Interdisciplinary Graduate Program in Neuroscience

University of Washington, Seattle
Self-study Document for Program Review

Degree offered: Ph. D. in Neuroscience
Last review: 2005

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Part A
Required Background Information for Review Committee

Section I Overview of Organization

Overview
The Graduate Program in Neuroscience is an interdisciplinary program dependent directly on the Graduate School. It comprises 136 faculty members who are eligible to mentor Ph.D. students, drawn from 27 departments on campus and 4 partner institutions across the city. This faculty is led by two Co-Directors, who serve 5-year terms. Currently, David Perkel (Biology and Otolaryngology) and Jane Sullivan (Physiology & Biophysics) hold those roles. Their terms run from Sept. 2012 – Aug. 2017.

Our goal is to train the best neuroscientists possible. We have exceptional breadth and depth of research interests, including neurodevelopment, neurodegeneration, addiction, ion channel physiology and pathology, systems neuroscience, and computational neuroscience. The breadth of our faculty allows us to provide interdisciplinary training drawing from a variety of techniques and approaches, including neuroanatomy, biochemistry, molecular biology, physiology, biophysics, pharmacology, *in vivo* animal and human brain imaging (e.g., PET, fMRI, M-EEG), computational modeling and behavior. In addition to a solid core of required courses that range from cellular neurobiology and synaptic function to cognition and neurobiology of human disease, students also receive instruction in other key areas of professional development through coursework, seminars and presentations on topics including grant writing, public speaking and bioethics. Faculty mentors and the Graduate Training Committee closely monitor student progress to ensure that each student receives the guidance he or she needs to succeed. Graduates emerge from the program prepared to conduct independent research and equipped to pursue a variety of career paths.

History
For the past 60 years, the University of Washington has been recognized as a leading center for research and training in neuroscience. About 50 years ago, the Department of Physiology & Biophysics in the Medical School joined with the Department of Psychology in the College of Arts and Sciences to create one of the country's first degree-granting interdisciplinary programs in neuroscience. That program has evolved over the years into the Interdisciplinary Graduate Program in Neurobiology & Behavior (http://depts.washington.edu/behneuro/), which was established in 1996. With its new name as of 2014, the Interdisciplinary Graduate Program in Neuroscience forms the cornerstone of training in neuroscience at the University of Washington. It receives strong support from the Graduate School, which provides funding for all first year students, for two full-time staff members who assist the Directors in all aspects of program administration, and for program-related events and activities.

A defining feature of our graduate program is the highly collaborative, interdisciplinary nature of the training received by our students. We continue to expand our faculty roster to include scientists working across the spectrum of neuroscience research areas, from atomic force microscopy of single synaptic vesicles to the genetics of emotion, in basic science as well as clinical labs. We are currently working with the local Allen Institute for Brain Science to provide learning opportunities for students who want to explore non-academic research options after graduation, and 4 of their Investigators are now members of our faculty. Maintaining a cohesive community of students and faculty is a high priority for the graduate program, fostered by a number of program-wide events that bring us all together throughout the year, including a weekly Seminar Series, a Retreat in the fall, a Posters & Pints recruitment event in the winter, and a Student Symposium in the spring.

Each of the program faculty members directs an independent laboratory conducting externally funded research in neuroscience, with a commitment to training graduate students . These faculty have primary appointments in the School of Medicine, the College of Arts and Sciences, and the College of Engineering.

Numerous core facilities and centers support the research efforts of our graduate program faculty and students at the University of Washington. These include two major natural science and health science libraries, the W.M. Keck Imaging Center with several confocal microscopes, a Regional Primate Research Center, the Bloedel Hearing Research Center, the Vision Science Center and Vision Research Core (including confocal and electron microscopes), the Pacific Northwest Udall Center for Excellence for Parkinson's Disease Research, the Eunice Kennedy Shriver Intellectual and Developmental Disabilities Research Center, the Institute for Learning and Brain Sciences (I-LABS), the Fred Hutchinson Cancer Research Center, the Center for Sensorimotor Neural Engineering, the UW Institute for Neuroengineering (UWIN), and the University of Washington Research Core facility (including a mass spectrometry core, a molecular virology core, and a bioinformatics core).

Structural Overview

The overall program organizational structure is shown in Appendix A. Overseeing the program, and nominating Co-Directors to the Dean of the Graduate School, is a Steering Committee, comprising the Chairs of the Departments of Physiology & Biophysics, Pharmacology, Biological Structure, Biology and Psychology, or their representatives. William Catterall, Chair of Pharmacology has served as the *de facto* Chair of this Steering Committee since its inception.

The Program Committee advises the Co-Directors on all aspects of the Graduate Program, including approval of changes in program requirements (e.g. the recent adoption of Individual Development Plans for all of our students) and new faculty appointments.

The Admissions Committee is composed of 13 of the program's faculty members and 5 students. Membership rotates, with each member serving 2-3 years. This committee reviews and recommends applicants for admission to the program, and is also charged with recruiting underrepresented minority students. For the current year, we received ~330 applications, interviewed 40, extended offers to 34—including 9 from underrepresented minority (URM) backgrounds—and 8 will be joining us, including one international student and an MSTP student; 4 of these 8 students come from URM backgrounds.

The Curriculum Committee continuously reviews and evaluates the curriculum (considering student evaluations of courses, new course proposals, etc.) and advises the program directors on changes to the curriculum. Most recently, this committee has been tasked with increasing the quantitative and computational components of the curriculum, in addition to recommending modifications to existing courses based on student and faculty feedback. This has led to the addition of two new required courses: Introduction to Neurostatistics and Quantitative Methods in Neuroscience. Current Topics in Neuroscience, a journal club course required for all first year students, which had previously been linked to the seminar series, has been modified to make it more relevant to the topics being covered in the first-year classes.

The Diversity Committee works to ensure that the program recruits a group of students from diverse backgrounds, and to promote the success of underrepresented students in the program by mentoring. Representatives from this committee, as well as other members of the program on an ad hoc basis, attend annual meetings of groups that promote diverse representation in STEM fields, such as the Society for the Advancement of Hispanics/Chicanos and Native Americans in Science (SACNAS) and the Annual Biomedical Research Conference for Minority Students (ABRCMS). We also co-host annual visits from Morehouse/Spelman undergraduate students interested in pursuing postgraduate studies in STEM fields.

The Graduate Training Committee is responsible for overseeing the progress of all students in the graduate program. The committee reviews the yearly progress reports and student evaluations submitted by each student and his or her dissertation advisor, and closely monitors and advises any student who is not making satisfactory progress. Efforts are currently underway to incorporate Individual Development Plans (IDPs) into the annual progress reports; our objective is to promote the use of IDPs to assist students in effectively managing their graduate training so it is most relevant to their long-term goals.

The Public Engagement Committee is responsible for identifying and pursuing opportunities to showcase exciting advances in neuroscience research that have been made by our faculty and students. One recent success was a partnership with the Seattle Arts & Lecture Series for a 5-lecture SAL U course 'Hacking the Brain to Reveal, Repair and Rebuild' that was open to the public and featured talks by 5 of our faculty members. We hope these efforts will lead to opportunities for advancement.

The Seminar Committee, comprising three faculty and three student members, solicits nominations of potential speakers from students and faculty, identifies student and faculty hosts, and invites the external (~10) and internal (~15) speakers for the Neuroscience graduate program seminar series. Our typically strong line-up of lecturers showcasing outstanding neuroscience research has made this a very popular and effective mechanism for promoting our graduate program. We co-host with local Center and Training Grant directors to bring in additional speakers whose research is in areas of overlapping interest.

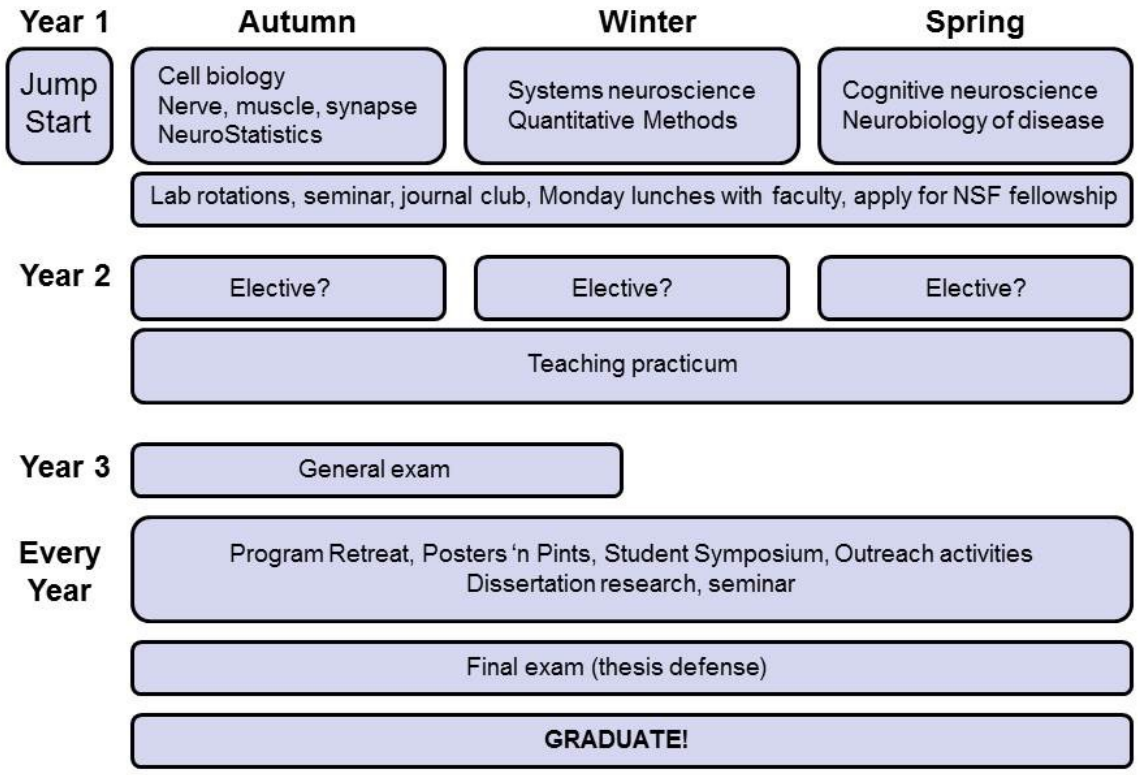
A list of each committee's current members can be found in Appendix A.

Name change in the Fall of 2014

From its inception in 1996, the program was known as the Graduate Program in Neurobiology & Behavior. In the fall of 2013, a proposal was put forward to change the name of the program to Graduate Program in Neuroscience. The main rationale was that "Neuroscience" is now the most universally recognized name for our field. The intention is for this new name to continue to encompass those scholars who study animal or human behavior with the goal of understanding the proximate neural or ultimate evolutionary mechanisms. In practical terms, one goal was to improve the visibility of the program to applicants, other members of the University, and the public at large. The proposal was approved unanimously (all six members voting) by the current Program Committee on October 3, 2013, and by our Steering Committee (Chairs of the five original founding departments of the program) on October 31, 2013. Following that, there was an online faculty vote between February 18 and March 7, 2014. Of 136 eligible faculty members, 72 (52.9 %) voted. 65 (47.8 %) were in favor, six (4.4 %) were opposed, and one (0.07 %) abstained. The name change became official as of September 16, 2015.

Section II Teaching and Learning

Overview
The goal of the Graduate Program in Neuroscience is to produce the best neuroscientists possible by providing our students with a broad and rigorous education that emphasizes coursework, research, and career-development skills.



Incoming students are introduced to the program with *JumpStart,* a three-day mini course before the fall quarter begins comprising a mix of lectures, laboratory exercises and demonstrations on molecular biology, electrophysiology, and fMRI, and visits to about 10 representative labs (see representative schedule in the Appendix.) Lunches during the JumpStart program are also attended by second-year students, who get to know their new program-mates and offer informal advice on navigating the new environment of graduate school. A session on grant writing broaches this topic with discussion guided by students who have successfully competed for external funding. Our annual *Program Retreat* is held in September of each year. This student-organized event features faculty and student talks throughout the day, and ends with a social hour incorporating neuroscience-themed games ('Beard or No Beard?', 'Neuroscience Jeopardy') played by student+faculty teams (see representative schedule in the Appendix.) In winter quarter, as part of our three-day

recruitment activities, students and faculty have an opportunity to present their research in a different format at the *Posters & Pints* event. In spring quarter, students have an additional opportunity to hone their speaking skills and learn more about each other's research at the *Student Symposium* (see representative schedule in the Appendix.) Throughout the year, students attend *First Friday* dinners, which are student-only events where they can share struggles and successes, and discuss science and graduate program-related topics in a relaxed setting that builds and sustains a sense of community across classes after students have joined labs that are spread across our large campus and beyond.

First year students complete three quarters of required coursework, as well as three quarter-long (10 week) rotations in labs of their choosing (*NEURO 526*). They attend a weekly journal club (*NEURO 527*) and seminar series (*NEURO 510*). In addition, first year students attend a weekly *Meet The Faculty Luncheon* during their fall and winter quarters; these sessions place the students in an informal setting with two graduate program faculty members. Students are encouraged to ask the faculty a wide range of questions covering their research, lab culture, philosophy of science, and personal career paths. By the end of spring quarter of their first year, students decide upon a dissertation lab and, during the following summer quarter, begin to assemble a Supervisory Committee.

Students in their second year typically complete the majority of their elective course credits, and their teaching practicum requirement (*NEURO 515*). By the end of fall quarter of the third year, students must take their General Exam in order to advance to candidacy; this exam has both oral and written components, and includes a public presentation on the student's proposed dissertation research. A more complete written thesis proposal must be submitted to the student's Supervisory Committee by the end of spring quarter of the third year.

In their 4th year and beyond, students continue their dissertation research, attend seminars and journal clubs, and participate in the Retreat, Student Symposium and Posters & Pints recruiting event. Many of our students are actively involved in the large local Society for Neuroscience award-winning Neuroscience Community Outreach Program (http://students.washington.edu/nbout/about/nboutreach.html). Finally, they graduate after successfully defending their dissertation research in a Final Exam. Students in our program take on average 6 years to complete their training. We are working to reduce the time to degree.

Coursework, Research and Examinations
Required Courses: first year All students in the Graduate Program enroll in a three-quarter graduate level neuroscience course (*NEURO 501, 502, & 503*) covering cellular neurophysiology, cellular and molecular neurobiology, developmental neurobiology, neuroanatomy, neuropharmacology, neural systems, neural computation, cognitive neuroscience and behavioral neuroscience (see below for a more complete description of these and all other required courses). This three-quarter sequence provides the requisite core of general neuroscience knowledge for all of our students. In fall quarter, students

also take *NEURO 504 Biophysics of Nerve, Muscle and Synapse* which covers nerve and muscle physiology, signal transduction mechanisms, synaptic transmission, and synaptic plasticity. Syllabi for each of these courses can be found in the Appendix.

The graduate program recognizes the importance of quantitative methods for conducting modern research in neurobiology. Mathematical models and computer simulations are introduced and used extensively throughout the first-year core courses. In response to student interest, all first year students take a 5-week *NEURO 511 Introduction to Neurostatistics* course in the fall. In the winter, all first year students are required to take *NEURO 545 Quantitative Methods in Neuroscience*, which introduces them to fundamental principles and methods of quantification applicable to the study of the nervous system. All of the trainees enroll in the *Neurobiology of Disease* course (*NEURO 559*) in spring quarter of their first year. This course was developed by neurologist Dr. Gwenn Garden, with grant aid from the NIH (NIH RFA Course Development in the Neurobiology of Disease: MH-05-011). Topics covered by lecture, patient videos and class discussion include: Common Mechanisms in Nervous System Diseases, Translational and Pathogenesis Research, CNS Ischemia, Inherited Diseases of Peripheral Nerves, Fronto-temporal dementia and Alzheimer's Disease, Inherited Neurodegeneration Associated with Polyglutamine Repeats, Epilepsy, Epidemiology in Neurological Disease, Hearing Loss, Amyotrophic Lateral Sclerosis, Parkinson's Disease, Muscular Dystrophies, Gene Therapy, Diseases of Neuromuscular Transmission, Inflammatory Polyneuropathies, Multiple Sclerosis, Autism, Anxiety Disorders, Acute and Chronic Pain, Psychosis and Schizophrenia, Affective Disorders and Substance Abuse.

Throughout their first year, students participate in a weekly journal club *(NEURO 527)* in which faculty-guided discussion of classic and contemporary papers are organized into 3 week-long modules linked by theme. Each module's theme is related to topics that are covered in NEURO 501-504 (e.g. Hodgkin & Huxley papers are covered while students are learning about the generation of action potentials in NEURO 504). In addition, students earn credit for attending the Program Seminar Series (*NEURO 510*) throughout their graduate careers.

During the first year, students are required to complete three one-quarter (10 week) laboratory rotations (*NEURO 526*). Students are encouraged to wait until shortly before each quarter begins to finalize their rotation plans, which increases the likelihood that they will select labs working on a variety of research topics and employing different model systems and technical approaches. Students are advised that they must select labs with funding and space for a new student, to minimize the chances that a student will need to complete a 4th rotation, which requires the Program Directors' approval and program financial support, to find a dissertation lab. The Directors work closely with any student who has not found a good 'fit' with any of his or her first three rotation labs, to maximize the chances of success. At the conclusion of each rotation, students deliver a short oral presentation describing their work at Rotation Talk seminars that are attended by students, faculty and the Graduate Program Directors. The rotation advisor provides a

written evaluation of the student's performance, and indicates whether or not they would be willing to accept the student into their lab.

Below is a description of each of the courses that are required for all first year students in the Graduate Program in Neuroscience:

NEURO 526: Introduction to Laboratory Research (4 credits, Fall, Winter, Spring quarters) Students carry out research projects in the laboratories of different faculty members on a quarterly rotation basis.

NEURO 527: Current Topics in Neurobiology & Behavior (1 credit, Fall, Winter, Spring quarters) *Rieke*
Critical discussion of fundamental issues in classic and contemporary neuroscience. The course is divided into independent 3-week modules, each focusing on one scientific topic based on keynote papers that have built that field. Emphasizes student participation.

NEURO 501: Introduction to Neurobiology: Molecular & Cellular Neurobiology (3 credits, Fall quarter) *Carlson*
Concepts and techniques of molecular and cell biology as applied to understanding development and function of the nervous system.

NEURO 504: Biophysics of Nerve, Muscle, and Synapse (3 credits, Fall quarter) *Sullivan, Zagotta*
Introduces biophysical properties of nerve and muscle cells. Topics include intrinsic electrical properties of neurons, ion channels, receptor signaling, calcium signaling, contraction of muscles, and synaptic function.

NEUBEH 511: Introduction to Neurostatistics (1 credit, Fall quarter) *Horwitz*
Introduces students to the theory and practice of biostatistics that are most commonly used in neuroscience research.

NEURO 502: Introduction to Neurobiology: Sensory & Motor Systems (5 credits, Winter quarter) *Sherk*
Introduction to neuroanatomy and modules on sensory and motor systems, examination of macroscopic and microscopic neural tissues.

NEURO 545: Quantitative Methods in Neuroscience (2 credits, Winter quarter) *Rieke, Bair, Fairhall* This course provides exposure to a variety of quantitative methods that are applicable to the study of the nervous system. It provides an intensive tutorial on mathematical methods and their application to neuroscience research. The course format revolves around computer exercises and discussion of journal papers. Topics can include linear systems theory, Fourier analysis, ordinary differential equations, stochastic processes, signal detection theory and information theory.

NEURO 503: Cognitive and Integrative Neuroscience (4 credits, Spring quarter) *Phillips*
A discussion of higher neural processes like learning, memory, and decision making. Lecture and laboratory discussion of original literature, exercises in data analysis and quantitative reasoning.

NEURO 559 Neurobiology of Disease (3 credits, Spring quarter) *Garden*
Introduces medically important neurological and psychiatric diseases and experimental approaches to understanding the basis for diseases and their treatments. Covers stroke, epilepsy, autoimmune diseases of the CNS, neurodegenerative diseases, autism, psychosis, anxiety disorders and mood disorders.

Elective Courses: Year 2 and beyond Students must complete at least 10 credits of elective courses. Students are generally encouraged not to take courses for elective credit in their first year, and to complete their elective requirement by the end of their third year. After joining a dissertation lab, students work with their advisors to devise an elective plan that is most relevant to their dissertation work; elective plans must be submitted to the graduate program for approval. Students may choose their electives from a core list of over 40 courses that have been preapproved by the Curriculum Committee (this core elective course list is provided in the Appendix). Students may also petition the Directors for permission to use a course that is not on the core list; input from the dissertation advisor and the chair of the Curriculum Committee guide the Directors' decisions in these cases.

Dissertation Research At the end of spring quarter in the first year, after completing three lab rotations, each student selects a lab in which to do his or her dissertation research (*NEURO 600/800*). The student and his or her advisor develop an original dissertation project with guidance from the student's Supervisory Committee. The student is expected to be involved in all aspects of the research, including generation of questions and hypotheses, experimental design, data collection and analysis, interpretation of findings and preparation of manuscripts for publication.

General Examination The General Examination consists of two written components and two oral sections. The written parts consist of a brief research proposal and answers to questions on prepared topics submitted by members of the Supervisory Committee. The oral sections consist of a 20 minute presentation on the thesis proposal and questioning about topics related to the area of the dissertation and general knowledge. The General Exam serves several important purposes in the training of students in the Graduate Program in Neuroscience: 1) it requires that the student formulate a novel scientific question and devise a method to answer it; 2) it ensures competence in areas of general knowledge; 3) it provides consistency of the examination for students; and 4) it ensures timely progress of the student through the program and toward the PhD. The student's advisor and the committee as a whole must be satisfied that the student is making good progress in the laboratory before the student is permitted to schedule a general exam. A student who has not demonstrated dedication and some degree of acumen in areas relevant to conducting the thesis research will not be eligible to take the general exam. A

student whose performance on the General Examination is considered to be not satisfactory may be allowed to have a first reexamination if the Supervisory Committee considers this to be appropriate. A student who does not pass the General Examination on the second attempt may be allowed a third and final attempt to pass the exam, but only with the approval of the Program Directors.

Final Examination and Thesis Defense When thesis research is completed, the student prepares a dissertation and submits it to his or her three-member Reading Committee (a subset of the Supervisory Committee) for review. The dissertation describes original research that advances the field of neuroscience, and clearly indicates training in research. Although not formally required, students are generally expected to have two first-author articles targeted for professional, peer-reviewed journals, such as the Journal of Neuroscience. The student defends the dissertation at the Final Exam, which includes a public lecture on the dissertation research, as well as a closed oral examination by the Supervisory Committee. As with the General Exam, a Graduate School Representative is present at the Final Exam, to ensure that all procedures are carried out fairly and in accordance with the guidelines of the Graduate School.

Section III Scholarly Impact

Our distinguished faculty has won numerous research awards including 7 NIH Jacob Javits Investigator Awards, two Cole Awards, three Gairdner Awards, 5 McKnight Foundation Awards, two NIH EUREKA Awards, two NIH Presidential Early Career (PECASE) Awards, two Bristol-Myers Squibb Awards, an Albert Lasker Award and a Nobel Prize. Four members of the faculty have been elected to the National Academy of Science, three have been elected to the American Academy of Arts & Sciences, eight have been named AAAS Fellows and three are Howard Hughes Investigators.

In the past 5 years, publications from our faculty and students have appeared in journals such as Science, Nature, Nature Neuroscience, Neuron, Journal of Neuroscience, and PNAS. Students in our program typically publish 2 first-author publications and an additional 1-2 co-authored publications based on dissertation research. The highly collaborative nature of our program members is demonstrated by over 85 co-authored publications in the past 10 years.

In the past 5 years, 16 of our students have received NSF Graduate Research Fellowships (4 entered the program with NSF awards and 12 received them after entering the program), and 5 have been awarded individual NRSA predoctoral fellowships. Of the 96 individuals who have graduated from our program in the past 10 years, 11 are in faculty positions, 45 are postdocs, 6 are in non-academic research-intensive careers (e.g. 4 are Scientists/Investigators at the Allen Institute for Brain Science), 11 are in research-related careers (e.g. 1 is a Director at Eli Lilly, 1 is a Researcher at Microsoft, 1 is a Researcher at Google), 5 are residents at medical schools, 8 are finishing up MD degrees, 5 recent

graduates are looking for jobs/postdoc positions, 3 are taking time off to stay home with kids, and 1 is a lawyer. We are proud of these accomplishments, while remaining committed to improvement on each of these metrics with guidance from our 2015 Program Evaluation.

Section IV Future Directions

There are currently no plans for any big changes to the Program. Our general view is that the program is working well and achieving its primary goals of training our graduate students in cutting edge neuroscience research, and providing them with the professional skills that will allow them to pursue research-intensive as well as research-related careers.

We will continue our efforts to attract and retain a diverse cohort of talented and committed graduate students. These efforts will include participation in graduate recruitment fairs at local and national meetings such as those of the Society for Neuroscience, SACNAS and ABRCMS; we are always looking for ways to revise our promotional materials to more effectively promote our program at these and other events. This past Fall, we met with Jan Harrison , Associate Director for Stewardship, to discuss changes to our admissions and recruitment processes, and use of private fellowship funds to increase the diversity of students who apply, are interviewed, are accepted and ultimately matriculate. After implementing some of her ideas, we have had a very successful year recruiting students from underrepresented backgrounds. In addition, we have scheduled a meeting with Ed Taylor, Vice Provost and Dean, Undergraduate Academic Affairs to discuss more ambitious plans to recruit more underrepresented minority students to our program.

We are currently implementing the use of Individual Development Plans (IDPs), and are continuously working to expand the list of professional development courses and workshops available to our students, with an emphasis on grant writing and public speaking. As the IDPs are a relatively new component of our program, we will be monitoring closely to see how our students and faculty members use this opportunity. The Graduate Training Committee will review each IDP to identify students facing academic or professional challenges as early as possible. We will solicit feedback to enhance the effectiveness of the IDP format while minimizing any redundancy with other training programs, such as Training Grants.

Having recently reviewed and revised our curriculum, we do not anticipating the development of new required courses, although we will continue to add new elective courses to our core list based on faculty initiative and student interest.

One of our on-going challenges is the assignment/replacement of course directors--a particular issue for us as an interdisciplinary graduate program because we lack some of the more persuasive mechanisms available to department chairs. Given our limitation to

positive reinforcement, finding appropriately-qualified faculty who are able to commit the time required for these positions is always difficult, but the current climate at NIH puts unprecedented demands on researchers seeking funding support, and fulfilling compliance requirements, leaving little 'free' time for teaching. This is particularly problematic for faculty in clinical departments that are traditionally non-supportive of teaching activities. We hope to work with the Graduate School to devise and implement novel strategies to enhance the appeal of teaching service in our courses.

We are applying for early-stage graduate training support through the NIH Jointly Sponsored Predoctoral Training Program in Neuroscience (JSPTPN). These funds would be used to support 2nd year graduate students who are just beginning their dissertation research and still completing their elective coursework and teaching requirements. By supporting early-stage students while they remain substantially engaged in important components of their training outside their dissertation labs, this training grant would give our students greater independence and control at a critical stage in their graduate careers. It would also expand the students' options for laboratories in which to do their dissertation research: although adequate funding is required for any faculty member who takes one of our students into his or her lab, JSPTPN T32 funding would provide flexibility for faculty who are anticipating the impending departure of a lab member, by giving them some leeway in the timing of accepting a new graduate student into the lab.

Advancement. We feel that it is crucial for our program to redouble its efforts to raise additional funds to help promote specific activities. We describe specific items we would like to support in the Opportunities section of the Part B (below).

Our current website is woefully outdated and hard to navigate. We have been working to identify a website developer with appropriate expertise to upgrade our site with two main goals in mind: 1) Enhanced visibility and recognition as the hub of neuroscience research in Seattle and the Pacific Northwest; and 2) streamlined access to both public and protected information of interest to our community, such as seminar schedules and student IDPs, respectively. We have some quotes in hand and anticipate moving forward quickly on this.

We face imminent staff turnover with the planned late-summer 2015 retirement of our Graduate Program Coordinator, Ann Wilkinson, who has been with the program for nearly 15 years. We will begin a search in June 2015 and aim to have the new person in place in time for at least one month of overlap before Ann leaves.

We look forward to working with Dr. David Canfield-Budde, the recently appointed inaugural Graduate School Director of Academic Affairs and Interdisciplinary Programs, to leverage new opportunities. Some of these goals are administrative, such as clarifying the budget process. More importantly, we aim to increase interaction with other interdisciplinary programs to align best practices for academic aspects of our program. We are thrilled that the graduate school has given us a clear point person with whom to

interact and look forward to using this resource to promote: communications; budget development; advancement; public outreach; and recruiting more diverse applicants.

Part B
Unit-defined Questions and Answers
One useful and current approach to taking stock of the current situation of an organization is the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis.

What are the **strengths** of the program?

Probably the biggest strength at the University of Washington is the ease of collaboration across labs, departments or schools/colleges. There are simply no administrative or cultural barriers that limit cross-unit projects and grant proposals. On the contrary, it feels easy to find creative solutions to promote interactions among research groups. This highly collaborative institutional feel is particularly strong in the Neuroscience Graduate Program. It is hard to convey this strength to those who have not spent time here, and we understand that we are not unique. This is, however, a highly prized aspect of our institutional culture, and preserving and enhancing it are high priorities.

With our large, diverse faculty, well-organized recruiting program and supportive community, we are able to provide an exceptionally broad and deep graduate training experience for our students. For example, a student interested in vision can work in an environment spanning the biophysics of phototransduction to gene therapy for visual disorders and human psychophysics. We feel we have a friendly collaborative environment that promotes excellence in research and research training in all domains.

A number of our graduates hold faculty positions at strong institutions around the country.: Sarah Allred (Rutgers), Felice Dunn (UC San Francisco), Jessica Fox (Case Western Reserve Univ.), Sean Georgi (Augustana College), Thomas Hnasko (UC San Diego), Roozbeh Kiani (New York Univ.), Deepak Lamba (Buck Institute), David Margolis (Rutgers), John Meitzen (North Carolina State Univ.), Abigail Person (Univ. Colorado Denver), and Siobhan Robinson (Oberlin College). In addition, Adam Bleckert, Julie Harris, Jonathan Ting, and Staci Sorensen are all Scientists or Investigators at the Allen Institute for Brain Science in Seattle. Two, Abigail Person and Roozbeh Kiani, have won Sloan Fellowships.

What are the **weaknesses** of the program?

Because our faculty are drawn from departments, programs, centers and institutes across campus and across Seattle, we are physically spread out, and this can hinder a sense of cohesiveness and belonging. Sometimes, the sheer size of our program can lead members to question the value of their individual contribution, resulting in, for example, low turnout of both students and faculty at the Student Symposium.

Some of our required courses need improvement, based on student evaluations and Curriculum Committee review, yet it can be difficult for the program to implement recommended changes, given the limitations on faculty incentives (e.g. lack of funding for developing and teaching of courses), as described above in Part A Section IV.

What **opportunities** are available for the program?

We would like to work more effectively with the Graduate School development team to identify opportunities to promote our program members' contributions to cutting edge neuroscience research, and to leverage these efforts into successful fundraising for the program. The Graduate School has been helpful in identifying external funding opportunities, and has provided assistance in the preparation of grant applications (although it has been a disappointment that an initiative to streamline the data collection that is typically required for these proposals does not seem to be moving forward). Additional funds could be used to enhance the appeal of our graduate program to top-notch applicants by providing, for example, Directors' Award support for later-stage student research and travel to present at meetings.

We also look forward to the further development of mutually beneficial partnerships with other neuroscience-themed groups on campus, including the undergraduate Neurobiology Program, the Center for Sensorimotor Neural Engineering, and the UW Institute for Neuroengineering, as well as the Allen Institute for Brain Sciences off campus. We aspire to serving as the hub of neuroscience research in Seattle.

What **threats** does the program face?

Increasing tuition and stipend levels, coupled with decreasing Federal funding have made, and will continue to make it harder to support students through the PhD. As the total annual cost of supporting a Ph.D. student approaches, or even surpasses that of a first-year postdoctoral researcher, our program could reach a tipping point at which individual faculty members each make the decision to recruit postdocs rather than students.

Faculty recruitment and retention. As the economy recovers and other institutions feel they have the resources to continue building in neuroscience, UW has neither prioritized nor developed significant fundraising interest in this area to recruit the most promising young neuroscientists into the UW faculty or to retain the most successful faculty members who receive enticing offers to move elsewhere. Furthermore, the Graduate Program in Neuroscience does not have any leverage to contribute to these crucial processes. We try as much as possible to coordinate and communicate information on job searches related to neuroscience across campus, but our impact on the campus-wide process is limited.

We face increasing challenges when recruiting students because of funding limitations. During recruitment, we highlight that our program provides guaranteed funding for as long as students are making satisfactory academic progress. That policy is in line with other

neuroscience programs around the country and it would be highly counterproductive to try to reduce that commitment. At the same time, we are completely up front that each student will need to find a supervisor with funding to support them. This effectively limits the pool of eligible faculty available to formally mentor our students for their dissertation research, and reduces the appeal of our program.

Our reputation, reflected in our ranking, is lower than we think it should be. In last year's US News Report, we were #22 globally, #15 in the US, and #4 in public institutions, behind three UC campuses (UCSD, UCSF and UCLA). We do not fully understand the reasons for our underperformance, but they probably include relatively few high-profile researchers and lack of institutional PR. A new and improved website that more clearly highlights our strengths will be a step in the right direction, but we would like to do more on this front.

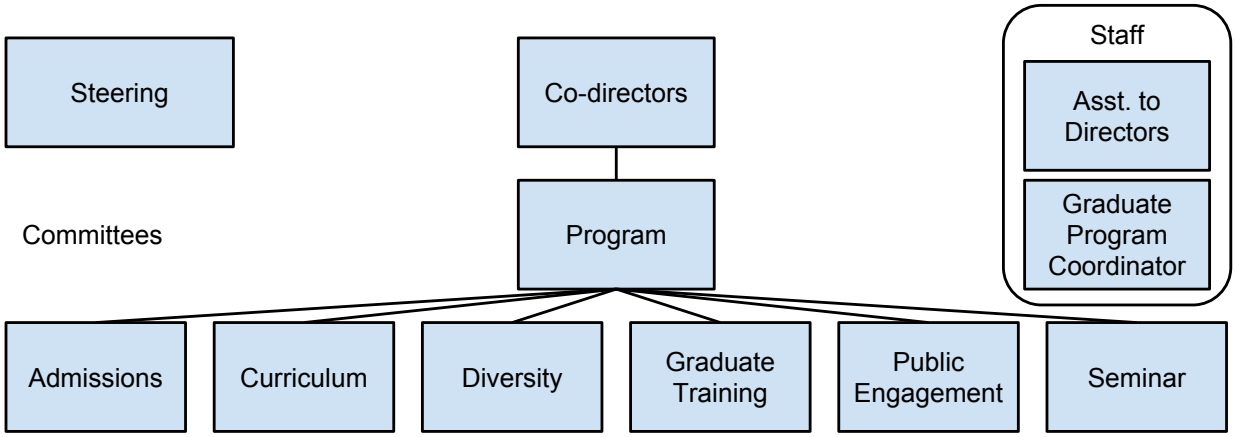
One potential solution to several of these problems would involve an institutional commitment to a campus-wide organization that unifies the field across all levels (undergraduate, graduate, research, outreach). We envision that such an entity (perhaps called UW Neuroscience) would be an umbrella structure to coordinate and promote efforts in education, research and service.

Additional specific questions for discussion with the review committee

1. How can we attract even more strong applicants and increase our yield of accepted applicants, from both traditionally represented and underrepresented backgrounds?
2. How can we increase participation by our faculty?
3. What should we be teaching our students that they aren't learning about already?
4. What is the best way to make our program members, both faculty members and students, aware of the rules and guidelines for our program?
5. Should we consider including all funded neuroscientists in Seattle on our faculty? If not, what should the criteria be? What problems might arise as our faculty numbers grow and what measures should be taken to avoid these problems?

Part C
Appendices

Appendix A: Organization Chart



Committee membership
Admissions: Chair Maureen Neitz, 10 additional faculty members and 5 student members (2-3 year terms).

Curriculum: Chair Paul Phillips, Eric Chudler, Jay Parrish, Fred Rieke, Nephi Stella

Diversity: Co-chairs Horacio de la Iglesia and Joseph Sisneros, Andres Barria, Martha Bosma, Jaime Olavarria and one student member.

Graduate Training: Chair Neil Nathanson, Martha Bosma, Farrel 'Ric' Robinson

Program: Co-chairs David Perkel and Jane Sullivan, Neil Nathanson, Maureen Neitz, Paul Phillips, Farrel 'Ric' Robinson, Rachel Wong

Public Engagement: Co-chairs Gwenn Garden and Adrienne Fairhall.

Seminar: Chair Anitha Pasupathy, Cecilia Moens, Larry Zweifel and three student members.

Steering: Chair William Catterall, Chair, Dept. of Pharmacology, and Chairs of the Departments of Physiology & Biophysics, Pharmacology, Biological Structure, Biology and Psychology (or their representatives).

Appendix B: Budget Summary

The following pages contain a summary of our expenditures over the 3 most recent biennia.

Appendix B: Budget Summary
3 most recent biennia

	2009-2010	2010-2011	BY09/11	2011-2012	2012-2013	BY11/13	2013-2014	2014-2015	BY13/15
Student Stipends									
Cost per student	$ 20,511	$ 20,511		$ 20,511	$ 20,511		$ 21,330	$ 22,014	
Number of students	7	9	16	10	15	25	8	8	16
Total Student Stipend Costs	**$ 143,577**	**$ 184,599**	**$ 328,176**	**$ 205,110**	**$ 307,665**	**$ 512,775**	**$ 170,640**	**$ 176,112**	**$ 346,752**
Administrative Staff									
Asst to Directors	$ 55,428	$ 55,428	$ 110,856	$ 55,428	$ 55,428	$ 110,856	$ 57,278	$ 72,000	$ 129,278
Benefits	$ 16,240	$ 16,961	$ 33,201	$ 18,624	$ 18,846	$ 37,469	$ 17,699	$ 19,944	$ 37,643
	$ 71,668	$ 72,389	$ 144,057	$ 74,052	$ 74,274	$ 148,325	$ 74,977	$ 91,944	$ 166,921
Grad Program Coordinator	$ 47,501	$ 47,501	$ 95,001	$ 47,501	$ 47,501	$ 95,001	$ 48,447	$ 49,419	$ 97,867
Benefits	$ 18,193	$ 17,385	$ 35,578	$ 15,865	$ 17,908	$ 33,773	$ 17,102	$ 16,704	$ 33,806
	$ 65,693	$ 64,886	$ 130,579	$ 63,366	$ 65,408	$ 128,774	$ 65,549	$ 66,123	$ 131,672
Total Admin Staff Costs	**$ 137,362**	**$ 137,275**	**$ 274,636**	**$ 137,418**	**$ 139,682**	**$ 277,099**	**$ 140,526**	**$ 158,067**	**$ 298,593**
Seminars									
Visiting Speakers									
Number of Visiting Speakers	11	11	22	8	5	13	7	6	13
Honorarium	$ 2,200	$ 2,200	$ 4,400	$ 1,600	$ 1,000	$ 2,600	$ 1,400	$ 1,200	$ 2,600
Travel Expenses	$ 8,800	$ 8,800	$ 17,600	$ 6,400	$ 4,000	$ 10,400	$ 5,600	$ 4,800	$ 10,400
Hotel	$ 3,850	$ 3,850	$ 7,700	$ 2,800	$ 1,750	$ 4,550	$ 2,450	$ 2,100	$ 4,550
Dinner	$ 3,300	$ 3,300	$ 6,600	$ 2,800	$ 1,750	$ 4,550	$ 2,800	$ 2,400	$ 5,200
Lunch	$ 825	$ 825	$ 1,650	$ 600	$ 375	$ 975	$ 525	$ 450	$ 975
Coffee/Cookies	$ 2,200	$ 2,200	$ 4,400	$ 1,680	$ 1,050	$ 2,730	$ 1,680	$ 1,440	$ 3,120
	$ 21,175	$ 21,175	$ 42,350	$ 15,880	$ 9,925	$ 25,805	$ 14,455	$ 12,390	$ 26,845
Internal Speakers									
Number of Internal Speakers	2	5	7	9	13	22	10	16	26
Coffee/Cookies	$ 358	$ 895	$ 1,253	$ 1,710	$ 2,470	$ 4,180	$ 2,000	$ 3,200	$ 5,200
Total number of seminars	13	16	29	17	18	35	17	22	39
Total Seminar Costs	**$ 21,533**	**$ 22,070**	**$ 43,603**	**$ 17,590**	**$ 12,395**	**$ 29,985**	**$ 16,455**	**$ 15,590**	**$ 32,045**

Rotation Talks																
Number of Talks		3		3				3		3				3		2		
Coffee/Cookies	**$**	**537**	**$**	**537**	**$**	**1,074**	**$**	**570**	**$**	**570**	**$**	**1,140**	**$**	**600**		***NA***	**$**	**600**
NA - no food allowed in room																		
JumpStart																		
Lunches	$	550	$	610	$	1,160	$	600	$	685	$	1,285	$	475	$	430	$	905
Supplies		100		100	$	200		100		100	$	200		100		100	$	200
	$	**650**	**$**	**710**	**$**	**1,360**	**$**	**700**	**$**	**785**	**$**	**1,485**	**$**	**575**	**$**	**530**	**$**	**1,105**
Orientation																		
Morning refreshments	$	120	$	154	$	274	$	165	$	188	$	353	$	186	$	186	$	372
AV/Room setup	$	25	$	25	$	50	$	34	$	34	$	68	$	37	$	37	$	74
Materials/flash-drives	$	140	$	240	$	380	$	200	$	300	$	500	$	180	$	180	$	360
	$	**285**	**$**	**419**	**$**	**704**	**$**	**399**	**$**	**522**	**$**	**921**	**$**	**403**	**$**	**403**	**$**	**806**
Monday Lunches (1st Yrs)																		
Cost of each lunch	$	12	$	12			$	13	$	13			$	9	$	9		
# of scheduled Mondays		8		17		25		16		19		35		13		10		23
# of students		7		12		19		10		15		25		9		9		18
# extra lunches		3		3		6		3		3		6		3		3		6
	$	**960**	**$**	**3,060**	**$**	**4,020**	**$**	**2,704**	**$**	**4,446**	**$**	**7,150**	**$**	**1,404**	**$**	**1,080**	**$**	**2,484**
Student Symposium/Party																		
Rentals	$	654	$	1,210	$	1,864	$	387	$	552	$	939	$	232	$	300	$	532
Symposium Catering	$	186	$	186	$	372	$	244	$	307	$	551	$	202	$	250	$	452
Spring Party catering	$	1,892	$	1,842	$	2,236	$	2,611	$	1,650	$	4,261						
	$	**2,732**	**$**	**3,238**	**$**	**5,970**	**$**	**3,242**	**$**	**2,509**	**$**	**5,751**	**$**	**434**	**$**	**550**	**$**	**984**
First Friday Dinners																		
Catering													$	1,863	$	3,000	$	4,863
(replaces Spring Party)													**$**	**1,863**	**$**	**3,000**	**$**	**4,863**
Annual Fall Retreat																		
Rentals	$	2,700	$	1,850	$	4,550	$	495	$	550	$	1,045	$	655	$	749	$	1,404
Catering	$	2,282	$	2,504	$	4,786	$	2,706	$	3,023	$	5,729	$	3,363	$	3,435	$	6,798
	$	**4,982**	**$**	**4,354**	**$**	**9,336**	**$**	**3,201**	**$**	**3,573**	**$**	**6,774**	**$**	**4,018**	**$**	**4,184**	**$**	**8,202**

All Faculty Meeting									
Coffee/Cookies	$ 179	$ 179	$ 358	$ 175	$ 258	$ 433	*NA*	*NA*	$ 0
NA - no food allowed in room									
SfN Social	$ 1,500	$ 963	$ 2,463	$ 1,426	$ 936	$ 2,362	$ 357	$ 1,732	$ 2,089
(Development)									
Recruiting/Interviews									
# of Interviewees	39	42	81	45	39	84	41	40	81
AirFare	$11,905.90	$15,036.40	$26,942.30	$13,743.40	$15,237.90	$28,981.30	$15,135.43	$13,686.18	$28,821.61
Shuttles	$1,250.00	$1,343.00	$2,593.00	$1,343.00	$1,268.00	$2,611.00	$1,330.00	$1,291.00	$2,621.00
Hotel Accomodations	$6,427.00	$9,802.00	$16,229.00	$11,231.00	$10,817.58	$22,048.58	$9,394.56	$12,560.00	$21,954.56
Conference room rentals	$1,000.00	$1,000.00	$2,000.00	$1,000.00	$1,000.00	$2,000.00	$1,000.00	$1,000.00	$2,000.00
Van Rentals	$1,575.87	$1,797.15	$3,373.02	$958.42	$858.40	$1,816.82	$926.63	$1,032.43	$1,959.06
Temp Personnel	$3,333.36	$7,368.31	$10,701.67	$4,343.71	$5,224.83	$9,568.54	$5,438.64	$4,597.56	$10,036.20
Faculty Dinners (T/TH)	$6,000.00	$6,000.00	$12,000.00	$6,000.00	$6,000.00	$12,000.00	$6,000.00	$6,000.00	$12,000.00
Combined Lunch (Wed)	$1,000.00	$1,509.00	$2,509.00	$1,155.30	$1,107.00	$2,262.30	$1,264.00	$1,390.00	$2,654.00
Neurobuddy Lunches (T/TH)	$1,485.00	$1,530.00	$3,015.00	$1,575.00	$1,485.00	$3,060.00	$1,515.00	$1,500.00	$3,015.00
Poster Event (Wed)		$1,950.00	$1,950.00	$1,950.00	$3,000.00	$4,950.00	$3,000.00	$3,000.00	$6,000.00
Orientation (Wed)	$750.00	$750.00	$1,500.00	$850.00	$850.00	$1,700.00	$850.00	$850.00	$1,700.00
Grad Student Party/Activities	$1,500.00	$1,500.00	$3,000.00	$1,500.00	$1,500.00	$3,000.00	$1,750.00	$1,750.00	$3,500.00
Total Recruiting Costs	**$36,227.13**	**$49,585.86**	**$85,812.99**	**$45,694.83**	**$48,387.71**	**$94,082.54**	**$47,645.26**	**$48,697.17**	**$96,342.43**
URM Recruiting									
SACNAS	$1,500.00	$1,500.00	$3,000.00	$2,000.00	$2,000.00	$4,000.00	$3,500.00	$2,750.00	$6,250.00
ABRCMS - Booth			$0.00			$0.00		$1,300.00	$1,300.00
Div Affairs/RecruitDay	$130.00	$100.00	$230.00	$100.00	$610.00	$710.00	$550.00	$700.00	$1,250.00
	$1,630.00	**$1,600.00**	**$3,230.00**	**$2,100.00**	**$2,610.00**	**$4,710.00**	**$4,050.00**	**$4,750.00**	**$8,800.00**
Office Expenses									
IT/Phones	$3,000.00	$3,000.00	$6,000.00	$4,000.00	$3,500.00	$7,500.00	$4,000.00	$4,500.00	$8,500.00
Office Supplies	$6,000.00	$10,000.00	$16,000.00	$4,000.00	$5,000.00	$9,000.00	$5,000.00	$5,000.00	$10,000.00
Computer/NonCapEqupt	$3,000.00	$11,500.00	$14,500.00	$800.00	$10,000.00	$10,800.00	$0.00	$750.00	$750.00
Misc Operational Expenses	$25,000.00	$30,000.00	$55,000.00	$32,000.00	$34,000.00	$66,000.00	$42,000.00	$40,000.00	$82,000.00
	$37,000.00	**$54,500.00**	**$91,500.00**	**$40,800.00**	**$52,500.00**	**$93,300.00**	**$51,000.00**	**$50,250.00**	**$101,250.00**
Estimated Total Expenditures	**$389,153.10**	**$463,089.71**	**$852,242.82**	**$461,128.74**	**$576,838.86**	**$103,7967.60**	**$439,970.93**	**$464,945.62**	**$904,916.55**

Appendix C: Information about Faculty

UW NEUROSCIENCE FACULTY LISTING FOR 2014-15 (*indicates Core Members in leadership positions)

Michael Ailion Assistant Professor of Biochemistry. Molecular mechanisms of neuromodulation.

Jihong Bai Assistant Member, Division of Basic Sciences, Fred Hutchinson Cancer Research Center; Assistant Professor of Biochemistry. Dynamic Regulation of synaptic function and development.

Wyeth Bair Assistant Professor of Biological Structure; Affiliate, NRPC. Computer modeling and electrophysiology of the visual system.

Sandra M. Bajjalieh Professor of Pharmacology. Molecular mechanisms of neurotransmission; role of synaptic vesicle proteins and lipid-modifying enzymes in regulated secretion.

Nigel Bamford Associate Professor of Neurology, Pediatrics and Psychology. Investigates neuroplasticity of the corticostriatal pathway.

Andrés Barría Associate Professor of Physiology & Biophysics. Molecular mechanisms controlling synaptic function and plasticity. Role of NMDA receptors.

Denis G. Baskin Research Professor of Biological Structure and Medicine (Endocrinology, Metabolism & Nutrition). Expression of genes for CNS peptides and receptors involved in food intake and obesity.

Joseph A. Beavo Professor of Pharmacology. Role of cyclic nucleotides in olfactory and visual signal transduction; cyclic nucleotide phosphodiesterases.

Michael D. Beecher Professor of Psychology and Biology. Auditory communication in birds.

Olivia Bermingham-McDonogh Associate Professor of Biological Structure. Mechanisms of development and regeneration of the mammalian auditory system.

Julie A. Bierer Associate Professor of Speech and Hearing Sciences. We are interested in how cochlear prostheses interface with the impaired auditory system.

Marc D. Binder Professor of Physiology and Biophysics. Physiology of mammalian motoneurons.

Martha Bosma Associate Professor of Biology. Development of central nervous system neurons using physiological and molecular techniques.

Mark A. Bothwell Professor of Physiology and Biophysics. Growth factor mechanisms in neural development and degenerative disease.

Geoffrey Boynton Associate Professor of Psychology. Functional organization of human visual perception.

***Eliot A. Brenowitz** Professor of Biology and Psychology. Neural, endocrine, and molecular bases of biologically relevant animal behavior. Plasticity of brain and behavior including neurogenesis, hormonal, and seasonal effects.

James F. Brinkley Professor of Biological Structure; Joint, Medical Education & Biomedical Informatics; Adjunct, Computer Science & Engineering. Neuroinformatics: representation, management, visualization and utilization of neuroscience data and knowledge.

Linda Buck Full Member, Fred Hutchinson Cancer Research Center (Basic Sciences Division); Investigator, HHMI; Affiliate Professor of Physiology & Biophysics. Odors, tastes, pheromones, stimulating specific behaviors or physiological effects in conspecifics.

Steven L. Buck Professor of Psychology; Adjunct of Radiology. Color vision; rod-cone interactions; human adult psychophysics.

Elizabeth Buffalo Associate Professor of Physiology and Biophysics. Our research is aimed at understanding the neural mechanisms that support learning and memory.

Steven S. Carlson Professor of Physiology and Biophysics. Synaptic function; molecular mechanisms involved in synapse formation during development.

***William A. Catterall** Professor p& Chair of Pharmacology. Molecular basis of electrical excitability; molecular and cellular biology of ion channels; function of calcium channels in neurotransmission.

Charles I. Chavkin Professor of Pharmacology. Neurophysiology of opioid peptides; behavioral stress and addiction mechanisms; electrophysiological and neurochemical studies of opioid receptor signal transduction and regulation; neuropathic pain mechanisms.

Daniel T. Chiu Professor of Chemistry. The development of new tools, based on nanmaterials, optics, and microfluidics, for interfacing and interrogating neuronal systems and synaptic function at the nanometer scale.

Howard Chizeck

Professor of Electrical Engineering; Adjunct Professor, Bioengineering; NSF Engineering Research Center for Sensorimotor Neural Enginering. Biorobotics, telerobotics and neural engineering.

Eric Chudler Research Associate Professor of Bioengineering and Anesthesiology & Pain Medicine; Executive Director, Center for Sensorimotor Neural Engineering. Central mechanisms of pain and nociception.

Jeremy Clark Assistant Professor of Psychiatry & Behavioral Sciences. In my lab we study the neurobiology of motivated behavior with a special emphasis on the long-term consequences of chronic drug use.

John I. Clark Professor and Chair of Biological Structure. Characterizing the functional mechanism for the protective actions of the stress protein, human alphaB crystallin, a lens protein that is upregulated in aging diseases and protects against protein unfolding/misfolding and aggregation in Alzheimer's, Huntington's, Parkinson's disease and cataracts.

Jonathan Cooper Affiliate Professor of Biochemistry; Member, Division of Basic Sciences, Fred Hutchinson Cancer Research Center. Signaling events that regulate cortical development.

Mark S. Cooper Associate Professor of Biology. Gastrulation and neurulation in zebrafish embryos; cell motility.

Ellen Covey Professor of Psychology, Structure and function of the central auditory system and the neural basis of echolocation; neural mechanisms for processing temporal patterns of sound.

Dennis M. Dacey Professor of Biological Structure and Core Staff Scientist of National Primate Research Center. Structure and function of the primate retina.

Valerie Daggett Professor of Bioengineering; Professor of Biochemistry; Adjunct, Biomedical & Health Informatics. Molecular modeling of proteins implicated in disease. Design and testing of diagnostic and therapeutic agents for neurodegenerative diseases.

Raimondo D'Ambrosio Associate Professor of Neurological Surgery and Regional Epilepsy Center; Adjunct, Neurology. Pathophysiology of glial cells and basic mechanisms of epilepsy. Specific current interest include glial extracellular ion homeostasis in traumatic brain injury, stroke and posttraumatic epilepsy; membrane potassium channels; edema.

Thomas Daniel Professor of Biology; Adjunct, Bioengineering. Dynamics and motor control of animal locomotion.

***Horacio O. de la Iglesia** Professor of Biology. Neural basis of circadian behavior.

Peter B. Detwiler Professor of Physiology and Biophysics. Signal transduction in retinal photoreceptors.

Ajay Dhaka Assistant Professor of Biological Structure. Molecular basis of somatosensory perception.

Jaime Diaz Professor of Psychology. Disruptions of the growth program affecting adult brain function and how other metabolic systems function.

Chris Diorio Associate Professor of Computer Science and Engineering; Adjunct, Electrical Engineering. CMOS learning chips; implantable electronics.

***Adrienne Fairhall** Associate Professor of Physiology & Biophysics. Adaptation and neural coding in the retina, neural computation as projection of a linear subspace with a nonlinear decision function, and adaptation of the neural code to temporally modulated statistics.

Susan Ferguson Assistant Professor, Psychiatry & Behavioral Sciences; Principal Investigator, Center for Integrative Brain Research, Seattle Children's Research Institute. My research focus is on using novel viral vector methods to unravel the role of cortico-basal ganglia circuitry in the development of behaviors that contribute to drug addiction, as well as in the processes that regulate decision-making, motivation and impulsivity.

Eberhard E. Fetz Professor of Physiology and Biophysics; Adjunct of Bioengineering. Properties of cortical and spinal neurons controlling limb movement in primates; dynamic neural network modeling; implanted recurrent brain-computer interfaces.

Ione Fine Associate Professor of Psychology. Effects of long-term visual deprivation, perceptual learning and plasticity, psychophysics, fMRI and computational vision.

Albert Folch Associate Professor of Bioengineering. Neurobiology on a chip (Neuro-MEMS): Microengineered systems to study synaptogenesis, axon guidance, ion channel activity, and olfaction, among other neuroscience topics.

Stanley Froehner Professor & Chair of Physiology and Biophysics. Molecular basis of synapse formation and function.

***Gwenn A. Garden** Professor of Neurology. Biology of neuroinflammation and pathogenesis of neurodegeneration in disorders caused by polyglutamine repeat expansions.

Richard Gardner Associate Professor of Pharmacology. Yeast as a model system to understand neurodegenerative diseases.

David Gire Assistant Professor of Psychology. Our group investigates how neural circuits process natural spatiotemporal olfactory sensory cues to guide flexible, ethologically relevant behaviors.

Sharona E. Gordon Professor of Physiology and of Biophysics. Ion channel biophysics & trafficking and regulation of neuronal plasticity in sensory transduction.

Thomas J. Grabowski Professor of Radiology and Neurology; Adjunct Professor of Psychology and Psychiatry & Behavioral Sciences. Functional magnetic resonance imaging studies of the neural systems basis of language and cognition in health and disease.

Chris Hague Associate Professor of Pharmacology. Functional characterization of adrenergic receptors.

Julie Harris Assistant Investigator, Allen Institute for Brain Science; Affiliate Assistant Professor, Biological Structure. My research interests include understanding the relationship between anatomical and functional neural circuitry between brain areas in normal and disease states.

Robert Hevner Professor of Neurological Surgery; Adjunct, Pathology; Seattle Children's Hospital Research Institute. Development of cerebral cortex and cerebellum; adult hippocampal neurogenesis; role of T-domain transcription factors.

Bertil Hille Professor of Physiology and Biophysics. Ion channels; excitable membranes; G proteins and their roles in cell physiology, calcium signaling, phosphoinositide regulation.

Philip J. Horner Professor of Neurological Surgery; Institute for Stem Cell & Regenerative Medicine. Regeneration in the adult CNS. Stem cell biology and regeneration in the damaged central nervous system.

Greg Horwitz Assistant Professor of Physiology & Biophysics. Neurophysiology of color vision, and computational & molecular techniques for studying neural circuits in vivo.

Clifford Hume Assistant Professor of Otolaryngology-HNS. Mammalian inner ear development, gene therapy of inner ear disorders, and imaging analysis of the inner ear.

James B. Hurley Professor of Biochemistry; Associate Investigator, HHMI. Mechanisms of phototransduction; light and dark adaptation.

Jeansok Kim Professor of Psychology. Neurocognitive effects of stress; basic mechanisms of fear.

Brian Kraemer Research Associate Professor of Medicine (Gerontology). Developing neuroprotective strategies for proteinopathy.

Patricia K. Kuhl Bezos Family Foundation Endowed chair in Early childhood Learning; Professor of Speech and Hearing Sciences; Co-Director, Institute for Learning and Brain Sciences. Speech perception throughout the lifespan with an emphasis on early development; behavioral as well as ERP, fMRI, and MEG studies on language processing.

Dianne F. Lattemann VA Senior Research Career Scientist; Research Professor of Psychiatry & Behavioral Sciences (VA); Adjunct, Psychology; Adjunct, Medicine Concurrent. Modulation of brain catecholamine function by hormones and metabolic status; diabetes, low blood sugar, and brain function; obesity and brain reward circuitry.

Adrian KC Lee Assistant Professor of Speech & Hearing Sciences. Auditory brain sciences and neuroengineering.

Ludo Max Director, Lab for Speech Physiology & Motor Control. We focus on the neural and sensorimotor processes underlying the control of orofacial and laryngeal movements involved in speech production as well as on human voluntary movements in general.

G. Stanley McKnight Professor of Pharmacology. The McKnight lab studies neuronal signal transduction pathways that are regulated by the cAMP/PKA system.

Dana L. Miller Assistant Professor of Biochemistry. The Miller lab uses *C. elegans* to understand how cells and organisms sense and respond to changes in the environment. We are particularly interested in the neuromodulation of responses to hypoxia (low oxygen) and hydrogen sulfide (H2S) that influence organism survival and neurodegeneration.

Kathleen Millen Associate Professor of Pediatrics. The Millen laboratory uses molecular genetic approaches to explore the pathogenesis of congenital birth defects of the human and mouse brain and to study genes essential for normal neurodevelopment.

***Sheri J. Y. Mizumori** Professor and Chair of Psychology. Neurobiology of learning and memory.

Cecilia B. Moens Affiliate Professor, Depts. of Biology; Member, Div. of Basic Sciences, FHCRC. Developmental genetics of brain patterning in the zebrafish.

Thomas J. Montine Chair of Pathology and Professor of Neurological Surgery; Alvord endowed Chair of Neuropathology; Adjunct, Neurology (OHSU). Structural and molecular bases of cognitive impairment in Alzheimer's and Parkinson's diseases.

***William J. Moody** Professor of Biology. Development of ion channel properties in mammalian cortical neurons. The role of spontaneous activity in cortical development, with some emphasis on the basic mechanisms underlying pediatric epilepsy.

Randall T. Moon Professor of Pharmacology; Investigator, HHMI; Director, Institute for Stem Cell and Regenerative Medicine. Functions and mechanisms of action of the wnt signaling pathways in embryonic development, regeneration, and diseases, and development of therapies to treat these diseases based on high throughput small molecule screens and genome-wide RNAi screens.

Chet Moritz Assistant Professor of Rehabilitation Medicine and Physiology & Biophysics. We are developing neuroprosthetic technology for the treatment of paralysis and other movement disorders.

Richard Morrison Professor of Neurological Surgery. Signal transduction pathways associated with neuronal cell death; genetic pathways involved in the development of brain tumors.

Scott O. Murray Associate Professor of Psychology. Understand the brain mechanisms and cognitive process by combining behavioral and functional (fMRI) measurements of neural activity.

Michael Mustari Research Professor of Ophthalmology; Adjunct Professor, Biological Structure; Core Staff, WNPRC. Neural mechanisms for visual processing and associated vestibular and oculomotor behavior.

***Neil M. Nathanson** Professor of Pharmacology. Signal transduction by neurotransmitter and neurotrophic factor receptors; regulation and molecular biology of muscarinic acetylcholine receptors and neurotrophic cytokine receptors.

Jay Neitz Professor of Ophthalmology. Biology of vision and vision disorders.

***Maureen Neitz** Professor of Ophthalmology. Biology of vision and vision disorders.

John F. Neumaier Professor of Psychiatry & Behavioral Sciences and Pharmacology. Regulation of serotonin receptors in animal models of mental illness.

Jeffrey Ojemann Professor of Neurological Surgery. Electrocorticography studies of cognition and brain-computer interface.

Jaime F. Olavarria Associate Professor of Psychology. Structure, function, and development of topographically organized circuits in the mammalian visual system.

Shawn Olsen Assistant Investigator, Allen Institute for Brain Science. Cortical mechanisms of visual behavior and cognition.

James Olson Full Member of Fred Hutchinson Cancer Research Center; Professor of Pediatrics; Adjunct, Pathology and Pharmacology. Development of new therapies for brain tumors and neurodegenerative diseases and studies neurogenic transcription factors.

Mark Opp Professor of Anesthesiology & Pain Medicine. Functional consequences of sleep-immune interactions.

Lee Osterhout Professor of Psychology. Psychological and neural underpinnings of human language; psychophysiological studies of human language and memory.

Leo Pallanck Professor of Genome Sciences. Genetic analysis of neurotransmitter release mechanisms in *Drosophila.*

Richard D. Palmiter Professor of Biochemistry. Behavioral analysis of mice with genetic deficiencies in norepinephrine, dopamine, neuropeptides, or synaptic zinc.

David Parichy Professor of Biology; Affiliate Member, Institute for Stem Cell & Regenerative Medicine Post-embryonic development of neural crest lineages.

Jay Parrish Assistant Professor of Biology. Mechanisms by which neurons initially establish and subsequently maintain dendritic coverage of their receptive field.

***Anitha Pasupathy** Associate Professor of Biological Structure and NRPC. Neural basis of visual shape representation and recognition in the primate brain.

Catherine Peichel Associate Member, Human Biology at Fred Hutchinson Cancer Research Center; Affiliate Professor of Biology. The genetic and neural basis of behavioral variation.

***David Perkel** Professor of Biology and Otolaryngology. Neural mechanisms of learning, focusing on vocal learning in songbirds; anatomical and electrophysiological techniques for study of neuronal processing related to behavior.

Steve Perlmutter Research Associate Professor of Physiology & Biophysics; Research Affiliate, NPRC. Neural control of voluntary movement of the arm and hand.

***Paul E.M. Phillips** Associate Professor of Psychiatry & Behavioral Sciences; Joint, Pharmacology. The role of rapid dopamine neurotransmission in motivated behavior and decision making, and its dysfunction in mental health disorders including addiction.

Nicholas Poolos Associate Professor of Neurology & Regional Epilepsy Center; Adjunct, Physiology & Biophysics. Ion channel biophysics, dendritic neurophysiology, epilepsy and mechanisms of antiepileptic drugs.

Chantel S. Prat Assistant Professor of Psychology and Institute for Learning & Brain Sciences. My research investigates the biological basis of individual differences in language and cognitive abilities.

Daniel Promislow Professor of Pathology. The study of natural genetic variation for mating behavior and neurodegenerative disease in Drosophila.

David W. Raible Professor of Biological Structure; Adjunct, Genome Sciences; Adjunct, Biology. Neural crest development in zebrafish.

Jan Marino "Nino" Ramirez PhD, Seattle Children's Research Institute, Director, Center for Integrative Brain Research. Understanding the neuronal basis of a variety of brain functions to find novel ways to treat and cure neurological disorders in children, including epilepsy, Rett syndrome, brain tumors, and sudden infant death syndrome.

Bruce R. Ransom Magnuson Professor & Chair of Neurology; Adjunct, Physiology & Biophysics. Physiology and function of glial cells; physiology of brain energy metabolism and role of astrocyte glycogen; pathophysiology of anoxic/ischemic/hypoglycemic injury in the mammalian brain.

Rajesh Rao Assistant Professor of Computer Science and Engineering. Computational neuroscience, machine vision and robotics, and brain-computer interfaces.

Wendy Raskind Professor of Medical Genetics, and Psychiatry & Behavioral Sciences; and Adjunct Professor of Genome Sciences. The genetic etiologies of Mendelian neurodegenerative disorders, including ataxias and parapareses, and the complex neurobehavioral disorder dyslexia.

R. Clay Reid Senior Investigator, Allen Institute for Brain Sciences; Affiliate Professor of Physiology & Biophysics. Deciphering how information is encoded and processed in neural networks of the visual system, using behavior, anatomy and physiology.

Thomas A. Reh Professor of Biological Structure; Adjunct Professor of Bioengineering; Adjunct Professor of Neurological Surgery. Determination of the mechanisms that control neuronal proliferation and differentiation during neurogenesis of the vertebrate CNS.

***Fred Rieke** Professor of Physiology and Biophysics; Adjunct, Physics; Adjunct, Ophthalmology. Visual signal processing and computation; phototransduction.

Jeff Riffell Assistant Professor of Biology. Olfactory neurobiology and chemical communication processes.

***Farrel R. Robinson** Professor of Biological Structure. Cerebellar control of movements using monkey eye movements as a model.

Edwin W. Rubel Professor of Physiology & Biophysics, Otolaryngology-HNS, and Adjunct Professor of Psychology. Regeneration and protection of inner ear and lateral line hair cells. Development and plasticity of the brainstem auditory pathways.

Jay Rubinstein Virginia Merrill Bloedel Professor & Director of Otolaryngology-HNS. The Rubinstein lab studies signal processing, physiology, and perception with inner ear implants using both computational modeling and experimental techniques.

Hannele Ruohola-Baker Professor of Biochemistry & Genome Sciences; Associate Director, Institute for Stem Cell & Regenerative Medicine; Adjunct, Biology. Molecular interactions underlying axis formation in Drosophila.

Luis Santana Professor of Physiology & Biophysics. Research in our laboratory focuses on cardiac and vascular smooth muscle. We are particularly interested in determining how cell-wide (or global) and local changes in Ca2+ modulate the function of these cells. To investigate this we combine a series of state-of-the-art techniques including patch-clamp electrophysiology, molecular biology, cell biology, confocal and two-photon microscopy.

John Scott Professor of Pharmacology. Specificity of synaptic signaling events that are controlled by kinase anchoring proteins.

Eric Shea-Brown Assistant Professor of Applied Mathematics. Computational and theoretical neuroscience.

Helen Sherk Professor of Biological Structure. Physiology and anatomy of mammalian visual cortex.

Joseph A. Sisneros Associate Professor of Psychology. Understanding how the vertebrate auditory system processes species-specific vocalizations and the adaptive mechanisms that are used to optimize the receiver's sensitivity to social communication signals.

William Spain Professor of Neurology; Joint, Physiology & Biophysics. Transformation of synaptic inputs into patterns of action potential output; information flow within the network of neurons.

Robert A. Steiner Professor of Obstetrics & Gynecology and Physiology & Biophysics. Reproductive neuroendocrinology.

Nephi Stella Professor of Pharmacology; Joint, Psychiatry & Behavioral Sciences. Activation of immune cells in the CNS.

Jennifer Stone
Research Associate Professor of Otolaryngology-HNS. Cellular and molecular regulation of hair cell regeneration in avian and mammalian species.

Daniel R. Storm Professor of Pharmacology. Molecular and cellular basis of long-term memory and memory persistence using an interdisciplinary approach.

***Jane Sullivan** Associate Professor of Physiology & Biophysics. Cellular and molecular mechanisms controlling synaptic transmission and plasticity.

Billie J. Swalla Professor of Biology. I am interested in the evolution of chordates, especially the central nervous system. We are studying the gene networks that specify the central nervous system, in invertebrate deuterostomes and chordate embryos and adults.

Stephen Tapscott Full Member, Fred Hutchinson Cancer Research Center; Professor, Department of Neurology (Medicine Concurrent); Research Affiliate, Center on Human Development & Disability; Adjunct, Professor, Department of Pathology. Myotonic dystrophy.

Bruce L. Tempel Professor of Otolaryngology-HNS and Pharmacology. Auditory Neurogenetics. We study the biological function of genes causing deafness, noise induced hearing loss and audiogenic seizures.

Gregory W. Terman Professor of Anesthesiology. Neurophysiology and pharmacology of synaptic plasticity in pain transmission pathways of the central nervous system as a model for the pathogenesis of chronic pain.

James H. Thomas Professor of Genome Sciences. Molecular evolution, especially the evolution and function of gene families implicated in environmental interactions and other rapidly changing selective pressures. Work is mostly on nematode and mammalian gene families, with some comparative analyses to other groups.

Kelly Tremblay Professor of Speech & Hearing Sciences. Rehabilitating older ears and older brains.

Eric E. Turner Professor of Psychiatry & Behavioral Sciences. We study the mechanisms of brain development and neural gene regulation, and brain pathways affecting mood and anxiety. Using transgenic mouse models.

Russell Van Gelder Chair and Professor of Ophthalmology. Ocular function in health and disease.

Jack Waters Affiliate Faculty/Associate Investigator, Allen Institute for Brain Science. Cortical circuits in sensory behaviors.

Kurt Weaver Research Assistant Professor of Radiology. My research focuses on the dynamic interplay between large-scale neural systems and cognitive function, how this interaction can better inform contemporary models of neurological and psychiatric disorders.

Jonathan Weinstein Associate Professor, Department of Neurology; Adjunct Associate Professor, Department of Neurological Surgery. All projects in my laboratory focus on characterizing the role of microglia in the ischemic preconditioning phenomenon and more generally in the pathophysiology of stroke.

John Welsh Professor of Pediatrics-Seattle Childrens Research Institute. Our work focuses on the role of neuronal oscillation in cognitive and motor function.

***Rachel Wong** Professor, Department of Biological Structure. Circuit assembly and reassembly in the developing nervous system.

Zhengui Xia Professor, Environmental Health & Occupational Health Sciences (Toxicology Program); Adjunct Professor, Pharmacology. Mechanisms of neuronal apoptosis and neurodegenerative disorders including Parkinson's disease; neurogenesis both during development and in adult brain.

Cyrus P. Zabetian Associate Professor of Neurology, Div. of Neurogenetics; Staff Neurologist, VA Puget Sound Health Care System. We study the genetics of neurodegenerative diseases with an emphasis on Lewy body disorders.

William N. Zagotta Professor of Physiology and Biophysics. Mechanisms of ion channel function.

Jing Zhang Shaw Endowed Chair and Professor of Pathology; Director, UW Medicine Neuropathology. Proteomics investigation of molecular mechanisms of Parkinson’s disease, and biomarker discovery for neurodegenerative diseases.

Larry Zweifel Assistant Professor of Pharmacology and Psychiatry & Behavioral Sciences. Understanding the mechanisms of phasic dopamine-dependent modulation of reward and punishment, and the role of dopamine in generalized fear and anxiety.

Appendix D Items

1) JumpStart schedule
2) Program Retreat schedule
3) Student Symposium schedule
4) NEURO 501 syllabus
5) NEURO 502 syllabus
6) NEURO 503 syllabus
7) NEURO 504 syllabus
8) NEURO 545 syllabus
9) NEURO 559 syllabus
10) 2014-2015 Core Electives list

Neuro JumpStart 2014

Wednesday Sept. 17

9AM Meet at Neuro office

9:15AM Overview from David & Jane HSB G-417

9:45AM Julie Bierer
Social Work 052

10:45AM Larry Zweifel
HSB J-611A

11:30AM Ajay Dhaka
HSB G-530

12:15PM LUNCH T-469
with 2nd year Students
(Clare, Kelly, Kaitlyn, Bethany, Elle, Yoni, Kanichi)

2:00PM KC Lee
Portage Bay Bldg 204

2:45PM Chet Moritz
HSB RR-815

3:30PM Grant Writing Info Session G-417
(Dina, Sarah P, Ali W, Alison M)

Thursday Sept. 18

9AM Meet at Neuro office

9:15AM Eric Shea-Brown
Lewis Hall 212

10:15AM Rachel Wong
HSB H-514

11:00AM Paul Phillips
HSB BB-1538

12:00PM LUNCH T-469

1:15PM RC circuits, APs, extra vs intra recording (Moody)
HSB T-366

2:30-5:30PM Leech lab
(Perkel/Kennedy; TAs: Aaron, Brooke, Matt S, Mark Wronkiewicz)

Friday Sept. 19

9AM Meet at Neuro office

9:15AM Molecular Biology Lab I
(Chris Hague)
HSB D-430

11:00AM Jeremy Clark
HSB BB-1567

12:00PM LUNCH T-469

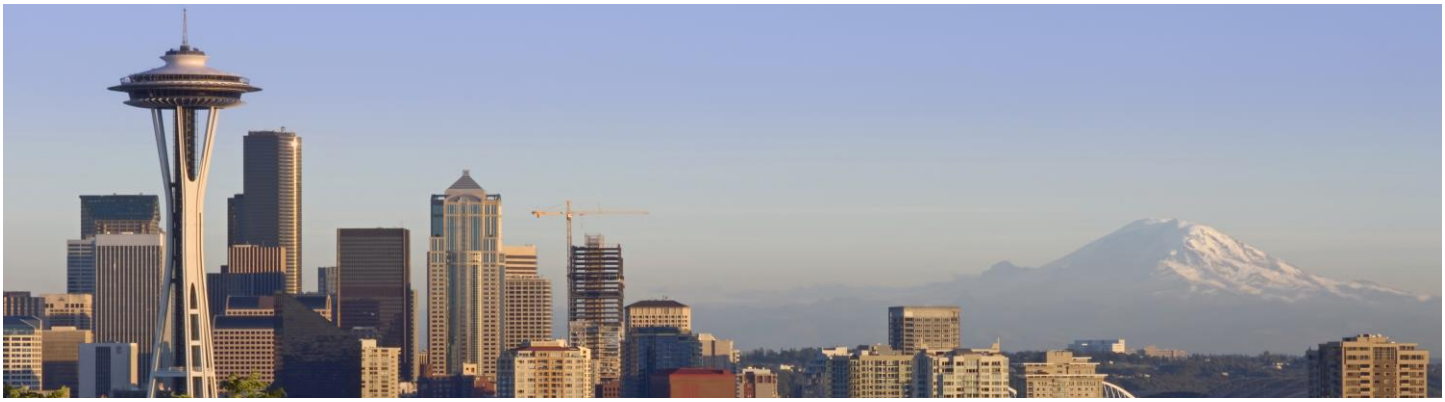
1-2:30pm Molecular Lab II

2:30PM Fred Rieke
HSB H-330

3:15PM Jeff Riffell
Kincaid 328

4PM Jay Parrish
Kincaid 200P

We are grateful to the Washington Research Foundation for supporting this program.



Neuroscience Program Retreat 2014
Waterfront Activities Center

Tuesday, September 9th

9:30am – 9:50pm Coffee and Pastries

9:50am - 10:00am **OPENING REMARKS**, **Jane Sullivan and David Perkel**

10:00am - 10:20am **Tatiana Anderson**, Neuro Graduate Student, Nino Ramirez Lab, Seattle Children's Research Institute

10:25am – 10:45am **Joy Sebe**, Research Scientist, Departments of Biology and Biological Structure

10:45am – 11:00am Break

11:00am - 11:50am **KEYNOTE SPEAKER: Jeff Riffell**, Assistant Professor, Department of Biology

11:55am - 12:05pm **OUTREACH PRESENTATION: Shea DiNino**, Neuro Student, Bierer Lab, Department of Speech & Hearing Sciences

12:05pm - 1:30pm **FIRST YEAR'S INTRODUCTIONS/LUNCH**

1:30pm - 1:50pm **John Neumaier**, Professor, Department of Psychiatry & Behavioral Sciences and Pharmacology

1:55pm - 2:15pm **Andrea McQuate**, Neuro Student, Lab of Andres Barria, Department of Physiology & Biophysics

2:15pm – 2:30pm Break

2:35pm - 2:55pm **Kathleen Millen**, Associate Professor, Seattle Children's Research Institute

3:00pm - 3:20pm **Brian Schmidt**, Neuro Student, Neitz Lab, Department of Ophthalmology;

3:25pm – 5:30pm **NEUROTRIVIA & HAPPY HOUR**



The Graduate Program in Neurobiology and Behavior
Student Symposium
June 13th, 2014

1:00-1:30pm **Yusha (Katie) Liu** (Neumaier Lab)
Role of 5-HT_{1B} autoreceptors in the expression of conditioned fear

1:30-2:00pm **Curtis Easton** (Moody Lab)
Genetic elimination of GABAergic neurotransmission reveals two distinct pacemakers for spontaneous waves of activity in the developing mouse cortex

2:00-2:30pm **Alison Mehravari** (Osterhout Lab)
Brain-based individual difference measures of reading skill in deaf adults

2:30-2:45pm Break, light refreshments

2:45-3:15pm **Candice Davidoff** (Neitz Lab)
The Genetics of Color Vision

3:15-3:45pm **Nick Hollon** (Philips Lab)
Mesolimbic dopamine transmission during choices involving cost-benefit tradeoffs

3:45-4:15pm **Dina Popovkina** (Pasupathy Lab)
Behavioral relevance changes feature selectivity in area V4

4:15-4:30pm Break, light refreshments

4:30-5:15pm **Job Search Panel**

Neubeh 501 – Autumn Quarter 2014
Molecular and Cellular Neurobiology
Mon., Wed., Fri. 9:30-10:20 AM
(Room G-328)
Steve Carlson (Course Director), Jay Parrish, Neil Nathanson, Mark Bothwell, Rachel Wong, Edith Wang, Greg Martin, Gwenn Garden and Philip Horner

Introduction and Methods

Sept. 24	Introduction & Overview	S. Carlson
Sept. 26	Methods in Protein Chemistry	S. Carlson
Sept. 29	Methods in Molecular Biology	M. Bothwell
Oct. 1	Methods in Microscopy	G. Martin

Development of the Nervous system

Oct. 3	Developmental neurobiology	R. Wong
Oct. 6	Developmental neurobiology	R. Wong
Oct. 8	Developmental neurobiology	R. Wong
Oct. 10	Neurotrophic factors I	M. Bothwell
Oct. 13	Neurotrophic factors II	M. Bothwell
Oct. 15	Cell Death	M. Bothwell
Oct. 17	Stem Cells	M. Bothwell

(*Email first Problem set – due at end of class Oct 27*)

Gene Regulation

Oct. 20	Gene Regulation 1	E. Wang
Oct. 22	Gene Regulation 2	E. Wang
Oct. 24	Gene Regulation 3	E. Wang

The Cytoskeleton of Neurons

Oct. 27	Actin and Microtubule Dynamics	J. Parrish
Oct. 29	Motors and Axonal Transport	J. Parrish
Oct. 31	Neurofilaments	J. Parrish

Glial Cells

Nov. 3	Astrocytes	G. Garden
Nov. 5	Microglia	G. Garden
Nov. 7	Myelin and Oligodendrocytes	P. Horner

(*Email Second Problem set – due at end of class Nov 17*)

Cell Biology of the Neuron and Synapse

Nov. 10	Protein sorting in neurons	S. Carlson
Nov. 12	Membrane traffic in neurons	S. Carlson
Nov. 14	Synaptic vesicles	S. Carlson
Nov. 17	Synaptogenesis and ECM	S. Carlson
Nov. 19	Synaptogenesis and ECM	S. Carlson
Nov. 21	Acetylcholine receptors	N. Nathanson

(Email Third Problem set – due at end of Class Dec 1)

Nov. 24	Regulation and localization of acetylcholine receptors	N. Nathanson
Nov. 26	No Class	

Nov. 28 **Thanksgiving Holiday**

Dec. 1	Glutamate receptors	N. Nathanson
Dec. 3	Gaba and glycine receptors	N. Nathanson
Dec. 5	Regulation of G-protein coupled signal transduction	N. Nathanson

(*Email last Problem set – due Tue Dec 9 by 5:00 pm in the Physiology & Biophysics Office – G424)*

Neurobiology and Behavior 502, Winter 2013

Home
Schedule
Class Info
Faculty
Powerpoints
Handouts
Interactive Quizzes

Schedule

Week 1		
Mon, 7 Jan Wed, 9 Jan Thur, 10 Jan LAB Fri, 11 Jan Fri, 11 Jan	Neuroanatomy survey 1 Neuroanatomy survey 2 Human brain Neuroanatomy survey 3 Chemical senses 1	Sherk Sherk Sherk Sherk Binder
Week 2		
Mon, 14 Jan Wed, 16 Jan Thur, 17 Jan LAB Fri, 18 Jan Fri, 18 Jan	Chemical senses 2 Chemical senses 3 Dissection of sheep brain Visual system: Eye and retina 1 Visual system: Eye and retina 2	Binder Binder Sherk Sherk Sherk
Week 3		
Mon, 21 Jan Wed, 23 Jan Thur, 24 Jan LAB Fri, 25 Jan Fri, 25 Jan	**NO CLASS, Martin Luther King Day** Visual system: LGN and primary visual cortex Dissection of sheep brain Visual system: Extrastriate cortex 1 Visual system: Extrastriate cortex 2	Sherk Sherk Sherk Sherk
Week 4		
Mon, 28 Jan Wed, 30 Jan Thur, 31 Jan LAB Fri, 1 Feb Fri, 1 Feb	Visual system: brainstem Somatosensory system: Receptors and sensation Human brain Somatosensory system: Maps and plasticity Somatosensory system: Pain	Sherk Sherk Sherk Sherk Sherk
Week 5		
Mon, 4 Feb Wed, 6 Feb Thur, 7 Feb LAB Fri, 8 Feb Fri, 8 Feb	Auditory 1 Auditory 2 Human brain Auditory 3 Auditory: higher functions & language	Tempel Tempel Sherk Tempel Sherk
Week 6		
Mon, 11 Feb Wed, 13 Feb Thur, 14 Feb LAB Fri, 15 Feb 9:30-11:20	Motor system 1 Motor system 2 Human brain **EXAM 1, sensory system**	Binder Binder Sherk
Week 7		
Mon, 18 Feb Wed, 20 Feb Thur, 21 Feb LAB Fri, 22 Feb Fri, 22 Feb	**NO CLASS, President's Day** Motor system 3 Human brain Motor system 4 Motor system 5	Binder Sherk Binder Binder
Week 8		
Mon, 25 Feb Wed, 27 Feb Thur, 23 Feb LAB	Motor system 6 Motor system 7 Human brain	Binder Binder Sherk

Fri, 1 Mar	Motor system 8	Binder
Fri, 1 Mar	Motor system 9	Robinson
Week 9		
Mon, 4 Mar	Motor system 10	Robinson
Wed, 6 Mar	Motor system 11	Robinson
Thur, 7 Mar LAB	**EXAM 2, neuroanatomy**	Robinson
Fri, 8 Mar	Motor system 12	Robinson
Fri, 8 Mar	Motor system 13	
Week 10		
Mon, 11 Mar	Motor system 14	Robinson
Wed, 13 Mar	Motor system 15	Robinson
Thur, 14 Mar LAB	Human brain dissection	Sherk
Fri, 15 Mar	Motor system 16	Robinson
Fri, 15 Mar	Motor system 17	Robinson

20 Mar, 4:00 **EXAM 3, motor system (take-home exam due)**

EXAMS AND GRADES

There will be three exams in this course, *all equally weighted. Although the last exam will be due at the time scheduled for the final exam, all three exams count equally. The first will be at the end of the sensory module (on Feb. 15), and will cover sensory systems. The second will be in the next-to-last week of the course (Mar. 7), and will cover neuroanatomy. It will have a practical as well as a written component (i.e., a "pin-test" portion), and will cover material presented in lab and in lecture. The third exam will cover motor systems, and will be a take-home exam, due Mar. 20. For the first and third exams, questions will be based primarily on lecture material.*

NEUBEH 503 – Spring 2014
Cognitive and Integrative Neuroscience

Week 1 (March 31 - April 4)
Topics: Introduction to course; Methods in systems neuroscience
M: Introduction to course; Methods in systems neuroscience
W: Methods in systems neuroscience
F: Methods in systems neuroscience
Instructor: Paul Phillips

Thurs Workshop: Associative learning
Instructor: Paul Phillips

Week 2 (April 7 - 11)
Topic: Learning
M: Non-associative learning in *Aplysia*
W: Non-associative learning in *Aplysia*
F: Candidate learning mechanisms in mammals
Instructor: David Perkel

Thurs Workshop:
Instructor: David Perkel

Week 3 (April 14 - 18)
Topic: Learning
M: Vocal learning
W: Vocal learning
F: Vocal learning
Instructor: David Perkel

Thurs Workshop: Discuss Problem Set 1
Instructor: David Perkel

Week 4 (April 21 - 25)
Topic: Signal detection and neuroimaging
M: Introduction and Signal Detection Theory
W: Neuroimaging I: fMRI / M/EEG
F: Group project brainstorming I
Instructor: KC Lee

Thurs Workshop: Discuss Problem Set 2
Instructor: David Perkel

Week 5 (April 28 - May 2)
Topic: Signal detection and neuroimaging
M: Neuroimaging II: Inverse Imaging / BCI?
W: Group project brainstorming II
F: Signal Detection II
Instructor: KC Lee

Thurs Workshop: Group presentations
Instructor: KC Lee

Week 6 (May 5 - 9)
Topic: Reward processing
M: Dopamine and neuromodulation
W: Motivation and hedonia
F: Computational models of reinforcement learning
Instructor:Paul Phillips

Thurs Workshop: Economic decision making
Instructor: Paul Phillips

Week 7 (May 12 - 16)
Topic: Reinforement learning
M: Dopamine and reinforcement learning
W: What information is conveyed by the afferent pathways to dopamine neurons?
F: Causal tests of dopamine and reinforcement learning
Instructor: Paul Phillips

Thurs Workshop: Discuss Problem Set 4; Volume transmission
Instructor: Paul Phillips

Week 8 (May 19 - 23)
Topic: Motor control and learning
M: Motor control
W: Motor control
F: Motor control
Instructor: Steve Perlmutter

Thurs Workshop: Discuss Problem Set 5; Workshop
Instructor: Paul Phillips; Steve Perlmutter

Week 9 (May 26 - 30)
M: Holiday: Memorial Day
Topic: Motor control and learning
W: Motor control
F: Motor control
Instructor: Steve Perlmutter

Thurs Workshop: Discuss Problem Set 6
Instructor: Steve Perlmutter

Week 10 (June 2 - 6)
M: Motor control
Instructor: Steve Perlmutter
Topic: Spatial cognition
W: Spatial cognition
F: Spatial cognition
Instructor: Sheri Mizumori

Thurs Workshop: Discuss Problem Set 7 (AKA Consiousness Workshop)
Instructors: Paul Phillips

CONJ 531, NEUBEH/PBIO 504 LECTURE SCHEDULE--2014

Meeting Time: MWF 10:30 - 11:20 AM --- HSB G-328

Lecture	Day	Date	Lecture Title	Lecturer
1.	Wed	Sept 24	**Introduction to cell membranes** *Background Reading:* Alberts et al., Molecular Biology of the Cell (5th Ed, Ch. 10, pp 617-650)	William N. Zagotta
2.	Fri	Sept 26	**Electrical properties of membranes** *Background Reading:* Alberts et al. (5th Ed, Ch. 11, pp 651-694,.), Levitan Ch. 3; Hille Ch. 1	William N. Zagotta
3.	Mon	Sept 29	**Electrical signaling proteins: ion channels** *Background Reading:* Levitan Ch. 4, Hille Ch. 3	William N. Zagotta
4.	Wed	Oct 1	**An electrical signal: the action potential** *Background Reading:* Levitan Ch. 6, Hille Ch. 2	William N. Zagotta
5.	Fri	Oct 3	**Molecular basis of ion channel function I: Mechanisms of permeation** *Background Reading*: Levitan Ch. 5, Hille Ch. 14,15 ***Problem set will be given out***	William N. Zagotta
6.	Mon	Oct 6	**Molecular basis of ion channel function II: Mechanisms of gating** *Background Reading*: Hille Ch. 18, 19	William N. Zagotta
7.	Wed	Oct 8	**Mechanism of Ligand Gating: Principles** *Background Reading*: Colquhoun (1998) Br J Pharmacol. 125:924-47; Colquhoun (2006) Br J Pharmacol. 147:S17-S26; Horrigan and Aldrich (2002) J Gen Physiol 120: 267-305 ***Problem set is due at the beginning of class***	Sharona Gordon
8.	Fri	Oct 10	**Mechanism of Ligand Gating: Molecular Basis** *Background Reading*: Armstrong & Gouaux (2000) Neuron 28:165-81; Jin & Gouaux (2003) Biochemistry 42: 5201-13; Richards & Gordon (2000) Biochemistry 39: 14003-11; Matulef & Zagotta (2003) Annu Rev Cell Dev Biol 19:23-44	Sharona Gordon
9.	Mon	Oct 13	**Membrane ligands** *Background Reading*: Lemmon (2008) Nature Reviews Mol Cell Biol 9:99-111; McLaughlin & Murray (2005) Nature 438:605-11	Sharona Gordon

Problem set will be given out

10.	Wed	Oct 15	**Mechanism of Ligand Gating: Multimodal Channels** *Homework will available on this web site*	Sharona Gordon
11.	Fri	Oct 17	**Basis of muscle contraction** *Background Reading*: Silverthorn, initial part of Ch.12, Muscles (pgs. 396-406 in 4th Ed.); Karp, sections 9.5 and 9.6, Microfilaments and Muscle Contractility (pgs. 360-374 in 5th Ed., Ch. 9) ***Problem set is due at the beginning of class***	Chip Asbury
12.	Mon	Oct 20	**Force production by muscle myosin** *Background Reading*: Alberts, Molecular Motors (pgs. 949-969 in 4th Ed., Ch. 16); Alberts, Light Can Be Used to Manipulate Objects (pgs. 575-576 in 4th Ed., Ch. 9)	Chip Asbury
13.	Wed	Oct 22	**Non-muscle motor proteins** *Background Reading*: Stryer, Molecular Motors (pgs. 391-416 in 4th Ed.); Karp, sections 9.1-9.3, Overview of Major Functions of Cytoskeleton, Study of the Cytoskeleton, and Microtubules (pgs. 328-357 in 5th Ed., Ch. 9)	Chip Asbury
14.	Fri	Oct 24	**'Unconventional' motors and motility** *Background Reading*: Alberts, Self-Assembly and Dynamic Structure of Cytoskeletal Filaments (pgs. 908-929 in 4th Ed., Ch. 16); Alberts, Mitosis (pgs. 1036-1050 in 4th Ed., Ch. 18) ***Problem set will be given out***	Chip Asbury
15.	Mon	Oct 27	**Excitation-contraction coupling** *Background Reading*: Silverthorn, Contraction is Regulated by Troponin and Tropomyosin, and Acetylcholine Initiates Excitation-Contraction Coupling (pgs. 406-409 in 4th Ed., Ch. 12); "Breakthroughs in Bioscience: Making Anesthesia Safer"	Chip Asbury

END OF CONJ 531 Instruction

16.	Wed	Oct 29	**Signaling from G protein coupled receptors via 5 classes of G proteins** *Background Readings*: Hille, Scholarpedia G Protein Coupled Receptors ***Problem set is due by 10:30 am in class for 504 students or in PBio Office (G-424) for 531 students***	Bertil Hille

17.	Fri	Oct 31	**The phospholipase C signaling system** *Background Reading*: Hille, Scholarpedia G Protein Coupled Receptors	Bertil Hille
18.	Mon	Nov 3	**Calcium: a dynamic second messenger, tools for study** *Background Reading:* Hille Chapter 9 (269-292)	Bertil Hille
19.	Wed	Nov 5	**Calcium signals: Excitable vs. nonexcitable cells** *Background Reading*: Hille Chapter 9 (269-292)	Bertil Hille
20.	Fri	Nov 7	**Evolution of signaling** *Background Reading*: Hille Chapter 22 (693-722) ***Problem set will be given out***	Bertil Hille
21.	Mon	Nov 10	**Presynaptic Mechanisms I: Calcium & exocytosis** *Background Reading*: Kandel, Schwartz & Jessell Chapter 14 (253-258) ***Problem set is due at the beginning of class***	
22.	Wed	Nov 12	**Presynaptic Mechanisms II: Quantal hypothesis** *Background Readings*: Kandel, Schwartz & Jessell Chapter 14 (258-270)	Jane Sullivan
23.	Fri	Nov 14	**Presynaptic Mechanisms III: Molecular basis of neurotransmitter release** *Background Reading*: Kandel, Schwartz & Jessell Chapter 14 (270-273)	Jane Sullivan
24.	Mon	Nov 17	**Society for Neuroscience Annual Meeting NO CLASS**	
25.	Wed	Nov 19	**Short-term Plasticity I: PPF** *Background Reading*: Nicholls, Martin, Wallace & Fuchs Chapter 12 (227-232) ***Problem set will be given out***	Jane Sullivan
26.	Fri	Nov 21	**Short-term Plasticity II: PPD** *Background Reading*: Nicholls, Martin, Wallace & Fuchs Chapter 12 (227-232)	Jane Sullivan

27.	Mon	Nov 24	**Postsynaptic Mechanisms I** *Background Reading*: "Neurons as conductors of electricity" Nicholls, Martin, Wallace & Fuchs Chapter 5 (3rd Edition) or Chapter 7 (4th edition). *Additional reading*: Fatt & Katz (1951) J Physiol 115: 320-370 ***Problem set is due at the beginning of class***	Andres Barria
28.	Wed	Nov 26	**Postsynaptic Mechanisms II** *Background Reading*: "Principles of Synaptic Transmission" Nicholls, Martin, Wallace & Fuchs Chapter 7 (3rd edition) or Chapter 9 (4th edition).	Andres Barria
29.	Fri	Nov 28	**HOLIDAY— NO CLASS**	
30.	Mon	Dec 1	**Postsynaptic Mechanisms III** *Background Reading*: "Synaptic Transmission III: Postsynaptic mechanisms" Johnston & Wu Chapter 13	Andres Barria
31.	Wed	Dec 3	**Long-term Plasticity I** *Background Reading*: "Plasticity in the adult nervous system" Purves, et al. *Neuroscience* Chapter 23; "Cellular Mechanisms of Learning and the Biological Basis of Individuality" Kandel, Schwartz & Jessell Chapter 63 (1259 – 1277) ***Problem set will be given out***	Andres Barria
32.	Fri	Dec 5	**Long-term Plasticity II** *Background Reading*: "Plasticity in the adult nervous system" Purves, et al. *Neuroscience* Chapter 23*;* "Cellular Mechanisms of Learning and the Biological Basis of Individuality" Kandel, Schwartz & Jessell Chapter 63 (1259 - 1277) ***Problem sets are due by 5PM on Mon Dec 8 in PBio Office (G-424)***	Andres Barria

CONJ531/NEUBEH/PBIO 504 COURSE HOUSEKEEPING

OUR WEB PAGE : **http://courses.washington.edu/PBIO504** contains at least:
---A copy of this schedule (updated if there are changes) with links to PowerPoint handouts.
---Links to electronic-reserve readings to the extent permitted by copyright laws.
---Any special notices and reminders
---Answers to problem sets.

---In lieu of a course bulletin board for appropriate course discussions you may want to have with peers, we encourage you to use the class email list jmsull_au14@uw.edu to send questions of interest to the class. The instructors will use this list to broadcast course information and answer questions. Students may also send questions directly to individual instructors (email addresses listed below).

CONJ 531 and NEUHBEH/PBIO 504--COURSE ADMINISTRATION
The courses are coordinated by Jane Sullivan, William N. Zagotta and the staff in the Department of Physiology and Biophysics (PBio) main office (Rm G424 HSB). Missing handouts can be obtained from the website. Organizational questions about the course may be directed to Dr. Sullivan or Dr. Zagotta and scientific questions to the instructors (see list of course faculty for contact information).

TEXTBOOKS
There is no required textbook. The following textbooks can be useful resources.

Alberts et al., *Molecular Biology of the Cell*, 5th edition, 2008

Hille, *Ion Channels of Excitable Membranes*, 3rd edition, 2001

Howard, *Mechanics of motor proteins and the cytoskeleton*, 2001

Johnston & Wu, *Foundations of Cellular Neurophysiology,* 1994

Kandel, Schwartz & Jessell, *Principles of Neural Science,* 4th edition, 2000

Karp, *Cell and Molecular Biology*, 5th edition, 2008

Levitan & Kaczmarek, *The Neuron: Cell and Molecular Biology*, 3rd edition, 2002

Nicholls, Martin, Wallace & Fuchs, *From Neuron to Brain*, 4th edition, 2001

Silverthorn, *Human Physiology: An Integrated Approach*, 4th edition, 2007

Stryer, *Biochemistry*, 4th edition, 1995

Some of these books are available for purchase at the South Campus Center branch of U Bookstore behind the Med School. Copies of these texts are on reserve in the Health Sciences Library Reserve shelf (room T-323). Those copies CANNOT be removed from the library. Many of the chapters of assigned reading are available on the course web page (see above).

BACKGROUND AND PREREQUISITES
The lectures assume biochemical knowledge at the level of an elementary biochemistry course, and all students are expected to have some background in the areas we will discuss at the level of general cell biology textbooks such as you will find in the Alberts textbook. We will assume you are at this introductory level before coming to the lecture. Alberts is an excellent general book that can help fill in missing background.

HANDOUTS
Handouts will be given for each lecture. Extra copies of class handouts (including Questions of the Day) and problem sets will be accessible on our web page (see above).

HOMEWORK
There will be daily small assignments, known as "Questions of the Day", and 6 larger problem sets with questions at the end of each section of the course. Your answers to the Questions of the Day will be collected daily before lecture and graded pass (1)/fail (0). Your larger problem sets (please use a computer printer where possible) will be collected in class on the day marked on the lecture schedule. Homework should be turned in on time, before the class discussion or posting of the answers. Discussion and debate about the Questions of the Day is encouraged, but you are expected to formulate the answers on your own. Working together should never produce identical answers.

GRADES
Your final grade will be based on (1) written answers to daily Questions of the Day (worth a total of 20% of your grade) and (2) written answers to problem sets on original papers (worth 80% of your grade).

HANDICAP NOTICE
To request disability accommodation; please contact the instructors in advance.

FACULTY

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Quantitative methods in neuroscience

NeuBeh 545/PBIO 545

Tu/Th 12:30-1:50, G328 HSB (except 1/13 when we meet in E216)

Date	Topic and Handouts	Reading and Discussion topics
1/6	Linear Algebra some logistics	linear algebra primer from Eero Simoncelli Linear transformations on Wikipedia Column space demo from class (note: requires some files from linear algebra tutorial - get those first)
1/8	Linear Algebra part 2 Discussion	linear algebra tutorial normrnd PlotVector Plot3DVector statsizechk note: you need all five files; make sure they are all on Matlab's path. You may already have normrnd and statsizechk if you have the statistics toolbox. Markov chain slides (optional part of tutorial)
1/13	Journal club **note: meet in E216**	Wandell, Foundations of Vision, Chapter 4 (good intro) or here: https://foundationsofvision.stanford.edu/chapter-4-wavelength-encoding/ Baylor, Nunn and Schnapf (1987) J Physiol 390:145-160. (primary paper) http://graphics.stanford.edu/courses/cs178/applets/colormatching.html (introduction to color matching)
1/15	Class Discussion	
1/20	Differential equations and neural dynamics	Howard Berg, *Random Walks in Biology*, Appendix B Hugh Wilson, *Spikes, Decisions and Actions*, Chapters 1, 2, 3 Wilson, Chapter 5 (numerical methods)
1/22	Differential equations and neural dynamics: Discussion	tutorial Simulink tutorial (optional)
1/27	Journal club:	Robinson (primary paper) Fuchs, Scudder and Kaneko (physiological counterpart to Robinson paper)

1/29	Class Discussion	Supplementary material: Villus material part 1 Villus material part 2 Villus material part 3 simulink model (works on Matlab 5)
2/3	Fourier Analysis, Filters and Convolution	Press et al., Numerical Recipes, pages 496-508 (2nd edition, this is beginning of Ch. 12); Ch. 13 Koch, Biophysics of Computation, Appendix B Wandell, Foundations of Vision, Appendix A (a mix of linear algebra and linear systems stuff).
2/5	Fourier Analysis, Filters and Convolution: Discussion	Fourier analysis tutorial linear systems primer from Eero Simoncelli (note this is not the same as the linear algebra one above - has a lot of Fourier stuff in it). linear systems primer from David Heeger Partha Mitra's open source Matlab code for spectral analysis, with links to online tutorials: http://chronux.org/home/ spectral analysis notes from Kleinfeld
2/10	Journal club:	methods paper (read first): Betzig discussion paper: Dani supplementary: Xu
2/12	Class Discussion	
2/17	Introduction to the Theory of Stochastic Processes	Howard Berg, *Random Walks in Biology*, Appendix A Koch, Chapter 15 Duda, Hart and Stork, Pattern Classification (2nd edition), Appendix 4 probability basics tutorial
2/19	Introduction to the Theory of Stochastic Processes: Discussion	Stochastic Processes Tutorial accessory files (note: make sure they are all on Matlab's path) Moment generating functions tuturial (you need both files in folder) Kemeny and Snell, *Finite Markov Chains* kemeny_snell_ch1

		kemeny_snell_ch2
2/24	Journal club:	Shadlen et al (primary paper for discussion) de la Rocha et al. (supplement re how correlated activity is shaped)
2/26	Class Discussion	
3/3	PCA and Dimensional Reduction	PCA tutorial Shlens PCA review rgc spike data single photon response data
3/5	PCA and Dimensional Reduction: Discussion	
3/10	Journal club:	Rust et al (primary discussion paper) Yang Dan complex cell paper Simoncelli chapter (good intro to PCA and friends) Golomb LGN paper Horwitz V1 paper
3/12	Class Discussion	

Instructors and contact info:

Adrienne Fairhall	fairhall@uw.edu
Fred Rieke	rieke@uw.edu
Wyeth Bair	wyeth.bair@gmail.com
Yoni Browning	yonib@uw.edu

Course project:

suggested projects

Computers, etc:

Computers with MATLAB are available in the PBIO computer room and the NeuBeh office.

Contact one of us if you are having problems finding a machine you can use.

Useful links:

site for Theoretical Neuroscience, Dayan and Abbott (see Exercises)

Villus web site

Mathematical details of Fourier analysis from Wolfram Research

Fourier transform primer (vision centered)

Spring 2014 - Neurol / NeuBeh / PBio 559

Neurobiology of Disease

meeting: Wed and Fri

10:30 - 11:50

G - 417

Course Evaluation - Instructors & Overall

Student presentations group #1

Student presentations group #2

Explaination of Written Assignment

examples Grant Proposal 1

example Grant Proposal 2

example critique

day	date	instructor	topic	video
Wed	4/2	G. Garden H. Tully	Introduction Disorders of neural development	
Fri	4/4	P. Phillips	Substance abuse O'Brien Gardner(2005) Kalivas Volkow (2005)	
Wed	4/9	J. Chamberlain	Muscular dystrophies and translational research in gene therapy text Therapy for DMD (2014)	DMD video
Fri	4/11	P. Horner	Traumatic Brain and Spinal Cord Injury	

Wed	4/16	W. Longstreth	Epidemiology in Neurological Disease text	
Wed	4/16	J. Rubinstein	Hearing Loss	
Fri	4/18	M. Neitz	Retinal disease	
Wed	4/23	S. Jayadev	Motor neuron disorders ALS Review: Kiernan et al (2011) Review: Ferraiulo et al (2011)	
Fri	4/25	N. Poolos	Epilepsy text Lerche (2013)	
Wed	4/30	G. Garden	Inherited neurodegeneration Sobue - SBMA JNC -Morfini Cerebellum - SCA7	
Fri	5/2	M. Weiss	Diseases of the neuromuscular junction/ Inflammatory polyneuropathies Myasthenia Gravis NBD Lambert-Eaton syndrome glossary	MG video CIDP video
Wed	5/7	J. Weinstein	CNS Ischemia (ppt) "Review by Luc Pellerin & Pierre Magistretti, pioneers in the CNS ischemia bioenergetics field, succinctly summarizing two decades of research on the astrocyte-neuron lactate shuttle (ANLS)" "Microglia in ischemic brain injury" text figures	Stroke video TED video

			websites for brain parenchymal & vascular anatomy: Harvard Med School whole brain atlas Loyola Neurovascular tutorial Allen Brain Atlas	
Fri	5/9	S. Webb	Autism text Cathy Lord: Assessment and intervention of ASD Simon Baron-Cohen: Autistic Spectrum Test are Linked to minds wired for science? Temple Grandin: The world needs all kind of minds 60 minutes: Diagnosing Autism	
Wed	5/14	L. Pallanck	Parkinson disease text	PD video
Fri	5/16	G. Terman	Acute & Chronic Pain (ppt) text Tracey & Dickenson review (2012) Basbaum et al (2009) Tracey & Bushnell (2009) other readings: Gate Control Theory TRPV1 Tolerance Phantom Pain Immune Cell Review Nociceptor Review	TED. video
Wed	5/21	student seminars		
Fri	5/23	A. Wundes / J. Goverman	Multiple Sclerosis (Wundes handout) (Goverman ppt) review 1 review 2 MS figure	MS video

			MS table	
Wed	5/28	T. Grabowski	Functional imagin and dementia	Alzheimer's video
Fri	5/30	J. Neumaier	Anxiety & Depression	
Wed	6/4	Student seminars		
Fri	6/6	J. Neumaier	Bipolar disorder and schizophrenia	
Wed	6/10	Research Proposals and Reviews Due		

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UNIVERSITY of WASHINGTON

The Graduate Program in Neuroscience

2014-2015 CORE ELECTIVES

AMATH 422/522: Computational Modeling of Biological Systems (3/5) *Shea-Brown* (Offered: W) Introduction to computational methods in biology and chemistry. Applications focus on statistical models, equilibrium models, discrete- and continuous- time deterministic models, and stochastic models arising in the biological and life sciences, and chemistry. Uses MATLAB for numerical computation and data analysis. Teaches tools in parallel with their computational implementation.

AMATH 533 / CSE 529: Neural Control of Movement: A Computational Perspective (3) *Todorov* (Offered: W) This graduate lecture course will provide a systematic overview of sensorimotor function on multiple levels of analysis, with emphasis on the phenomenology amenable to computational modeling. Topics include musculoskeletal mechanics, neural networks, optimal control and Bayesian inference, learning and adaptation, internal models, neural coding and decoding. Required background: Vector calculus, linear algebra, Matlab (or permission of instructor).

BIOEN 498 B: Neural Engineering (3) Daniel (Offered: A) This course is an introduction to Neural Engineering. It introduces technologies for monitoring electrical activity at scales ranging from whole organ (wireless EEG, implantable microelectrodes, olfactogram) to single cells (patch clamp techniques, microelectrode arrays, calcium imaging); technologies for stimulation of neurons in vivo (cortical microelectrodes) and in vitro (iontophoresis, uncaging, microfluidics); and devices for replacement of neural function (implantable electrodes, brain-computer interfaces, artificial retina, neurorobotics). The course includes visits to neural engineering laboratories in the UW campus following lectures by world leaders, e.g. Karl Bohringer (EE; implantable microelectrodes), Brian Otis (EE; wireless transduction of neural recordings), Adrienne Fairhall (P-Bio; computational models of neuronal activity), Eb Fetz (P-Bio; brain-computer interfaces).

BIOL 418: Biological Clocks and Rhythms (3) *de la Iglesia* (Offered: S) This course will focus on theory and current research topics in the field of circadian rhythms and other forms of biological rhythmicity, such as annual and tidal rhythms. The course will consist of lectures and discussion sections. Lectures will focus on the theoretical background that students will apply in discussion sections, which will include aspects that range from molecular and cellular basis to ecological and evolutionary aspects of biological rhythms. Discussions will be based on journal articles that students will be in charge of reading and leading the discussion. *Note that this is a 400 level course.*

BIOL 429: Models in Biology (4) *Odell* (Offered: A) Explores use of models in biology in a wide range of topics, including morphogenesis, nerve signals, ecological interactions, population biology, and evolutionary theory. Emphasis on the biological insights models can provide rather than mathematical techniques. Prerequisite: either ZOOL 470, MATH 125, MATH 128, MATH 134, MATH 145, or Q SCI 292.

BIOL 580 C & D Seminar in Physiology (2) *Perkel* (Offered: A,W) Advanced topics in synaptic physiology. Review of classic and modern papers addressing fundamental problems in synaptic physiology. Prerequisite: NeuBeh 501 or equivalent. All students by permission only. Section C to be graded, Section D to be C/NC.

BIOST 517: Applied Biostatistics I (4) *Emerson* (Offered: A) Introduction to the analysis of biomedical data. Descriptive and inferential statistical analysis for discrete, continuous, and right censored random variables. Analytic methods based on elementary parametric and non-parametric models for one sample; two sample (independent and paired), stratified sample, and simple regression problems.

BIOST 518: Applied Biostatistics II (4) *Kerr* (Offered: W) Multiple regression for continuous, discrete, and right censored response variables, including dummy variables, transformations, and interactions. Introduction to regression with correlated outcome data. Model and case diagnostics. Computer assignments using real data and standard statistical computer packages. Prerequisite: BIOST 517 or permission of instructor.

CONJ 532: Signal Transduction: From the Cell to the Nucleus (1.5) *Beavo, Moon, Storm* (Offered: A, weeks 6 to 10) Intracellular signaling pathways leading from cell membrane receptors to nucleus. Pathways activated by seven transmembrane receptors and G-proteins, insulin/PI3 kinase, nitric oxide and WNTs and mechanisms of signal termination. Cytokine/Jak/Stat signaling and role of subcellular localization in signal transduction. Prerequisite: basic knowledge of biochemistry.

CONJ 534: Selected Problems in Nervous System Development (1.5) *Cooper, Moens* (Offered: W) Introduces students to current issues in developmental neurobiology. Topics include regionalization of the neuroectoderm, mechanisms of neurogenesis, axon patterning and plasticity, and cell death. Not intended to be comprehensive; examines the experimental basis for current views in the field of a few topical issues.

CONJ 541: Molecular Biology of Cellular Processes (1.5) *Bornstein* (Offered: Spr) Translational control; cytoskeleton and molecular motors; protein targeting, sorting and secretion; apoptosis; regulation of cell function by extracellular matrix. Prerequisite: comprehensive undergraduate course in biochemistry and molecular biology or permission by instructor.

CONJ 542: Development (1.5) *Raible* (Offered: Spr) Molecular mechanisms of development; molecules and pathways used for the patterning of developing organisms. Similarities and differences in the making of plants, invertebrates, and vertebrates. Prerequisite: Comprehensive undergraduate courses in Biology, Molecular Biology, or permission by instructor.

CONJ 556: Drug Addiction: Mechanisms, Prevention and Treatment (2) *Chavkin* (Offered: A) Presents the key advances, insights, methods, and challenges for our understanding of drug addiction from psychological, pharmacological, psychiatric, community prevention, legal, and neurodevelopmental perspectives. Enhances familiarity with the multidisciplinary approaches required to understand addiction as a disease.

CSE 599E: Introduction to Brain Computer Interfacing (3) Rao (Offered: Spr)
Can the brain directly exert control over external objects? Can information from the outside world be directly relayed to the brain without using our sensory organs? Can our mental and physical capabilities be augmented beyond the limits imposed by biological evolution? These are some of the questions we will explore as we delve into the emerging world of brain computer interfacing. We will learn about invasive and non-invasive brain-computer interfaces (BCIs) for controlling cursors, prosthetic arms, wheelchairs, and robotic avatars. We will learn how such BCIs are enabling communication in locked-in patients and helping restore movement and mobility in paralyzed and disabled persons. We will also learn about other applications of BCI technology such as security, lie detection, alertness monitoring, entertainment, gaming, education, and human augmentation. The course will be self-contained and include primers on neuroscience, signal processing, and machine learning, followed by specific case studies of BCIs based on multi-neuronal activity, electrocorticography (ECoG), and electroencephalography (EEG). The course is directed at graduate students and advanced undergraduates from the physical sciences (e.g., computer science, engineering, physics, mathematics) and the life sciences (e.g. neuroscience, biology, psychology).

NEURO 528: Computational Neuroscience (3) *Rao, Fairhall* (Offered: Spr) Introduction to computational methods for understanding nervous systems and the principles governing their operation. Topics include representation of information by spiking neurons, information processing in neural circuits, and algorithms for adaptation and learning. Prerequisite: elementary calculus, linear algebra, and statistics, or by permission of instructor. Offered: jointly with CSE 528.

NEURO 541: Neuroendocrinology (3) *Steiner* (Offered: W, odd years) Emphasizes the cellular and molecular aspects of several topics in neuroendocrinology, including neuropeptide genes, reproduction, steroid hormone regulation of gene expression, mechanisms of hormone action, endocrine rhythms and neural oscillators. Offered: jointly with PBIO 509.

NEURO 545: Quantitative Methods in Neuroscience (2) *Rieke, Bair* (Offered: W, odd years) This course provides exposure to a variety of quantitative methods that are applicable to the study of the nervous system. It provides an intensive tutorial on mathematical methods and their application to neuroscience research. The course format revolves around computer exercises and discussion of journal papers. Topics can include linear systems theory, Fourier analysis, ordinary differential equations, stochastic processes, signal detection theory and information theory. Prerequisites: NEUBEH 501-503, or equivalent. Enrollment is limited to advanced graduate students in NEUBEH & PBIO, except by permission of the instructors. Offered: jointly with PBIO 545.

NEURO 548: Molecular Mechanisms of Synaptic Plasticity (2) *Barria* (Offered: Spr)
5-Week mini course discusses recent primary literature on the molecular mechanisms underlying structural and functional changes of dendritic spines in the mammalian brain as result of synaptic activity and experience.

NEURO 549: Molecular Basis of Neurodegenerative Disease (2) *Pallanck* (Offered: W) This elective, seminar-style course will introduce the student to a broad range of neurodegenerative diseases, focusing upon the approaches that have led to recent discoveries and emphasizing the elucidation of mechanisms and pathways of disease pathogenesis. Offered: jointly with PHCOL 549 and GENOME 549.

NEURO 550: Biophysics of Calcium Signaling (1) *Santana, Hille* (Offered: Spr, odd years)
Introduction to cellular calcium signaling including theoretical and technical issues of calcium signal detection and biological conclusions. Faculty will lecture and students will lead discussion of papers in class and write a short paper at the end of course. Prerequisite: CONJ 531. Offered: jointly with PBIO 550.

NEURO 552: Synaptic Integration (1) *Binder, Powers* (Offered: A, odd years) Reading and discussion of recent papers on how neurons in the central nervous system integrate concurrent synaptic inputs. Topics include: effects of driving force on synaptic currents, effects of synaptic conductances on dendritic properties, transfer of synaptic currents from dendrites to soma, transformation of synaptic currents into spike train outputs, active linear summation of synaptic inputs. Offered: jointly with PBIO 552.

NEURO 554: Motor Learning: Cellular and Network Mechanisms (1) *Fetz, Perlmutter* (Offered: W)
Five-week mini-course reviews the current state of research on cellular and network mechanisms of motor learning. After an introductory overview of behavioral and physiological examples of motor learning in various species and systems, students choose specific topics for discussion, using the primary literature as a source. Offered: jointly with P BIO 554.

NEURO 556: Axon Pathfinding Mechanisms (1) *Bothwell* (Offered: even years, W) Examines mechanisms governing axon growth cone behavior during embryonic development and during regeneration in the injured adult. Discusses approaches employing both invertebrate and vertebrate model systems. Offered: jointly with P BIO 556.

NEURO 557: Ion Channel Gating (1) *Gordon, Zagotta* (Offered: Spr) Compares and contrasts mechanisms of gating in ligand-gated and voltage-gated ion channels. Covers basics of ligand gating and voltage gating, kinetic schemes, inactivation and desensitization, gating currents and partial agonists, and ion channel structure. Offered: jointly with P BIO 557.

PHCOL 512: Neuropharmacology An Analysis of Drug Targets in the Nervous Systems (4, 5) *Bajjalieh* (Offered: Spr) General pharmacology of drugs affecting the autonomic and central nervous systems. Emphasis on current research approaches to understanding the basic mechanisms of drug action.

PHCOL 529: Ion Channel Pharmacology (2) *Catterall, Tempel* (Offered: odd years, A) Current topics in ion channel structure, function, genetics, and pharmacology, including consideration of their role in electrical signaling in cell membranes and in information transfer and processing in the nervous system, and the sites and mechanisms of action of drugs and toxins on them. Prerequisites: CONJ 501, 502, 503 or permission of instructor.

PHCOL 530: Neuronal Signaling Pathways (2) *Beavo, Storm* (Offered: even years, W) Advanced consideration of the molecular events between drug or hormone binding to receptors and the resulting responses. Roles played by cyclic nucleotides and other second messengers. Adenylate cyclase, phosphoinositide-mediated regulation, phosphodiesterases and protein kinases. Prerequisites: UCONJ 532 or permission of instructor.

PHCOL 531: Genetic Analysis of Signaling Systems (2) *McKnight, Moon* (Offered: odd years, Spr) Current topics involving signal transduction will be discussed with an emphasis on genetic analysis of multicellular systems and creative experimental design. Prerequisites: CONJ 531,532 or permission of instructor.

PHCOL 534: Molecular Basis of Addictive Drug Action (2) *Chavkin* (Offered: even years, A) Advanced consideration of the effects of drugs on neurotransmission and higher order neural systems including current topics in receptor pharmacology, transmitter release and reuptake mechanisms, synaptic plasticity, and neurodegeneration.

PHCOL 537: Molecular Neurobiology of the Cell Membrane (2) *Bajjalieh, Nathanson* (Offered:odd years, W) Advanced consideration of the structure and function of cell membranes, membrane proteins, and lipid-mediated signal transduction. Processes important to nervous system functioning will be emphasized. Prerequisites: CONJ 531, 532 or permission of instructor.

PSYCH 408: Mechanisms of Animal Behavior (4) *Sisneros* (Offered: Spr) Comparative exploration of physiological and perceptual mechanisms that control behaviors necessary for survival and reproduction in animals. Model systems discussed include animal communication, mate choice, escape behavior, learning and memory, orientation, biological rhythms, foraging behavior. Offered: jointly with BIOL 408.

PSYCH 420: Drugs and Behavior (3) *Diaz* (Offered: Spr) Animal and clinical research on the behavioral consequences of drug intake.

PSYCH 421: Neural Basis of Behavior (5) *Diaz* (Offered: A, W) Anatomical and physiological principles and resultant behavior involved in the integrative action of the nervous system. 431 recommended but not required to follow 421.

PSYCH 426: Neurobiology of Learning and Memory (4) *Mizumori* (Offered: Spr) Theory and research on how animals learn and remember, including basic concepts of brain plasticity, how brain areas and neurons adapt to changes in experiences throughout the lifespan, and cellular and structural substrates of a "memory."

PSYCH 448A: Seminar in Psychology (5) *Fine* (Offered: A) Development, plasticity and rehabilitation of sensory systems.

PSYCH 504: Core Concepts in Behavioral Neuroscience (3) *Bernstein, Kim, Covey* (Offered: A) Historical and contemporary perspectives in behavioral neuroscience. Current methodologies and research strategies. May include sensory processing, genetics, behavioral neuroendocrinology, developmental neural plasticity, neurobiology of learning and memory, lifespan perspectives on behavioral neurobiology, and psychopharmacology. Prerequisite: graduate standing in Psychology, or permission of instructor.

PSYCH 538B: Introduction to Programming for the Behavioral Sciences (4) *Fine, Boynton* (Offered: Spr) This class will be a tutorial for programming techniques in Matlab that are particularly relevant to researchers in behavioral sciences. The class will give a researcher with no or little experience in programming the tools they need to design and program their own experiment, do basic analysis, and plot their results. For example, we will include classes on experimental design, stimulus presentation, experimental timing, graphical user interfaces, curve fitting, randomization techniques, basic statistics, and customized data plotting, debugging and code optimization techniques.

PSYCH 541: Advances in Animal Behavior (3-5) *Brenowitz, Sisneros, Beecher* (Offered: A, W, Spr) Intensive readings from the current literature on an emerging topic or theoretical perspective in animal behavior. Student presentations and discussion. Prerequisite: graduate standing in Psychology or permission of instructor.

PSYCH 542: Advances in Behavioral Neuroscience (3-5) *Sisneros, Covey* (Offered: A, Spr) Intensive readings from the current literature on an emerging topic or theoretical perspective in behavior science. Student presentations and discussion. Prerequisite: graduate standing in Psychology or permission of instructor.

PSYCH 551: Seminar in Animal Behavior (1-2, max. 30) *Brenowitz* (Offered: A) Weekly meetings for discussion of current topics. Prerequisite: graduate standing in Psychology, or permission of instructor.

PSYCH 552: Seminar in Behavioral Neuroscience (1-2, max. 30) *Bernstein, Covey, Olavarria* (Offered: A, W, Spr) Weekly meetings for discussion of current topics. Prerequisite: graduate standing in Psychology, or permission of instructor.

SPHSC 594: Capturing Brain Dynamics: A Combined Neuroscience and Engineering Approach (4) *Lee* (Offered: W) Introduces methods for capturing brain dynamics using an emerging neuroimaging technique known as magnetoencephalography (MEG). Uses techniques to examine perception and cognitive processes and their implications for future brain-computer-interface (BCI) design. Prepare students for interdisciplinary research in neuroscience and engineering.

UCONJ 510: Introductory Laboratory Based Biostatistics (2.5) *Mancl* (Offered: Sum) Introduces methods of data description and statistical inference for experiments. Covers principles of design and analysis of experiments; descriptive statistics; comparison of group means and proportions; linear regression; and correlation. Emphasizes examples from laboratory-based biomedical sciences, and provides demonstrations using standard statistical programs.

UCONJ 524: Developmental Neurobiology (3) *Reh, Wong* (Offered: Spr) Survey of contemporary issues in developmental neurobiology, including neurogenesis and differentiation; electrophysiological, morphological, and neurochemical regulation of cellular phenotype; neuronal pathways and synaptic contacts; cellular and synaptic plasticity; and behavior. Examination of molecular biological, morphological, electrophysiological, and behavioral approaches. Prerequisite: background in neurophysiology.