Five-Year Academic Program Review

Biochemistry and Molecular Biology

Reviewed by: Paul Gorman, Joanne Noone, Margaret Scharf

Reviewed on: May 29, 2014

Contents

Five Year Academic Program Review

1. Introduction

Program Name: Biochemistry and Molecular Biology (BMB)

1.1 Identify the participants in the self-evaluation process. Please select all that apply.

X Faculty

X Students

Staff

Alumni

Employers

Others, please specify

1.2 When were meetings held to complete this self-evaluation process? Add date fields as needed.

During our monthly faculty meetings, we discuss pertinent issues regarding our graduate program when they arise. Such discussions include student involvement in our monthly Seminar series, future courses, faculty involvement in the teaching process, stipends, etc.

Until recently, we also elicited feedback weekly from BMB students during lunch meetings held after our weekly Seminars. Unfortunately, these had to be cancelled due to recent OHSU policy changes forbidding departmental expenditures on these sorts of activities.

1.3 Who prepared the document?

David Farrens, Director, Graduate Program in Biochemistry and Molecular Biology.

1.4 Who reviewed the report?

Graduate Program Steering Committee and Graduate Program Faculty.

1.5 Provide the faculty vote on the final draft of the report.

Number of faculty eligible to vote: **13**

Number Agreed: 13

Number Provisionally Agreed:0

Number Disagreed: 0

Number Abstained: 0

2. Overview

2.1 Describe the program mission and goals.

General Description of the Discipline of Biochemistry and Molecular Biology. [Note – the description below was implemented prior to the adoption of the Student Learning Outcome statements (SLO's). Many fields of biomedical research focus on whole organisms. Biochemistry and Molecular Biology (BMB) often focuses intensely at the other end of the spectrum – the molecular level. BMB researchers feel that knowing, at the physical level, how different components of our cells (proteins, DNA and RNA, lipids) work is a requirement for truly understanding how cells function and how they communicate with each other, for example, to transmit signals or fight disease.

Mission. The mission of the Department of Biochemistry and Molecular Biology (BMB) at OHSU is to promote outstanding fundamental research on mechanisms of disease at atomic and molecular levels of resolution.

Rationale. Since Biochemistry is the study of life at the molecular level, it provides the foundations of a wide range of other scientific disciplines, including virology, genetics, immunology, cell biology, microbiology, pharmacology and medicine. We aim to ensure students obtaining a degree in BMB have a strong foundation in the logic and application of the molecular and physical sciences, thus empowering them to later specialize in a wide range of subjects of their choice.

Goals. The goal of the BMB Graduate Program is to provide its graduate students with a rigorous and complete education in the underlying principles and practice of modern biochemistry and molecular biology. This will not only enable them to participate actively in the processes described above, but also empower them to successfully participate in whatever endeavors their future holds post graduate training, thus broadening their career opportunities..

Expectations. We expect a BMB student to be able to understand and critically evaluate existing knowledge about his or her research project, as well as synthesize, create and publish new knowledge. Specifically, we expect BMB students to excel at the following skills:

Thinking:

- Critically evaluate existing knowledge relevant to his/her field of research
- Identify significant and original scientific problems
- Understand current policies regarding ethical behavior expected of a research scientist

Doing:

- Design and conduct independent, innovative research and employ analytical skills
- Collect, store, and evaluate data using best lab practices
- Conduct oneself in a professional and respectful manner with all faculty, students and staff

Communicating:

- Clearly and accurately communicate findings using a minimum of jargon
- Produce written documents appropriate for publication
- Continue self-education and connect with others by attending seminars, meetings, symposiums or conferences
- Maintain a safe workspace, adhere to all safety regulations and display responsible conduct in research

Another way to re-phrase these expectations is through use of the recently approved OHSU Shared Learning Outcome (SLO) Statements for the PhD:

A BMB PhD graduate will be able to:

1. Demonstrate a basic knowledge of central concepts in the relevant scientific field;
2. Demonstrate advanced knowledge in one specialized area;
3. Advance knowledge in selected area of concentration;
4. Formulate hypothesis based on current concepts in the field;
5. Design, conduct, and interpret their own research;
6. Demonstrate doctoral-level competence in written and verbal communication;
7. Interpret and critique scientific literature;
8. Apply fundamental knowledge of ethics in research; and
9. Develop ancillary skills, where necessary, to obtain positions outside scientific research.

2.2 How do these align with, and contribute to, the fulfillment of OHSU's mission, strategic goals and core themes?

The BMB Graduate Program is fully in line with the OHSU's mission statement: (http://www.ohsu.edu/xd/about/facts/missions.cfm). As outlined in this document, we specifically:

- Strive for excellence in education, research and scholarship, as evidenced by high quality publications, formal and informal research presentations, and in many case, external grant support.
- Have a dynamic interdisciplinary environment that stimulates the spirit of inquiry, initiative, and cooperation among students, faculty and staff, as evidenced by regular formal and informal scientific discussions of research, and co-authored publications involving several students and faculty.
- Educate tomorrow's scientists to prepare them for a lifetime of learning, leadership and contribution.
- Explore new basic and applied research frontiers in biomedical sciences.

Documented examples of these activities can be seen in the titles of various faculty and students papers (see *Appendix 2 - Students*), and in our monthly seminar series, which are open to the public.

It is important to note that the above SLOs map to the OHSU Core Competencies in the following manner:

- Professional Knowledge and Skills (SLO 1, 2 & 3)
- Reasoning and Judgment (SLO 4, 5, & 8)
- Evidence-based Practice and Research (SLO 7)
- Lifelong Learning (SLO 3, 4, & 7)
- Communication (SLO 6 & 9)
- Professionalism & Ethics (SLO 8 & 9)
- Interprofessional Teamwork (SLO 8 & 9)
- Safety & Quality Improvement (SLO 1, 4 & 5)
- Systems (SLO 8 & 9)

2.3 Describe the curriculum, and if more than one award is given, highlight the progression in difficulty. Use the "Attach File" button below to upload the curriculum.

Overview. The BMB Graduate Program is a member of the Program in Molecular and Cellular Biosciences (PMCB) at OHSU. Thus, in the 1st year, BMB students take required conjoint PMCB. These are: CONJ650: Practice and Ethics of Science, CONJ661: Structure and Function of Biological Molecules, CONJ 662: Genetic Mechanisms, CONJ 663: Bioregulation, and CONJ 664: Cell Structure and Function.

BMB Requirements: Along with the above required courses, BMB students are required to take the CONJ elective CON668: Molecular Biophysics and Experimental Bioinformatics, in order to familiarize themselves with the tools and analyses used to study the structure, biophysics and chemistry of macromolecules. Students are also required to take BCMB619: Mol. and Biochem. Basis of Disease, in order to learn presentation skills.

Finally, starting in the year 2 through the end of the program all BMB students are required to enroll in a Journal Club, BCMB 605. They are also required to register for, attend and present their thesis work annually in the Departmental Seminar Series, BCMB 607,

BMB Electives: BMB requires a total of 9 credit hours of elective courses to be eligible for the Biochemistry & Molecular Biology Ph.D. degree. Students are strongly encouraged to start taking at least one elective course relevant to their field of study no later than winter term of their second year. Some of these classes include:

BCMB 620: Biochemical & Biophysical Properties of Membranes, BCMB 628: Protein Crystallography, BCMB 625: Advanced Molecular Bio. & Nucleic Acid Biochemistry, BCMB 618: Protein Design: How Structure is Related to the Function of Proteins, BCMB 630: Intro to Biophysics (PSU/OHSU joint course), BCMB 631: Adv. Biophysics (PSU/OHSU joint course).

Appendix 1 is a copy of the Biochemistry and Molecular Biology Academic Guideline.

We make this document available to all interested parties online, here: (http://www.ohsu.edu/xd/education/schools/school-of-medicine/departments/basic-science-departments/biochemistry-molecular-biology/graduate-program/upload/BIOCHEMISTRY-AND-MOLECULAR-BIOLOGY-Academic-Guidelines-2.pdf#page=1&zoom=auto,0,792).

3. Faculty and Staff Resources (Use the State of the Program Reports from the last five years to address these questions.)

3.1 Describe the major research thrusts of faculty, areas in which the research is particularly strong, areas that need to be strengthened and current research support.

BMB Research Activities and Strengths. BMB faculty use a range of scientific approaches to assess protein structure and function, to evaluate the interactions of receptors with their ligands and transporters with their cargo within biological membranes, to dissect the biochemical properties of signal transduction networks and transcriptional pathways that influence cell fate and function, and to investigate the essential properties of disease-causing viruses and protozoan pathogens.

A key tenet of biochemistry is that the 3-dimensional structure of a molecule drives its function. Thus, biochemical research often involves obtaining structural knowledge about biomolecules, and defining the chemical mechanism involved in their particular function. Such knowledge makes it possible to not only understand how molecules function, but also predict how they will interact with each other in both known and unknown situations.

For these reasons, Biochemistry departments in Universities are typically the home of structural biologists. OHSU is no exception. Of the 33 primary and associate faculty, ~ 50% are fully or at least partially involved in structural biology pursuits. Among these faculty, 4 are x-ray crystallographers, by far the highest density of such research on campus.

How BMB Leverages their Research Activities and Strengths to benefit their Graduate Student Training. Along with the coursework described above and the hands-on training BMB graduate students obtain working in their respective laboratories, BMB students are exposed to cutting edge BMB research through mandatory participation in our two seminar programs.

One Seminar series includes scientists from throughout the country who discuss their research to BMB faculty and students (note these seminars are open to and well-attended by the entire OHSU community). The other (discussed above) involves all of our graduate students and post-doctoral fellows, who have the opportunity to discuss their work on a regular basis in front of a

friendly but critical audience of their peers, and thereby gain valuable experience in presentation skills.

BMB Participates Heavily in Education at OHSU in Roles Outside its Own Program. As the BMB faculty are committed to teaching and mentoring the next generation of biomedical scientists through involvement in graduate and post-graduate education, BMB faculty participate enthusiastically in teaching missions across OHSU, not only in its own program. These activities include a heavy teaching presence in the campus-wide Program in Molecular and Cellular Biosciences (discussed above) conjoint courses.

In fact, BMB not only teach heavily in the PMCB, but BMB faculty are directors or co-directors in three of the offered CONJ courses. These include CON661: Structure and Function of Biological Molecules (director and co-director, Ujwal Shinde and David Farrens); CONJ 664: Cell Structure and Function (director, Linda Musil), and CONJ 668: Molecular Biophysics and Experimental Bioinformatics (director and co-director, Ujwal Shinde and David Farrens). A BMB faculty member is also presently acting as the Chair of the Conjoint Curriculum Committee (Michael Chapman).

The BMB faculty also enthusiastically participate in teaching in the Neuroscience Graduate Program, and the OHSU MD-PhD Program.

The BMB faculty also play a prominent role in the didactic education of our first year medical students. Cell Structure and Function (CSF) course, one of four basic science courses in the first year medical school curriculum, has been directed by BMB faculty member Dr. Buddy Ullman for years, and BMB faculty serve as lecturers for the biochemistry component of CSF and as facilitators for the many small group workshops in the course. In addition, Dr. Ullman is an active participant in the Biochemical Basis of Disease course at the end of the first year medical school curriculum and also lectures in a second year medical school course. Dr. Ullman has won 48 teaching awards and honors for his teaching efforts.

Future Endeavors. BMB is taking a major role in developing a new graduate level track in Quantitative Biosciences, which is designed to provide opportunities for students seeking to learn more physical and quantitative approaches, activities that are increasingly becoming necessary to solve fundamental biomedical research problems.

3.2 Describe how OHSU has maintained adequate qualified faculty members and staff members in relation to the program's growth over the last five years.

A total of 33 BMB faculty participate in graduate training. Among these, **13** have a **primary** appointment in BMB, and 20 are associated faculty members. Associated faculty include members with appointments in the Vollum Institute (6), the Shriners Research Center (3), Portland State University (2), Physiology and Pharmacology (1), Reed College (1), the SOM-Pediatrics Department (1), Molecular Microbiology & Immunology (1), Ophthalmology (1), Pulmonary and Critical Care Medicine (1), Jungers Center for Neurosciences Research (1), the School of Dentistry (1), and the Knight Cancer Center (1).

Since 2008, BMB has lost 3 faculty, due to retirement (2) or leaving OHSU (1). Four faculty have been added to our program. One, with a primary appointment in Biochemistry and Molecular Biology, was recently recruited from MIT following a national search.

3.3 How successful has the program been in attracting and retaining faculty and leadership from demographically diverse backgrounds?

BMB is committed to recruiting and retaining the best scientists, regardless of race, sex, or ethnicity. Currently we have **3 women among our 12 primary faculty**. Among all BMB faculty, 8 were born outside the U.S.

3.4 If recruitment and retention efforts have not produced desired diversity, what are your plans to recruit diverse faculty? What resources will be used or are needed to achieve these results?

Our ability to recruit new faculty depends on funds from the Dean, and no such funds are currently available. However, we did actively pursue diversity in our above mentioned recruitment of a junior faculty member, interviewing two women and two men for the position (all but one of whom were non-US born).

3.5 What services has the program utilized to increase program effectiveness and further the academic mission? Please choose all that apply.

Teaching and Learning Center

Provost's Office

X Library

X **Center for Diversity and Inclusion**

X Student Health

X Registrar

Financial Aid

X ITG

Campus Planning and Development

None

Other, please specify

Research Funding and Development Services

4. Enrollment/Degree Production (Use the State of the Program Reports from the last five years to address these questions. Each question has an "Attach File" option where charts or tables can be uploaded to demonstrate or emphasize your analysis.)

4.1 Is the five-year enrollment trend appropriate to the program's resources and capacity?

BMB was integrated into the Program in Molecular and Cellular Biosciences (PMCB) over a decade ago, and since then recruitment of students into the laboratories of BMB graduate faculty has steadily declined. We have matriculated ~2 students/year, with 10 students graduating with PhDs in the last 5 years (2008-12). This number is approximately half the number of graduates per year compared to when the Biochemistry and Molecular Biology Program was separate and independent, which graduated 18 students in the five years prior (2003 and 2007).

Please see *Appendix 2-Students*. The BMB faculty ideally would like to enroll ~ 3- 4 students/year.

Information on current 8 BMB Graduate students is also provided in *Appendix 3 – Current Students*, and is made publicly available online at: http://www.ohsu.edu/xd/education/schools/school-of-medicine/departments/basic-science-departments/biochemistry-molecular-biology/graduate-program/students.cfm

4.2 Has the number and/or quality of matriculates changed in the last five years? If so, how? What is the impact?

The number and/or quality of matriculates have not changed significantly in the last five years.

4.3 Is the five-year trend in awarding degrees and certificates appropriate to the program's resources and capacity?

Please see above.

4.4 How successful has the program been in attracting students from demographically diverse backgrounds?

BMB is committed to training the best students possible, regardless of race, sex, sexual orientation, or ethnicity. During the review period, we have admitted 11 women and 15 men. Of these, one was a URM, one LGBT, and 5 from an international background.

4.5 If you have not achieved desired results, what are your plans to recruit diverse students that add value to the learning environment? What resources will be used or are needed to achieve these results?

BMB does not directly control admission into its program; students must first be admitted into the Program in Molecular and Cellular Biosciences (PMCB). However, BMB does have representativeness on the PMCB admissions committee, and BMB faculty participate actively during the recruitment interview process.

Since 2012 OHSU School of Medicine offers five $1,000 Promising Scholar Awards to outstanding students, that have been admitted to any PhD or Master's program in the SOM and who will enhance student diversity

4.6 What is the evidence of regional, national or international need for additional qualified individuals such as the program is producing? Please specify.

Over the past 5 years, all but one BMB graduates have obtained positions as post-docs in academia, residents in medical schools, or positions in government and industrial laboratories.

4.7 Program availability (please select all that apply):

X Full-time

Part-time

Evening

Weekend

Place-bound

On-line

5. Other Resources

5.1 What is the current budget (present year) for this program?

Students are currently funded off of various training grants, as well as individual PI's grants. The BMB Department also holds in reserve funds to ensure students stipends will be paid in case of gaps in a given PI's funding. Each student is an estimated ~ $40,000/year cost obligation to the department if not covered by external funding sources such as grants.

We have previously submitted one Training Grant to obtain more funding for students, and have plans to do so again in the near future, after we have completed the implementation of the reviewers' suggestions. These include increasing joint PSU/OHSU educational collaborations, which we are doing with BCMB 630: Intro to Biophysics (PSU/OHSU joint course), and BCMB 631: Adv. Biophysics (PSU/OHSU joint course).

5.2 What revenue sources does the program have access to? Choose all that apply:

Tuition

State Appropriations

Clinical/Patient Care

X Grants/Contracts

Philanthropy

X Indirect Cost Return

Other, please list

5.3 How does tuition (or graduate stipends) compare to similar programs at other institutions (ideally, compare against programs on the institutional peer list)?

Graduate stipends are not set by BMB, but rather, are set by OHSU School of Medicine Graduate Studies. A comparison with similar programs at other institutions suggests that our stipends are comparable, when adjusted for Portland's cost of living.

5.4 Evaluate the adequacy of other resources necessary to support this program (e.g. library, computer equipment, facilities, research labs, clinical placements).

BMB has excellent laboratory resources. BMB is also arguably the most instrumentation – heavy department on campus. BMB facilities include advanced computational and X-ray crystallographic capabilities, as well as state of the art biophysical instrumentation, including fluorescence and proteomic. Together, these give BMB students exposure to and training on advanced, modern instruments.

5.5 Has anything happened since the last review that has influenced expenditures?

N/A

6. Student Learning Outcomes and Assessment (Use assessment reports from the past five years.)

6.1 Summarize how faculty members engage in ongoing systematic collection and analysis of meaningful, accessible and verifiable data that are appropriate indicators of student and graduate achievement of student learning outcomes.

All of the BMB required and elective courses are graded, and an online grade-book is kept with DegreeWorks (SunGard Higher Education).

The research progress of the individual BMB students is evaluated in a number of ways, both formal and informal.

Formal assessments include the student meeting at least once a year with his/her Thesis Advisory Committee (TAC), which is made up of composed of 4-5 faculty. Near completion of the course of studies, the students TAC typically meets more frequently. After each meeting, the Chair of the TAC is asked to briefly summarize the students' progress, and this information is kept on file. These reports are collated for review by the Program's Steering Committee.

Another formal assessment involves the student presenting his/her research activity to the entire department in the BMB weekly seminar series, followed by a period for questions and answers. These yearly formal presentations are open to the public and are **mandatory** for each year except the last, when in its place, the student presents and then defends his or her Thesis work, again, in a formal presentation that is open to the public.

In addition to the above formal requirements, students periodically meet informally with the Program Director to discuss matters related to their training.

6.2 Summarize how the results are used to improve the program curriculum, learning experiences, instruction, student recruitment and/or academic and learning support.

The faculty discusses the students' performance in the above activities with each other, and with the students involved and these deliberations are to improve the program when possible.

6.3 Describe briefly any other evidence considered in evaluating your program's effectiveness (student time-to-degree, retention and graduation rates, advisor/advisee relationships, mentoring).

It is our understanding that the average time from matriculation at OHSU to PhD degree is 5.1 years. For BMB students, the average over the past five years was 6.06 years, and all but two who passed the Qualifying Exam went on to graduate with a PhD or are still in the program, or transferred with the mentors to another University.

All the students met the mandatory BMB requirement to be an author on at least one manuscript, and almost all made the strongly suggested goal of having at least one first author publication. . BMB students were listed on 67 total publications. The average for the 23 BMB students who completed the program over the time of assessment was 2.9 publications per PhD graduate

6.4 What evidence does the program have about employment and/or further professional or graduate-level activities of program completers? What and how are alumni doing (e.g., industry or self-employment, geographic location, job, success indicators)?

All BMB graduates have been able to obtain postdoctoral positions in academia or government, or positions in industry, including institutions such as Duke, UCLA, the ETH-Zurich, the NIH and OHSU.

7. Other Information (optional)

N/A

8. Analysis and Conclusions

8.1 What are the strengths and achievements of the program's faculty, students and graduates?

The goal for the BMB program is to train students who can think independently, produce scientific research and actively analyze it, and then describe their findings to the public. We feel our students' excellent time-to-degree, publications, and capabilities to rapidly find positions after graduation demonstrate the quality of our training program.

Examples of this success include the fact that BMB students were first-authors on 19 publications, including manuscripts published in prestigious journal such as Science, Nature, EMBO, Virology, JBC and Biochemistry.

8.2 How will the self-study be used for improvement against goals and targets? How will it inform planning, decision making and allocation of resources and capacity for the next five years?

On the one hand, this self-study has confirmed to us that we are doing a good job training graduate students, especially given the decrease in direct resources into our program by the institution.

However, there is always room for improvement. Based on this self-study, we have identified a number of action items we will focus on to improve several areas in the future. These include:

Part 1. Introduction. Develop more specific mechanisms for collecting and utilizing student feedback.

Part 3. Faculty and Staff Resources. Work on ways to increase diversity outreach to underprivileged and URM communities. Best practices for doing so are currently under discussion.

Part 4. Enrollment/Degree Production. Continue our efforts to attract students to the BMB Graduate Program, for example, by continuing to give lectures at institutions with high undergraduate populations. We are also exploring opportunities to increase potential funding for more slots by maximizing revenue stream capture from external funding sources.

One of our concerns is that the decline in matriculation following integration of the BMB program into PMCB is a reflection of a biomedical mission highlighted by the umbrella program. The Quantitative Bioscience and Biomedical Engineering initiative will, it is hoped, allow us to better address the needs of the larger number of students applying to biochemistry graduate programs who are technically-oriented and will consider field of application later in career.

Part 5. Other Resources. Continue pursuing other options for external funding options, such as Training Grants.

Part 6. Student Learning Outcomes and Assessment. Begin implementingmetrics to assess effectiveness and outcomes of the new school-wide SLOs.

8.3 What new resources and/or support do you need to achieve these goals and improvement targets?

More institutional financial support would be the most direct and effective way to achieve these goals.

9. Response to Previous Program Reviews

N/A.

10. Signature and Submission

The preparer's email address below acts as a signature verifying the report is complete and ready for submission.

Preparer's email address:

farrensd@ohsu.edu

Date Submitted:

11/12/13.

Date of Final Amendment:

1/16/14

BIOCHEMISTRY AND MOLECULAR BIOLOGY
GUIDELINES AND EXPECTATIONS FOR Ph.D. STUDENTS
(Years 2+)

These rules pertain to all students in the Department of Biochemistry and Molecular Biology (BMB). They are in partnership with the guidelines and requirements set forth by the Program in Molecular and Cellular Biosciences (PMCB), and the Graduate Council of the Oregon Health & Sciences University (OHSU) School of Medicine. All BMB students are responsible for reading this document.

The Ph.D. program is organized as follows:

Year 1:	Complete PMCB requirements
Year 2	Complete the PMCB Qualifying Examination Undertake the research leading to the Ph.D. thesis Complete required and elective courses Attend and participate in Departmental seminars and a journal club
Years 3 +	Create a Research Advisory Committee (RAC) Advance to PhD candidacy Continue research leading to the Ph.D. thesis Attend and present research at Departmental Seminars and a journal club of choice closest to thesis work

REQUIRED BMB GRADUATE COURSES YEAR 2

Fall/Winter/Spring Term

BCMB 605	Journal Club	3 courses
BCMB XXX	Elective credits	1 course
BCMB 607	Departmental Seminar Series	3 courses
CON 665, 667 & 668	Two of these courses must be taken in Year 2 if it was not selected during Year 1 as part of the PMCB required courses	3 credits
BCMB 619	Mol. & Biochem. Basis of Disease	1 credit*
BCMB 601	Research	11 - 14 credits/term

REQUIRED BMB GRADUATE COURSES YEAR 3

Fall/Winter/Spring Term

BCMB 605	Journal Club	3 courses
BCMB XXX	Elective credits	2 courses
BCMB 607	Departmental Seminar Series	3 courses
BCMB 619	Mol. & Biochem. Basis of Disease	1 credit
BCMB 601	Research	11 - 14 credits/term

Summer Terms

BCMB 601	Research	16 credits

*If course not offered substitute one elective course

BMB SPECIFIC COURSE REQUIREMENTS

Students are required to register for, attend and present their thesis work annually in the Departmental Seminar Series, BCMB 607, held Tuesdays at noon as well as attend a Journal Club, BCMB 605 (Years 2 through end of program).

If a student wishes to be excused from taking a required course, the student and advisor should jointly petition the Graduate Curriculum Committee stating their reasons for wishing to be excused from the requirement. The curriculum Committee will decide the issue by a majority vote.

Only course work (required and elective), and not research, journal club or seminar credits, will contribute to the GPA. Students must receive a grade of A or B in the required courses specified in this document. If a student does not receive an A or B, the student must repeat the course the following year. The course can be repeated one time only. Failure to receive an A or B the second time will result in dismissal from the program. The required courses for which this rule applies are CON 650, 661, 662, 663, 664, 665, 667 and 668. The grade of Incomplete is reserved for circumstances in which a student is unable to complete the course requirements the end of the term in which the course is offered due to circumstances beyond their control (i.e. illness) AND it is possible to fulfill the remaining requirements within the subsequent term to earn a grade.

If a graduate student fails a semester of research credits (i.e. receives No Pass (NP) on research), the student is put on immediate academic probation. The student is required to obtain a passing grade on the next term (and subsequent terms) of research credits or the student may be dismissed from the BMB graduate program.

A pre-qualifying graduate student is required to notify and meet with his/her mentor, graduate program director (GDP) and graduate program coordinator (GDC) immediately upon receiving a failing grade on the research credits in any one term. The GDP will suggest a course of action that the student must follow in correcting his/her academic performance.

A post-qualifying graduate student (in consultation with his/her mentor, GDP and GPC) is required to schedule a Research Advisory Committee (RAC) meeting immediately upon receiving a failing grade on his/her research credits in any one term. This RAC meeting must take place within two weeks of receipt of the failing grade on the research credits. The mentor and RAC will suggest a course of action that the student must follow in correcting his/her research programs.

The courses BCMB 605 Journal Club and BCMB 607 Seminar require documentation of attendance in order to be considered for the grade of ‘Pass.’ A total of 3 absences are allowed per term. A graduate student missing more than 3 will receive a grade of ‘No Pass’ and will be placed on immediate academic probation. The student must receive a ‘Pass’ the subsequent term and every term thereafter. Following the receipt of the first ‘No Pass,’ a pre-qualifying exam student must immediately meet with their mentor, GDP and GDC. A plan for insuring the attendance goal for the next term should be designed. Two grades of ‘No Pass’ in either of these activities disqualifies a student from taking their qualifying exams, resulting in dismissal from the BMB graduate program. If a student who has advanced to candidacy receives two grades of ‘No Pass’ in either activity they may be dismissed from the BMB Graduate Program.

Elective Courses: A total of 3 elective courses are required to be eligible for the Biochemistry & Molecular Biology Ph.D. degree. Students are strongly encouraged to start taking at least one elective course no later than winter term of their second year. The following are only a few of the popular electives taken by the graduate students in BMB. Other courses available are listed in the course catalogue and graduate students are encouraged to speak to their mentor and/or GPD when considering taking other courses. Some of the elective courses are offered every other year, relative dates are noted below:

BCMB 620	Biochemical & Biophysical Properties of Membranes	2 credits/Winter Term
BCMB 628	Protein Crystallography	2 credits/Winter Term

BCMB 625	Advanced Molecular Bio. & Nucleic Acid Biochemistry	3 credits/Spring Term
BCMB 618	Protein Design: How Structure is Related to the Function of Proteins	3 credits/Winter Term
BCMB 630	Intro to Biophysics (PSU/OHSU joint course)	3 credits/Winter Term
BCMB 631	Adv Biophysics (PSU/OHSU joint course)	3 credits/Spring Term

PH.D QUALIFYING EXAMINATION

The purpose of the Qualifying examination in BMB is two-fold. First the examination will determine if the student has acquired sufficient knowledge and skills to pursue his or her Ph.D. thesis work. Second, the exam will provide the student with the opportunity to practice the preparation of a research proposal. Before taking the candidacy examination, the student must have completed the BMB course requirements. In the event that a course is not offered before the end of the second year, and the student is otherwise prepared to take the candidacy examination, the examination may proceed without completion of the course and with approval from the Graduate Education Committee. However, the required course must be taken prior to the thesis defense.

Format of the Examination:

Note: BMB guidelines are in accordance with PMCB written guidelines with minor differences that are outlined and bolded.

Oral examination: The oral examination will probe the breadth of the student's knowledge and also the depth of the student's understanding of his/her research proposal. The student is expected to begin the oral examination by giving a short (20-30 minute) formal presentation summarizing the written proposal. Audio-visual aids may be used. Questions from the Qualifying Examination Committee should focus primarily on issues pertaining to the proposal; however, the student is responsible for all areas of cellular and molecular biology that have been covered during the first two years of graduate study. Therefore, students also should expect questions on general knowledge in addition to questions relating to the scientific background pertinent to their areas of specialization, as well as more general issues related to the proposed experiments. Student should be prepared to discuss the rationale for the proposed study, the strengths and limitations of the proposed experimental strategies and the potential pitfalls and alternative.

Written examination: The qualifying examination will consist of written research proposal prepared by the student within his or her general area of research, but not directly on the student's research project, followed by an oral examination. The proposal should use the general format of the "Research Plan" section of an NIH RO1 (http://grants.nih.gov/grants/funding/phs398/phs398.html). The research plan should have the substance and content, including original thinking, appropriate for such an application. That is, it shall have the following sections:

1. Specific Aims
2. Background and Significance
3. Experimental Design and Methods
4. Literature Cited

The significance, feasibility and the relationship of the proposal to current literature will be important criteria for evaluation. The reference listings must include citations of original papers from the literature. Website addresses may be included as a supplement. The total length of the proposal is limited to 10 single-spaced pages using a 12-point font and/or no more than 15 characters per inch and ½ inch margins. Proposals submitted in an inappropriate format will be returned to the student for reformatting, which will delay the qualifying examination.

Before embarking on preparation of a research proposal, **the student will submit two abstracts** of approximately 300 words each to the Graduate Student Coordinator (GSC). The abstracts should describe specific research problems which have been designed by the student and **which may be related to but not directly on the student's thesis research project**. Abstracts will be reviewed and the Qualifying Examination

Committee (QEC) will select one topic for development. If the QEC deems none of the proposals suitable, the student will present additional proposals in a time frame designated by the QEC

During the preparation of the proposal, the student is encouraged to seek constructive criticism by others, however excluding the thesis advisor. During the oral examination, the student will be expected to make a 20-30 minute presentation of the research proposal, which will be followed by questioning that may cover all areas of biochemistry and molecular biology relating to the proposal.

Defined Categories:
Pass (unconditional)
Pass (conditional)
Fail (Retry)
Fail (Final)

Students who pass the examination conditionally will be required to complete additional work (e.g. rewriting of the proposal, re-examination by the Examination Committee on basic knowledge). The additional work, and date by which it must be completed, will be specified in writing by the chair of the Examination Committee. Upon the recommendation of the Examination Committee, a student who fails the candidacy examination may be given the option of taking a second examination. The second Examination Committee will either pass the student or recommend that the student not be admitted to candidacy for the Ph.D. degree.

Timing of the Examination
Each student is expected to complete the qualifying examination by no later than the end of the summer term (this is not true for a re-examination) of their second year in the program, in compliance with the PMCB requirements.

On or before **July 13** of their second year, students must submit two abstracts to the Graduate Student Coordinator.

July 19: the Graduate Program Director will select a Qualifying Examination Committee (QEC) responsible for conducting the student's qualifying examination. A chair of the QEC will be designated. The student is notified of the names of the panel members.

July 26: The QEC notifies the student in writing of selection of the examination topic and the acceptance or of any weaknesses or specific suggests for improvement to their proposal.

August 6: students must have their examination dates scheduled. Examinations must be completed at least ten days before the beginning of the Fall term.

Students submit their final written proposal to the QEC and their thesis advisor at least one week prior to the Examination date. Students must submit a letter to the QEC from their thesis advisor describing the advisor's role during preparation of the proposal (see "Role of Thesis Advisor and Other Faculty" in the PMCB guidelines).

A student who is asked to repeat the candidacy examination will be expected to do so within 2 months of the initial examination.

Examination committee
The Graduate Program Director will appoint a 5-member examination committee for each student based on the topic to be presented by the student and, as they see fit, the nominations of the student involved. **Names of the examiners nominated by the student should be submitted to the Graduate Program Director together**

with the abstracts of his or her proposals. *The student's thesis advisor may not serve on the examining committee*, but may attend the examination as an observer.

RESEARCH ADVISORY COMMITTEE

Purpose: The purpose of the Research Advisory Committee (RAC) is to advise and oversee the progress of the student's entire graduate education and training. The Committee should be composed of two or more primary faculty members of the Department of Biochemistry and Molecular Biology, and faculty members with primary appointments outside of BMB with appropriate research expertise, to total four members. *The Chairperson of the committee cannot be the Student's Research Advisor (mentor).* If the focus of the student's research changes, then appropriate changes of personnel in the RAC can be made. The RAC should advise the student in matters of curriculum requirements and research objectives. The RAC will determine whether the required coursework has been taken and may recommend additional coursework pertinent to the specific research goals. Members of this committee may also serve subsequently on the Thesis Examination Committee. In this way, these faculty members will be familiar with research, and will have the opportunity to communicate possible concerns they may have bout your work early to allow time to address these concerns. RAC meetings usually involve an oral presentation by the student of thesis research goals and progress.

Forming the Committee: Immediately following passing the qualifying exam, students in consultation with their mentor should construct a Research Advisory Committee. Students must meet with their RAC within 6 months of passing the Qualifying Examination and every 9 months to one year following the first meeting. *It is the responsibility of the student to organize and schedule these meetings*

The First Meeting: Students are encouraged to form their RAC as early as possible, but the first formal meeting must be held by the end of Winter Term in the student's third year. At least one week prior to the first meeting, the student will be expected to send the Committee Members an updated half-page description of his/her immediate research goals, a copy should also be sent to the Graduate Program Coordinator (GPC) along with a list of the RAC members and the RAC meeting date. At the first meeting, the student will present a 5-minute introduction to the research problem and one member of the committee will be selected to serve as chair of the committee. *It is the responsibility of the student to schedule this meeting.*

Subsequent Meetings: The RAC will meet every 9 months to one year, or more frequently if deemed necessary. The student will update the committee on the progress made toward the research objectives and the completion of required course work. At least one week prior to the meeting, the student will be expected to send the RAC members and the GPC an updated summary that should be no more than three pages. The meeting will begin with the student giving a 15-minute overview of his/her more recent results and future directions. Following each committee meeting, the chair should prepare a brief memo evaluating the student's progress and send it to the GPC.

Final Meeting: Three to four months prior to anticipated thesis defenses the student would have a RAC meeting to obtain approval for the beginning of thesis writing.

Advancement to PhD Candidacy: Students will advance to PhD candidacy once they have passed their qualifying examination *and* have formed their RAC.

Stipends: Students in BMB receive a monthly stipend for living expenses. Students will receive an increase in their stipend payment only after they have passed their qualifying exam, formed their RAC and submitted the Adv. to Candidacy form to the GPC. The increase will begin the month following submission of the form.

Non-compliance: Non-compliance can and will result in the revocation of certain Departmental privileges (e.g. Student's Departmental e-mail account), academic probation and possible dismissal from the graduate program.

BMB Preparation and Submission of Thesis: All instructions and guidelines adopted by the Graduate Council By-Laws shall be carefully followed.

OHSU BMB Graduate Program, student report September 2003–February 2013														
Name	**URM**	**Date matricul (PMCB)**	**Date joined BMB**	**Qualifying exam (advance to PhD)**	**Thesis defense**	**Grad Term**	**Time to graduation**	**Mentor**	**Publications**	**# Pubs**	**Thesis title**	**Awards & Training grant support**	**Position after PhD/ Current position**	**current email**
Gallegos, Jayme	no	200301	200401	11/29/2007	1/2/2008	200803	5.75	Lu, Hau	1. SCF TrCP1 activates and ubiquitylates TAp63gamma, **Gallegos** JR, Litersky J, Lee H, Sun Y, Nakayama K, Nakayama K, Lu H. J Biol Chem. 2008 Jan 4;283(1):66-75. Epub 2007 Oct 28.PMID:17965458 2. SAG/ROC-SCF beta-TrCP E3 ubiquitin ligase promotes pro-caspase-3 degradation as a mechanism of apoptosis protection. Tan M, **Gallegos** JR, Gu Q, Huang Y, Li J, Jin Y, Lu H, Sun Y. Neoplasia. 2006 Dec;8(12):1042-54. PMID:17217622 3. Balance of Yin and Yang: ubiquitylation-mediated regulation of p53 and c-Myc. Dai MS, Jin Y, **Gallegos** JR, Lu H. Neoplasia. 2006 Aug;8(8):630-44. Review. PMID:16925946	3	Regulation of the Transcription Factor p63 by BTRCP	Research Week Student Poster 2011	Post-Doc Fellow, OHSU, Molly Kulesz-Martin	gallegoj@ohsu.edu
Li, Yanping	no	200300	200302	2/12/2008	5/16/2007	200801	5.50	Lu, Hau	1. The interaction of Epac1 and Ran promotes Rap1 activation at the nuclear envelope. Liu C, Takahashi M, **Li** Y, Dillon TJ, Kaech S, Stork PJ. Mol Cell Biol. 2010 Aug;30(16):3956-69. doi: 10.1128/MCB.00242-10. Epub 2010 Jun 14. PMID: 20547757 2. Ras is required for the cyclic AMP-dependent activation of Rap1 via Epac2. Liu C, Takahashi M, **Li** Y, Song S, Dillon TJ, Shinde U, Stork PJ. Mol Cell Biol. 2008 Dec;28(23):7109-25. doi: 10.1128/MCB.01060-08. Epub 2008 Sep 29. PMID: 18824540 3. Ras-mutant Cancer Cells Display B-Raf Binding to Ras That Activates Extracellular Signal-regulated Kinase and Is Inhibited by Protein Kinase A Phosphorylation. **Li** Y, Takahashi M, Stork PJ. J Biol Chem. 2013 Sep 20;288(38):27646-57. doi: 10.1074/jbc.M113.463067. Epub 2013 Jul 26. PMID: 23893412 4. B-Raf is required for positive selection and survival of DP cells, but not for negative selection of SP cells. Dillon TJ, Takahashi M, **Li** Y, Tavisala S, Murray SE, Moran AE, Parker DC, Stork PJ. Int Immunol. 2013 Apr;25(4):259-69. doi: 10.1093/intimm/dxs104. Epub 2013 Jan 18. PMID: 5. Structure-specific recognition protein 1 facilitates microtubule growth and bundling required for mitosis. Zeng SX, **Li** Y, Jin Y, Zhang Q, Keller DM, McQuaw CM, Barklis E, Stone S, Hoatlin M, Zhao Y, Lu H. Mol Cell Biol. 2010 Feb;30(4):935-47. doi: 10.1128/MCB.01379-09. Epub 2009 Dec 7. PMID: 19995907 6. Human SSRP1 has Spt16-dependent and -independent	7	Function of structure-specific recognition protein-1 in gene regulation and mitosis		Post-Doc Fellow, OHSU	liya@ohsu.edu

Wirz, Jacqueline	no	200301	200401	6/6/2008	7/20/2010	201100	8.00	Bachinger, H	1. Nicotinamide Adenine Dinucleotide-induced Multimerization of the Co-repressor CtBP1 Relies on a Switching Tryptophan. Madison DL, **Wirz** JA, Siess D, Lundblad JR. J Biol Chem. 2013 Sep 27;288(39):27836-48. doi: 10.1074/jbc.M113.493569. Epub 2013 Aug 12. PMID: 23940047 2. Dealing with data: a case study on information and data management literacy. Haendel MA, Vasilevsky NA, **Wirz** JA. PLoS Biol. 2012;10(5):e1001339. doi: 10.1371/journal.pbio.1001339. Epub 2012 May 29. No abstract available. PMID: 22666180 3. Crystal structure of the human collagen XV trimerization domain: a potent trimerizing unit common to multiplexin collagens. **Wirz** JA, Boudko SP, Lerch TF, Chapman MS, Bächinger HP. Matrix Biol. 2011 Jan;30(1):9-15. doi: 10.1016/j.matbio.2010.09.005. Epub 2010 Oct 13. PMID: 20932905 4. Reverse signaling via a glycosyl-phosphatidylinositol-linked ephrin prevents midline crossing by migratory neurons during embryonic development in Manduca. Coate TM, **Wirz** JA, Copenhaver PF. J Neurosci. 2008 Apr 9;28(15):3846-60. doi: 10.1523/JNEUROSCI.5691-07.2008. PMID: 18400884 5. A dimeric mechanism for contextual target recognition by MutY glycosylase. Wong I, Bernards AS, Miller JK, **Wirz** JA. J Biol Chem. 2003 Jan 24;278(4):2411-8. Epub 2002 Nov 18. PMID: 12441341	5	Collagen and Collagen Associated Proteins: Studies on the Type XV Trimerization Domain and the P3H1:CRTAP:CypB		Biomedical Sciences Librarian, OHSU	wirzj@ohsu.edu
Dunham, Thomas D.	no	200401	200502	2/25/2009	4/30/2009	201000	6.00	Schumacher,	1. 1. Cysteine residues in the human cannabinoid receptor: only C257 and C264 are required for a functional receptor, and steric bulk at C386 impairs antagonist SR141716A binding. Fay JF, **Dunham** TD, Farrens DL. Biochemistry. 2005 Jun 21;44(24):8757-69. PMID: 15952782 2. Structural basis for ADP-mediated transcriptional regulation by P1 and P7 ParA. **Dunham** TD, Xu W, Funnell BE, Schumacher MA. EMBO J. 2009 Jun 17;28(12):1792-802. PMID: 19461582 3. Segrosome structure revealed by a complex of ParR with centromere DNA. Schumacher MA, Glover TC, Brzoska AJ, Jensen SO, **Dunham** TD, Skurray RA, Firth N. Nature. 2007 Dec 20;450(7173):1268-71. PMID: 18097417	3	The Role of P1 ParA in the partitioning of the P1 Plasmid		Business School	dunhamt02@hotmail.com
Curtis, Damian	no	200501	200503	2/4/2008	4/26/2011	201200	7.00	Lundblad, James	1. Neuronal eotaxin and the effects of CCR3 antagonist on airway hyperreactivity and M2 receptor dysfunction. Fryer AD, Stein LH, Nie Z, **Curtis** DE, Evans CM, Hodgson ST, Jose PJ, Belmonte KE, Fitch E, Jacoby DB. J Clin Invest. 2006 Jan;116(1):228-36. Epub 2005 Dec 22. PMID: 16374515	1	Biochemical functions of C-terminal Binding Proteins: Their role in short-range repression and dimerization		Scientist, AgraQuest Inc, Davis CA	snappy4tom@gmail.com
Sinha, Abhinav	Foreign	200501	200503	4/15/2008	5/11/2012	201203	7.75	Farrens, David	1. Monomeric rhodopsin is the minimal functional unit required for arrestin binding. Tsukamoto H, **Sinha** A, DeWitt M, Farrens DL. J Mol Biol. 2010 Jun 11;399(3):501-11. doi: 10.1016/j.jmb.2010.04.029. Epub 2010 Apr 22. PMID: 20417217 2. Dynamics of Arrestin-Rhodopsin Interactions: Identification of Two Distinct, Separate Sites on Arrestin that Interact with TM6 on Rhodopsin. **Sinha** A.,Jones, A, Fay, J. and Farrens D.l. Biochemistry. (*in press*)	2	GPCR Signal Attenuation: Biochemical and Spectroscopic Analysis of interaction with Affiliate Proteins		Research, India	abhinavsin@gmail.com

Severyn, Christopher	no	200600	200603	6/18/2008	7/17/2010	201100	5.25	Rotwein, Pet	1. Conserved proximal promoter elements control repulsive guidance molecule c/hemojuvelin (Hfe2) gene transcription in skeletal muscle. **Severyn** CJ, Rotwein P. Genomics. 2010 Dec;96(6):342-51. doi: 10.1016/j.ygeno.2010.09.001. Epub 2010 Sep 19. PMID: 20858542 2. Molecular biology, genetics and biochemistry of the repulsive guidance molecule family. **Severyn** CJ, Shinde U, Rotwein P. Biochem J. 2009 Aug 27;422(3):393-403. doi: 10.1042/BJ20090978. Review. PMID: 19698085	2	Regulation and Evolutionary Origins of RGMc/Hemojuvelin Expression: A Muscle-Enriched Gene Involved in Iron Metabolism		Resident, Duke University Medical Center, Durham NC	berkeley2pdx@msn.com
Fay, Jonathan F	no	200601	200603	12/4/2007	8/14/2012	201300	7.00	Farrens, David	1. A key agonist-induced conformational change in the cannabinoid receptor CB1 is blocked by the allosteric ligand Org 27569. **Fay** JF, Farrens DL. J Biol Chem. 2012 Sep 28;287(40):33873-82. Epub 2012 Jul 30. PMID: 22846992 2. Cysteine residues in the human cannabinoid receptor: only C257 and C264 are required for a functional receptor, and steric bulk at C386 impairs antagonist SR141716A binding. **Fay** JF, Dunham TD, Farrens DL. Biochemistry. 2005 Jun 21;44(24):8757-69. PMID: 15952782 3. Stability of dark state rhodopsin is mediated by a conserved ion pair in intradiscal loop E-2. Janz JM,**Fay** JF, Farrens DL. J Biol Chem. 2003 May 9;278(19):16982-91. Epub 2003 Jan 23. PMID: 12547830 4. The Membrane Proximal Region of the Cannabinoid Receptor CB1 N-Terminus Can Allosterically Modulate Ligand Affinity. **Fay** JF, Farrens D.L. Biochemistry (*in press)* 5. Dynamics of Arrestin-Rhodopsin Interactions: Identification of Two Distinct, Separate Sites on Arrestin that Interact with TM6 on Rhodopsin. Sinha A.,Jones, A,**Fay,** J. and Farrens D.l. Biochemistry. (*in press*)	5	Purification and structural analysis of the cannabinoid receptor CB1: Insights into allosteric regulation of a GPCR.	2013 Resko Outstanding Doctoral Thesis Award, Tarter Trust, NIDA Training, Gordon Research	Post-Doc Fellow, OHSU	fayj@ohsu.edu
Nili, Mahta F	no	200601	200603	6/6/2008	9/23/2011	201201	6.25	Rotwein, Peter	1. Proteomic analysis and molecular modelling characterize the iron-regulatory protein haemojuvelin/repulsive guidance molecule c. **Nili** M, David L, Elferich J, Shinde U, Rotwein P. Biochem J. 2013 May 15;452(1):87-95. doi: 10.1042/BJ20121845. PMID: 23464809 2. Defining the disulfide bonds of insulin-like growth factor-binding protein-5 by tandem mass spectrometry with electron transfer dissociation and collision-induced dissociation. **Nili** M, Mukherjee A, Shinde U, David L, Rotwein P. J Biol Chem. 2012 Jan 6;287(2):1510-9. doi: 10.1074/jbc.M111.285528. Epub 2011 Nov 22. PMID: 22117064 3. Soluble repulsive guidance molecule c/hemojuvelin is a broad spectrum bone morphogenetic protein (BMP) antagonist and inhibits both BMP2- and BMP6-mediated signaling and gene expression. **Nili** M, Shinde U, Rotwein P. J Biol Chem. 2010 Aug 6;285(32):24783-92. doi: 10.1074/jbc.M110.130286. Epub 2010 Jun 8. PMID: 20530805 4. Pro-protein convertases control the maturation and processing of the iron-regulatory protein, RGMc/hemojuvelin. Kuninger D, Kuns-Hashimoto R, **Nili** M, Rotwein P. BMC Biochem. 2008 Apr 2;9:9. doi: 10.1186/1471 2091-9-9. PMID: 18384687 5. Selective binding of RGMc/hemojuvelin, a key protein in systemic iron metabolism, to BMP-2 and neogenin. Kuns-Hashimoto R, Kuninger D, **Nili** M, Rotwein P. Am J Physiol Cell Physiol. 2008 Apr;294(4):C994-C1003. doi:	5	Structure and function of the iron-regulatory protein, repulsive guidance molecule c/hemojuvelin	F31 HL095271 (NRSA) and ARCS Foundation Scholarship (Portland Chapter), PMCB T32, NL Tarter Trust Grant	Post-Doc Fellow, UCLA, LA CA	mahta.nili@yahoo.com

Piscitelli, Chayne L	no	200601	200603	12/16/2008	1/20/2011	201102	5.50	Gouaux, Eric	1. Structure of β-adrenergic receptors. Brueckner F, **Piscitelli** CL, Tsai CJ, Standfuss J, Deupi X, Schertler GF. Methods Enzymol. 2013;520:117-51. doi: 10.1016/B978-0-12-391861-1.00006-X. PMID: 23332698 2. Insights into transport mechanism from LeuT engineered to transport tryptophan. **Piscitelli** CL, Gouaux E. EMBO J. 2012 Jan 4;31(1):228-35. doi: 10.1038/emboj.2011.353. Epub 2011 Sep 27. PMID: 21952050 3. Neurotransmitter/sodium symporter orthologue LeuT has a single high-affinity substrate site. **Piscitelli** CL, Krishnamurthy H, Gouaux E. Nature. 2010 Dec 23;468(7327):1129-32. doi: 10.1038/nature09581. PMID: 21179170 4. Unlocking the molecular secrets of sodium-coupled transporters. Krishnamurthy H, **Piscitelli** CL, Gouaux E. Nature. 2009 May 21;459(7245):347-55. doi: 10.1038/nature08143. Review. PMID: 19458710 5. A competitive inhibitor traps LeuT in an open-to-out conformation. Singh SK, **Piscitelli** CL, Yamashita A, Gouaux E. Science. 2008 Dec 12;322(5908):1655-61. doi: 10.1126/science.1166777. PMID: 19074341	5	Structure and Mechanism of LeuT		Post-Doc Fellow, ETH Zurich, Paul Scherrer Institue, Villigen, Switzerland	cpiscitelli@gmail.com
Gray, Lawrence W	yes	200601	200603					Lutsenko, Svetlana	1. Wilson disease at a single cell level: intracellular copper trafficking activates compartment-specific responses in hepatocytes. Ralle M, Huster D, Vogt S, Schirrmeister W, Burkhead JL, Capps TR, **Gray** L, Lai B, Maryon E, Lutsenko S. J Biol Chem. 2010 Oct 1;285(40):30875-83. PMID: 20647314	1			transferred to John Hopkins SOM with mentor	
Logue, Jeremy	no	200601	200603					Scott, David					transferred to Univ Washington	
Ramakrishnan, Parvathy [1]	Foreign	200601	200603	10/9/2007				Shinde, Ujwal	1. The mechanism by which a propeptide-encoded pH sensor regulates spatiotemporal activation of furin. Williamson DM, Elferich J, **Ramakrishnan** P, Thomas G, Shinde U. J Biol Chem. 2013 Jun 28;288(26):19154-65. doi: 10.1074/jbc.M112.442681. Epub 2013 May 7. PMID: 23653353	1			transferred to graduate school in India	
Zuzel, Vesna	Foreign	200701	200703		7/6/2010	201100 MS	4.00	Lutsenko, Svetlana	1. Therapeutic Targeting of ATP7B in Ovarian Carcinoma. Mangala LS, **Zuzel** V, Schmandt R, Leshane ES, Halder JB, Armaiz-Pena GN, Spannuth WA, Tanaka T, Shahzad MM, Lin YG, Nick AM, Danes CG, Lee JW, Jennings NB, Vivas-Mejia PE, Wolf JK, Coleman RL, Siddik ZH, Lopez-Berestein G, Lutsenko S, Sood AK. Clin Cancer Res. 2009 Jun 1;15(11):3770-80. PMID: 19470734 2. Cell-specific trafficking suggests a new role for renal ATP7B in the intracellular copper storage.Barnes N, Bartee MY, Braiterman L, Gupta A, Ustiyan V, **Zuzel** V, Kaplan JH, Hubbard AL, Lutsenko S. Traffic. 2009 Jun;10(6):767-79. PMID: 19416479 3. Cellular multitasking: the dual role of human Cu-ATPases in cofactor delivery and intracellular copper balance. Lutsenko S, Gupta A, Burkhead JL, **Zuzel** V. Arch Biochem Biophys. 2008 Aug 1;476(1):22-32.	3	ATP7B expression and trafficking in the intestine and overy: insights into specialized function		Exploring opportunities	vzuzel@googlemail.com
Summerton, Jean	no	200800	200801	9/7/2010				Chapman, Michael	1. Hyperconjugation-mediated solvent effects in phosphoanhydride bonds. J Phys Chem A. 2012 Oct 18;116(41):10209-17. doi: 10.1021/jp306607k. Epub 2012 Oct 9. **Summerton** JC, Evanseck JD, Chapman MS. PMID: 23009395	1		AHA 09PRE2020112, Vertex Scholar		summerto@ohsu.edu
McCraw, Dustin [2]	no	200801	200801	5/6/2008	5/9/2012	201203	4.75	Chapman, Michael	1. Structure of adeno-associated virus-2 in complex with neutralizing monoclonal antibody A20. **McCraw** DM, O'Donnell JK, Taylor KA, Stagg SM, Chapman MS. Virology. 2012 Sep 15-30;431(1-2):40-9. doi: 10.1016/j.virol.2012.05.004. Epub 2012 Jun 9. PMID: 22682774	1	Towards a Structural Understanding of Adeno-associated Virus Serotype 2 and its Recognition by Anibodies		Post-doctoral position at the NIH.	mccrawd2012@alumni.ohsu.edu

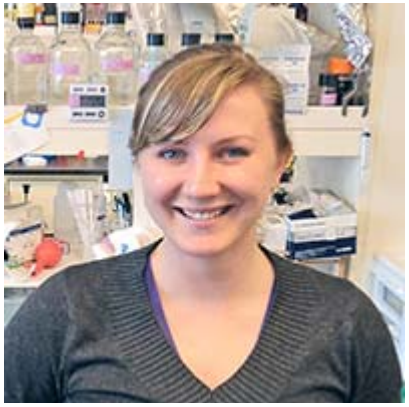
Abu-Hassan, Diala	Foreign	200901	201101	4/5/2011	9/6/2013			Acott, Ted			A denuded anterior segment model for transplantation of differentiated IPSCs as a therapeutic strategy for glaucoma			abuhassa@ohsu.edu
Montgomery, Nathan T	no	201001	201100	7/23/2013				Bachinger, Hans	1. Posttranslational modifications in type I collagen from different tissues extracted from wild type and prolyl 3-hydroxylase 1 null mice. Pokidysheva E, Zientek KD, Ishikawa Y, Mizuno K, Vranka JA, **Montgomery** NT, Keene DR, Kawaguchi T, Okuyama K, Bächinger HP. J Biol Chem. 2013 Aug 23;288(34):24742-52. doi: 10.1074/jbc.M113.464156. Epub 2013 Jul 16. PMID: 23861401	1				montgomn@ohsu.edu
Elferich, Johannes	Foreign	201101	201200	9/25/2012				Shinde, Ujwal	1. Substrate Inhibition of Uracil Phosphoribosyltransferase by Uracil Can Account for the Uracil Growth Sensitivity of Leishmania donovani Pyrimidine Auxotrophs. Soysa R, Wilson ZN, **Elferich** J, Forquer I, Shinde U, Riscoe MK, Yates PA, Ullman B. J Biol Chem. 2013 Oct 11;288(41):29954-64. doi: 10.1074/jbc.M113.478826. Epub 2013 Aug 28. PMID: 23986453 2. KHARON1 mediates flagellar targeting of a glucose transporter in Leishmania mexicana and is critical for viability of infectious intracellular amastigotes. Tran KD, Rodriguez-Contreras D, Vieira DP, Yates PA, David L, Beatty W, **Elferich** J, Landfear SM. J Biol Chem. 2013 Aug 2;288(31):22721-33. doi: 10.1074/jbc.M113.483461. Epub 2013 Jun 13. PMID: 23766511 3. The mechanism by which a propeptide-encoded pH sensor regulates spatiotemporal activation of furin. Williamson DM, **Elferich** J, Ramakrishnan P, Thomas G, Shinde U. J Biol Chem. 2013 Jun 28;288(26):19154-65. doi: 10.1074/jbc.M112.442681. Epub 2013 May 7. PMID: 23653353 4. Propeptides of eukaryotic proteases encode histidines to exploit organelle pH for regulation. 5. **Elferich** J, Williamson DM, Krishnamoorthy B, Shinde U. FASEB J. 2013 Aug;27(8):2939-45. doi: 10.1096/fj.12-226886. Epub 2013 Apr 12. PMID: 23585398 [PubMed - in process] 6. Proteomic analysis and molecular modelling characterize the iron-regulatory protein haemojuvelin/repulsive guidance molecule c. Nili M, David L, **Elferich** J, Shinde U, Rotwein P.	10		AHA Fellow, PMCB Retreat Poster Award		elferich@ohsu.edu
Jones-Hackathorne, Amber M	no	201100	201103	9/25/2012				Farrens, David	1. Dynamics of Arrestin-Rhodopsin Interactions: Identification of Two Distinct, Separate Sites on Arrestin that Interact with TM6 on Rhodopsin. Sinha A., **Jones,** A, Fay, J., Schafer, C. and Farrens D.l. Biochemistry. (*in press*).	1		NSF S-STEM 2007-2008, ARCS Scholar		joneshac@ohsu.edu
Martin, Jessica Lindsay	no	201100	201103	9/25/2012				Ullman, Buddy				Tarter Trust, MMI T32, NSF GRFP Honorable Mention		majessic@ohsu.edu
Schafer, Christopher T	no	201101	201200	9/25/2012				Farrens, David	1. Dynamics of Arrestin-Rhodopsin Interactions: Identification of Two Distinct, Separate Sites on Arrestin that Interact with TM6 on Rhodopsin. Sinha A., Jones, A, Fay, J., **Schafer, C.** and Farrens D.l. Biochemistry. (in press).			ARCS Scholar		schaferc@ohsu.edu

Williamson, Danielle M	no	201201	201201	9/25/2012				Shinde, Ujwal	1. The mechanism by which a propeptide-encoded pH sensor regulates spatiotemporal activation of furin. **Williamson** DM, Elferich J, Ramakrishnan P, Thomas G, Shinde U. J Biol Chem. 2013 Jun 28;288(26):19154-65. doi: 10.1074/jbc.M112.442681. Epub 2013 May 7. PMID: 23653353 2. Propeptides of eukaryotic proteases encode histidines to exploit organelle pH for regulation. 3. Elferich J, **Williamson** DM, Krishnamoorthy B, Shinde U. FASEB J. 2013 Aug;27(8):2939-45. doi: 10.1096/fj.12-226886. Epub 2013 Apr 12. PMID: 23585398 4. Propeptides are sufficient to regulate organelle-specific pH-dependent activation of furin and proprotein convertase 1/3. Dillon SL, **Williamson** DM, Elferich J, Radler D, Joshi R, Thomas G, Shinde U. J Mol Biol. 2012 Oct 12;423(1):47-62. doi: 10.1016/j.jmb.2012.06.023. Epub 2012 Jun 25. PMID: 22743102 5. Small molecule inhibition of HIV-1-induced MHC-I down-regulation identifies a temporally regulated switch in Nef action. Dikeakos JD, Atkins KM, Thomas L, Emert-Sedlak L, Byeon IJ, Jung J, Ahn J, Wortman MD, Kukull B, Saito M, Koizumi H, **Williamson** DM, Hiyoshi M, Barklis E, Takiguchi M, Suzu S, Gronenborn AM, Smithgall TE, Thomas G. Mol Biol Cell. 2010 Oct 1;21(19):3279-92. doi: 10.1091/mbc.E10-05-0470. Epub 2010 Aug 11. PMID: 20702582 6. Akt and 14-3-3 control a PACS-2 homeostatic switch that integrates membrane traffic with TRAIL-induced apoptosis. Aslan JE, You H, **Williamson** DM, Endig J, Youker RT, Thomas	6		PMCB T32, Tarter Trust		willidan@ohsu.edu
Hadd, Andrew C [2]	no	201201	201201	transferred in as 3rd year PhD					1. Structural diversity and protein engineering of the aminoacyl-tRNA synthetases. Perona JJ, **Hadd** A. Biochemistry. 2012 Nov 6;51(44):8705-29. PMID: 23075299 2. Structural conservation of an ancient tRNA sensor in eukaryotic glutaminyl-tRNA synthetase. Grant TD, Snell EH, Luft JR, Quartley E, Corretore S, Wolfley JR, Snell ME,**Hadd** A, Perona JJ, Phizicky EM, Grayhack EJ. Nucleic Acids Res. 2012 Apr;40(8):3723-31. PMID: 22180531 3. Synthesis of Glu-tRNA(Gln) by engineered and natural aminoacyl-tRNA synthetases. Rodríguez-Hernández A, Bhaskaran H, **Hadd** A, Perona JJ. Biochemistry. 2010.	3				hadd@ohsu.edu
Rauch, Benjamin J [2]	no	201201	201201	transferred in as 3rd year PhD										rauch@ohsu.edu
Martin, Gregory M	no	201301	201400					Shyng, S.L.	1. **Martin,** G., Chen, P.-C., Devaraneni, P., and Shyng, S.-L. Correcting biogenesis and trafficking defects of ATP-sensitive potassium channels using pharmacological ligands. Under review in Frontiers in Physiology.	1				martingr@ohsu.edu
1 transfer from CDB to BMB 2 transfer student from outside OHSU	26 total (3 transferred out, one got MS)									67.00				
Average							**6.06**		**67 total, 19 first author**	**2.9**				

Appendix 3. BMB Graduate Students (current)

Johannes Elferich,
BS- U. Munich.
Shinde Lab

Andrew Hadd
BS – U. Colorado, Boulder.
Perona Lab

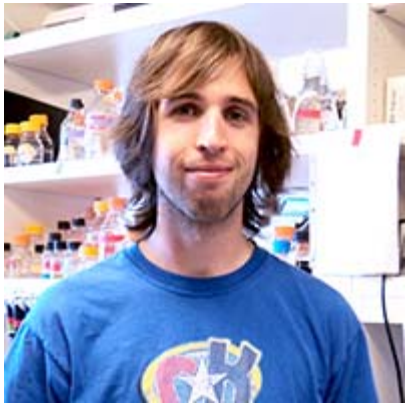


Amber Jones-Hackathorne
BS - Evergreen State College
Farrens Lab

Jessica Martin
BS - Washington State University
Ullman Lab

Nathan Montgomery
BS - University of Oregon
Bachinger Lab

Ben Rauch
BS - Skidmore College
Perona Lab



Chris Schafer
Michigan Tech.
Farrens Lab

Danielle Williamson
BS - Whitman College
Shinde Lab