscience Program (with 0% appointments in a tenure home department). The Neuroscience Program is not a tenure granting unit and it has limited laboratory space. Hiring tenure stream faculty into the Neuroscience Program requires split appointments with a tenure granting department. These faculty have teaching and service obligations to the Neuroscience Program and to the tenure home department. This arrangement provides recruiting challenges (recruiting “split appointment” faculty is not a simple task) and also time management challenges for young faculty as they work to establish successful and funded research programs while balancing the

demands of two units. These challenges have become larger than anticipated during the rapid growth of the undergraduate major and the increasing teaching demands associated with this growth. While our interdepartmental Ph.D. program has successfully met its teaching needs as faculty are willing to volunteer time to contribute to team taught graduate courses (we often have 10 or more instructors in a graduate course) which have small enrollments (a maximum of 18 students), team teaching does not work well in large undergraduate courses.

Establishing a Department of Neuroscience would address the challenges listed above and would ensure that we can maintain high quality research, teaching and service activities. It is very important that faculty feel “ownership” of a program and its students and departmental status will help ensure that faculty ownership. A Department of Neuroscience would have 15 tenure stream faculty who have active and funded neuroscience research laboratories and who are also committed to undergraduate education and training of Ph.D. students. This program would be modeled on the Department of Neuroscience at the University of Pittsburgh which supports an undergraduate major, an interdisciplinary Ph.D. program and is housed in the College of Arts and Sciences, a large undergraduate serving college. Departments of Neuroscience at Big Ten Universities are housed in the College of Medicine. Faculty for the new department could come from current faculty appointed wholly or partially in the Neuroscience Program (assuming they chose to be part of the new department), faculty from other departments who would want to change department affiliations and from new hires.

The Department of Neuroscience will be the administrative home to the interdisciplinary Ph.D. training program in Neuroscience. It is essential to maintain the interdisciplinary participation of the broader neuroscience faculty across campus including Grand Rapids where a large cohort of active neuroscience researchers are currently training 5 neuroscience Ph.D. students. There are several reasons for maintaining the interdisciplinary Ph.D. training program. Firstly, the strength of the interdisciplinary program is the breadth of neuroscience training available to our students as faculty are based in multiple departments (Psychology, Physiology, Neurology and Ophthalmology, Pharmacology and Toxicology, Translational Science and Molecular Medicine). The broad training opportunities for our Ph.D. students need to be maintained. Secondly, 15 faculty in the Department of Neuroscience would not be able to provide enough training slots (funding) to support the 32-36 Ph.D. students in our program. Providing non-departmental training laboratories will ensure that we can maintain the critical mass and diverse pool of Ph.D. students required of a vibrant and successful program. Thirdly, NIH funding of T32 training grants requires that the training program be interdisciplinary and not department-based. If we are to continue to compete successfully for T32 training grants to support neuroscience Ph.D. students we must maintain the interdisciplinary structure of the Ph.D. program.

Establishment of a Department of Neuroscience would provide the stability needed to support and grow high quality B.S. degree program where students receive state of the art didactic and research training in neuroscience. The B.S. program in Neuroscience has an opportunity to be a signature program for M.S.U. as there are very few undergraduate neuroscience programs offered at R1 universities (most Neuroscience departments are housed in medical schools or at smaller colleges without substantial research infrastructure). Our program would provide undergraduates all of the research opportunities available at a R1 university while also providing a small college feel as there would be an identified cohort of faculty responsible for student

education and long term success. Our program would be particularly noteworthy as classroom instruction would be provided by research active and extramurally funded faculty with nationally and internationally recognized research programs. This will be accomplished while also maintaining the highly successful interdisciplinary Neuroscience Ph.D. training program.

External Review of the Neuroscience Program Michigan State University

External Reviewers:

James P. Herman, University of Cincinnati

Kristen A. Keefe, University of Utah

Alan F. Sved, University of Pittsburgh

Report submitted: February 2, 2015

Overview

The Neuroscience Program (NSP) at Michigan State University, encompassing an established inter-departmental doctoral training program and a rapidly developing undergraduate major, is strong and well-positioned to become even stronger. The report of the Internal Review Committee provides a nice description of the programs, so we won't repeat that here. Rather, our report will focus on what we view as the key strengths and issues. During our review of the NSP, we met with various groups of faculty and graduate students, including a visit to the Grand Rapids campus. Below we provide our comments regarding what we considered the particular strengths of the graduate and undergraduate programs, as well as issues to consider moving forward. However, prior to presenting those bulleted points, we provide some general comments.

In general, the graduate program is flourishing under the direction and administrative oversight provided by James Galligan and his colleagues. A clear strength of the program is the faculty, particularly their active engagement and thoughtful approach to graduate education. The students are well trained in a highly supportive environment that facilitates their growth and development, preparing them for successful careers as neuroscientists. Similarly, the undergraduate program is strong and growing very rapidly, showing that the time is ripe for putting a structure in place to ensure the long-term success of a sizable major. This should involve the development of a Neuroscience Department to be a home for the major. However, as the Department of Neuroscience develops, care should be taken so as not to disrupt the strength of the interdepartmental graduate program.

Graduate Program Description and Structure:

Commendations:

- The graduate neuroscience program (NSP) is strong in terms of quality of mentoring. The students universally reported feeling supported and welcome in the program. The support and mentoring is a major reason reported as to why students choose to matriculate into the MSU NSP.

- The breadth of neuroscience training is clear strength, and is critical for competitiveness for future support from the jointly sponsored T32 grant. The students strongly are in favor of the course content delivered and retaining it.
- Mentoring and training toward diverse career outcomes also is readily apparent and appreciated by the students.
- Strong and effective efforts have been made to bridge the East Lansing and Grand Rapids campuses, such as alternating seminars and research presentations, as well as live streaming courses and seminars. Students on the East Lansing campus report feeling as close to the students in Grand Rapids as they do to students who also are on the East Lansing campus but are in a different building. Indeed, the program is doing a phenomenal job of making the two-campus system work. In our view, there is no "integration" issue with respect to the two campuses.
- The program is effectively recruiting very good applicants to the NSP. While few students overall matriculated into the program last year, we consider this an anomaly. The recruiting effort overall is seen as effective by the students and faculty who are pleased with the quality of the applicants and matriculated students.
- Students universally liked the qualifying exam in its present format, and they clearly understand and agree with the objectives of the examination.
- The leadership of the program has been and continues to be very strong. The faculty are strongly committed to and engaged in the program across multiple departments and levels of seniority. Further, the program is highly regarded by faculty and administration.
- Graduate students feel that their opinions are solicited and listened to in terms of program administration, design, recruitment.

Recommendations:

- Continue the recent focus of the NSP on making offers to the most competitive graduate students, rather than bringing in a set number of students. Continue efforts to recruit applicants of the highest quality. This effort should include timely website redesign to clearly highlight the research strengths at MSU. It is critical that this occurs before next year's recruiting season.
- It is the strong and unanimous opinion of this external review board that the Neuroscience Graduate Program remain a broad-based, interdepartmental program rather than a program based in an emerging Dept. of Neuroscience. Such interdepartmental structure will be critical for future success on T32 training applications, as well as providing appropriate breadth of training in neuroscience and maintaining cohesiveness across the broader neuroscience community (including the GR campus).

- While the curriculum was reviewed as being strong, some tinkering may be in order: a) Move the majority of the coursework into the first year; b) Provide hands-on experiences in a methods and experimental design course divided between the EL and GR campuses and incorporate modern approaches in neuroscience research; c) Use more "active learning" approaches for delivery of the graduate curriculum; d) Provide greater coverage of cellular and molecular biology; e) Ensure that all faculty teaching in the graduate program have the necessary training or technical support to effectively deliver content via distance technologies.
- Work in concert with the Graduate School to deliver its courses (e.g. RCR) and professional development opportunities via video and/or in parallel on the GR campus.
- There is a need to secure increased mechanisms for graduate stipend support. Some of these may be linked to additional TA positions associated with the growing undergraduate major. Such support will enhance the research capabilities of neuroscience faculty at MSU.
- To assure continued growth of MSU as a leader in neuroscience research, attention will have to be given to infrastructure, including renovation of current research space (e.g. Giltner Hall) and/or new construction, and also continued improvement of the animal facilities supporting the research endeavors.
- Continue initiatives in place to ensure timely progression of students through the program and to completion of the PhD degree, as well as for timely submission and publication of research.

Undergraduate Program Description and Structure:

Commendations

- The time is ripe for establishment of an undergraduate neuroscience major. This is evidenced by the recent success of recruiting large numbers of students into the major.
- A successful undergraduate major of the size expected to develop will likely require the establishment of a separate Department of Neuroscience to house and administer the program. It is nice to see that discussions at the upper-level administration to establish a department of neuroscience are underway.
- The passion and energy of those faculty currently involved in the undergraduate major will ensure the success of the program, provided they receive adequate support from the university.
- Though we did not delve into the undergraduate program curriculum in detail, it seems to be thoughtfully assembled, with appropriate core courses

and electives. The required new laboratory course appears to be top notch, though the program directors should be cautious not to devote too many resources to this course at the exclusion of other important courses and programs

Recommendations

- The Internal Academic Review report thoughtfully considered issues related to the undergraduate program and the report includes important recommendations.
- The large undergraduate major will require significant additional resources and these resources will need to be made available without impacting other important programs, such as the graduate program in neuroscience and programs in other departments.
- Faculty engagement is critical and NSP faculty in diverse departments will need to be kept involved. Communication will be key, and NSP faculty currently involved in the graduate program should be included in discussions of both the developing undergraduate program and the formation of the Neuroscience Department.
- Faculty staffing of the undergraduate courses will require careful consideration of the appropriate faculty size of a new department and also how faculty in other departments might contribute to the teaching of the undergraduate curriculum. The use of faculty positions split between the Neuroscience Department and other departments needs to be carefully considered.
- Careful consideration will need to be given to the teaching the curricula of both a graduate and undergraduate program without overburdening individual faculty. Creative synergies between courses in the two programs should be considered.
- In further developing the program it may be useful to obtain information from other successful large neuroscience majors at other top research universities.
- Laboratory research is a valuable component of the major and the program will need to be creative in finding suitable laboratory experiences for the large number of majors.
- Movement of existing faculty into the Neuroscience Department needs to be carefully considered, and involve consultation with all stakeholders. It is critical that construction of the Department be performed in such a way as to avoid disruption of interdepartmental or faculty relationships. Generation of rifts or turf wars would likely harm both the graduate and undergraduate programs.