

Materials linked from the November 20, 2015 Graduate Council agenda.

# **Oregon State University**

## **Graduate Program Review Report**

### **Biochemistry and Biophysics Graduate Program**

**February 15-16, 2015**

#### **Review Panel:**

Dr. Lisa Ganio, Professor, Forest Ecosystems and Society, OSU

Dr. Donald Jump, Professor, Nutrition, OSU

Dr. Larry McReynolds, Senior Scientist, New England Biolabs

Dr. Bertrand García-Moreno (Chair), Professor, Biophysics, Johns Hopkins

## **1. OVERALL RECOMMENDATION: Maintain**

## **2. EXECUTIVE SUMMARY OF FINDINGS AND RECOMMENDATIONS**

Every era has a dominant discipline that shapes it intellectually, technologically, and even socially. The first half of the 21<sup>st</sup> century will be dominated by quantitative biology. Biochemistry and biophysics being historically the quantitative branches of biology, are both poised to play a leading role as organizing and informing disciplines in the biological sciences in this century. OSU is fortunate to have a Department of Biochemistry and Biophysics (DBB) with a national and international reputation for world-class and original research on molecular mechanisms of living processes. Undergraduate (majors and non-majors) and graduate students and postdoctoral fellows receive outstanding classroom and laboratory training in the DBB.

The Department, and in particular its Biochemistry & Biophysics Graduate Program (BBGP), represent a foundational science central to the health of the biological sciences at OSU. The BBGP offers a curriculum of very high quality that has a measurable impact in programs and departments beyond the DBB. The BBGP offers only one track that combines training in both biochemistry and biophysics. The reviewers found the curriculum to be very strong, state-of-the-art, comparable to that of any of the best graduate programs in this field in the country. The courses in this program are taught by top-notch, research active faculty. The BBGP is predominantly a Ph.D. granting program, composed mainly of students from the US with approximately even representation of male and female students. The average time to completion of the Ph. D. degree is 5.7 years, which is better than the national average of 6 years. The graduate students in the program are without exception very pleased with the quality of the program and with the opportunities for state-of-the art research with internationally renowned faculty.

**STRENGTHS:** (1) The DBB is very strong, very democratic, supportive of the youngest members of its faculty, and in general doing well. (2) The BBGP also appears to be in very good health and vibrant. A very positive atmosphere permeates the BBGP. The program was described by the graduate students as a close knit community where everybody gets along, where everybody is accessible and interactions are good. The faculty concurred. (3) The program is relatively well positioned to participate in some of the major initiatives at OSU (e.g. big data, marine biology and material sciences). (4) The Department has some outstanding faculty who are extraordinarily committed to the success of the BBGP. (5) The graduate students are happy and, more importantly, they get excellent, personalized training and they emerge very well prepared for their future careers.

**WEAKNESSES:** (1) The Department lacks a strategic plan, especially one that articulates how BBGP fits within the vision for the COS. (2) Size could be construed as both a strength and a weakness. The Department and the BBGP do not need to grow, but they are not well protected from fluctuations related to stasis or retirements. (3) The graduate program is underfunded. (4) Graduate students need more career planning. (5) Graduate students take too many courses. (6) Ethnic diversity is lacking. (7) The research in BBGP does not receive the recognition within OSU it deserves. (8) The program would benefit from more research grants in the Department.

**OPPORTUNITIES:** (1) The biological sciences are undergoing a revolution and OSU has a very strong program in a critical area. Ongoing changes in the biological sciences need to be reflected in the offerings in the graduate programs. There are many opportunities for growth into new research areas in the DBB that would have a healthy impact on the BBGP. (2) The BBGP should grow. New resources have to be dedicated to this end. (3) There is room for increased collaborations between Departments. (4) With minor tweaking of the curriculum the graduate students would be better served.

**THREATS:** (1) In the current research funding climate it is impossible to operate without a safety net to protect against fluctuations in the numbers of graduate students and research funds. The BBGP does not have a safety net and this perilous situation should be remedied at once. (2) Research is not recognized at OSU as an important component of the teaching mission and the BBGP in particular does not seem to receive the recognition it deserves. If the balance between teaching and research duties is not managed correctly, the research mission will suffer and so will the Department's reputation and ranking. (3) A move to centralize funding and other resources used to support graduate students would remove much needed flexibility from the graduate program. The model for the financing of graduate students needs to be clarified and probably reconsidered.

**KEY RECOMMENDATIONS:**

- **A vision and a long-term plan are needed:** The vision and the long-term plan for the DBB and the BBGP should acknowledge other efforts within OSU.
- **Improve diversity:** Efforts should continue to increase ethnic diversity in BBGP and in the DBB.
- **Increase financial support for graduate students:** Without increased financial resources the continued vitality and success of the BBGP and the ability of faculty to secure funding is threatened.
- **Identify new sources of funding for graduate students:** Efforts should be made to identify private and industry sources of graduate student funding.
- **New funding model for graduate students:** The Department's fiscal autonomy appears to be eroding and that is not in the best interests of the DBB, the BBGP, the COS, or OSU.
- **Tweak the curriculum:** The curriculum is highly successful, yet students would benefit from a few minor changes. Consider increasing the emphasis on computation. Take advantage of the entire wealth of courses across OSU. Examine carefully the merits and role of slash courses. Shift the emphasis away from courses (minimize course requirements) and towards research.
- **Size and stability of the faculty:** The faculty need not grow, but the COS should help minimize the deleterious consequences of fluctuations in faculty numbers and productivity.
- **High impact hires are needed:** The faculty need not grow but a couple of high impact hires would be beneficial. The high initial cost would be offset by visibility and long term benefits.
- **Increase collaborations within COS and beyond:** Practice selective excellence within the DBB and the BBGP, and achieve breadth through collaborations across campus.
- **Raise more research funds:** Incentivize the faculty to seek research funds aggressively.
- **Improve the balance between teaching and research:** If teaching loads are unreasonable, the research mission will suffer.

- **Develop research infrastructure:** Some of the financial burden of the research infrastructure should shift to the administration. State-of-the-art research requires state-of-the-art infrastructure and in the current funding climate individual investigators will be unable to develop the necessary infrastructure on their own.
- **Facilitate submission of grant proposals:** Administrative support is urgently needed to facilitate the preparation and submission of grant proposals.
- **Raise the profile of BBGP:** A regular symposium at OSU should be organized to raise the profile of the program nationally and within OSU.

### 3. DETAILED FINDINGS

#### INTRODUCTION

Professor Brenda McComb (Dean of the Graduate School, OSU), appointed a team to review the Biochemistry and Biophysics Graduate Program (BBGP) on Feb. 16, 2015. The Review Team included the following: Dr. Bertrand García-Moreno, Chair, Biophysics, Johns Hopkins University (Panel Chair); Dr. Larry McReynolds, Senior Scientist, New England Biolabs; Dr. Lisa Ganio, Professor, Forest Ecosystems & Society-OSU (Graduate Council); Dr. Donald Jump, Professor, Nutrition Program Biological and Population Health Sciences-OSU (Graduate Council). Dean McComb hosted the Review Team dinner on the evening of Feb. 15<sup>th</sup>; this provide an opportunity to meet one another, learn the background associated with review, and share expectations for the evaluation process. The following morning the team met first with Professor Gary Merrill, (Department Chair). This was followed by meetings with Professor Douglas Keszler (Associate Dean for Research and Graduate Affairs-College of Science), the BBGP program committees, Program Faculty with the younger and the senior faculty divided into two separate groups, Sastry Pantula (Dean College of Science); a facilities tour and a meeting with the BB graduate students. The review panel concluded the day with exit meetings with Dr. Merrill and with the Program faculty. Once done, the Review Team met in Executive Session to share perspectives on programmatic activities during the past 10 years and the stated perspective of the faculty, students and Dean Pantula. The Review Team agreed to individually prepare a draft for assigned sections of the final report. The completed draft was shared, revised and accepted by all Review Team members prior to submission to Dean McComb on April 31, 2015.

#### MISSION

- **Essential role for biochemistry and biophysics.** The BBGP is a core biological science program, the type of program that is represented in any major US land grant university. BBGP is a key component of the overall University initiative of “One Health”. It provides a Ph. D. curriculum of the highest quality. Besides serving its own students, the offerings are important to many other graduate programs that have biological science at their core, such as pharmacology, EMT, MCB, NUTR, etc. For example, these programs depend on BBGP to provide quality graduate-level instruction in biochemistry. Biochemistry and biophysics have emerged as two of the most important organizing disciplines in the era of quantitative biology. They are evolving and growing rapidly. The core curriculum in BBGP itself will have to evolve to reflect changes in these rapidly evolving disciplines. The dependence of other graduate programs on the offerings at BBGP will only increase. That is how central and important the core components of BBGP are to the well being of biological sciences at OSU.

• **Issued identified by the chair of DBB and Director of BBGP.** The BBGP is managed by a rotating Graduate Program Director. Dr. Michael Freitag is the current Graduate Program Director and all indications are that he has been a caring, competent, outstanding Director. The DBB has had a rotating chair that serves between 3 to 5 years with 0.75 FTE. Dr. Gary Merrill has served as chair for the last several years and he too appears to have been an outstanding and competent Chair. The Department has done well under his leadership. He plans to step down from the position and expects the position to be filled by one of the current BB professorial faculty. Dr. Merrill expressed the desire to “maintain” the program at its current level of faculty and not to expand the number of students in the program, but other faculty thought there was room for some growth. DBB has recently hired several new young faculty, which will be very good for the future of the Department. Dr. Merrill identified several areas of concern, which resonated with the review committee: (a) inability to sustain the faculty in a steady state owing to loss of positions by retirement; (b) difficulty with recruiting minority students to enhance the diversity of the graduate program; (c) difficulty by faculty in obtaining extramural research funding, (d) lack of a safety net for graduate students. These are addressed in detail ahead.

• **DBB and BBGP as a priority and as a hub within OSU.** As biochemistry and biophysics are central to many areas of biological research, the DBB and BBGP could play an important role as a hub within OSU. The administration believes that the DBB is doing a good job. They also view increased cross-college collaborations as possible and desirable. A strong Department and Program can, indeed, be involved in these collaborations. The senior faculty expressed concern that these interactions are expected to happen in an ad hoc basis without much support from the administration. There is much to be said for the disciplinary cohesiveness that comes from being organized in units or relatively small size, as is the DBB. On the other hand, virtual group of faculty as, for example, represented by the School of Life Sciences, could be useful to the overall efforts across OSU. There is strength in synergy and synergy may be critical for the future strength and success of the DBB and the BBGP.

• **Recommendation #1: A vision is needed:** The Department and the Program stand to play a central role in biological sciences at OSU, but the Department in particular needs to articulate a clearer vision for itself and this has to be reflected in the Program. They need to develop a long-term plan to describe where they want to be in ten years in terms of size of faculty, number of students, areas of expertise represented in the DBB and the BBGP. The plan must acknowledge and dovetail with the initiatives and trajectory of COS and of other programs and units at OSU. The Department and the Program should be encourage to practice selective excellence by identifying a few areas in which they develop deep expertise. They have done this well in the past, but this area of science is changing rapidly and the DBB should adapt to these changes. The breadth that is essential for the best graduate training can come from interactions with other graduate programs.

## **RECRUITMENT, ENROLLMENT, SELECTIVITY, QUALITY OF STUDENTS**

• **Overall** The tables that were provided to the committee show clearly that the BBGP is in good health. The number of applicants has decreased over the last 10 years but that parallels the national trend. On the other hand, the number of female applicants has increased over this period, which is not the national trend, not even in the biological sciences. This is an excellent

situation for the BBGP to be in. The number of international students has decreased but to the extent that international students are desirable, that is something that can be offset with a targeted effort or with a few key contacts at foreign universities.

What is most important is that the applicant pool is still very strong. In terms of admissions metrics (i.e. GPA near 3.5, increasing GPA), matriculation rate (near 50%) and success rates (low attrition), the applicants that are admitted are comparable to those in the top research universities in the country, or better. The student body is gender balanced but ethnically it is not very diverse, dominated by white, domestic students.

• **Size of the program.** Currently the program targets the entry of 5 Ph. D. students per year. The size of the program is governed by two factors: (1) financial support for graduate students from the COS and, (2) research grants to faculty. In many ways the size of the BBGP today reflects the state of the DBB. Dean Keszler thought that all aspects of the BBGP are controlled at the Departmental level and that there is room for improvement and growth, for example, by having Departments work more closely together to create large center-type organizations that would increase the number of research opportunities for graduate students and increase the funding available for them. The review committee recognized that these interactions would strengthen the BBGP, but it also recognized that some seed money might be necessary to foment these interactions. Dean Keszler also thought it was timely and important for the senior faculty to take on new initiatives, such as attempting to secure NIH training grants or NSF grants, and in general, encouraging them to submit more grant proposals because the size of the BBGP is intimately linked to the research opportunities. In his opinion it is important to grow graduate programs because size can be one of the factors that impact distinction and visibility. Unfortunately the future of training grants is not obvious. Several institutes at NIH have discontinued training grants and the entire future of training grants is under scrutiny. The committee did not think it was necessarily a good idea to invest the very large amount of time required to apply for a training grant considering that the outcome is highly uncertain. The senior faculty concurred that training grants might be a way to go, but that it would be difficult at this juncture to justify the effort that would be required.

The executive committee of the BBGP thought that the quality and number of graduate students is continuing to increase, that many changes were done in the last 10 years that have fueled improvements and that have led to an increase in the number of students in the program. The momentum and energy of the graduate students in BBGP was palpable. The junior faculty was also happy with the quality of the current graduate students and confident that they can sustain this quality. They were more eager than the senior faculty to see the program grow, but they recognized that this is a complex decision linked intimately to the funding model and to the success of PIs in securing research grants.

The size of the BBGP is appropriate for the state of the DBB as it exists today. This should not be construed as a statement that the status quo is appropriate. The status quo is defined primarily by the resources available and by the very conservative research and training model in place, which is not appropriate for the current research funding climate. To continue to stay at the forefront, modest growth in the BBGP will eventually be necessary. Because the ability to grow is governed by finances and by the size of the faculty, this is addressed in the next section.

- **The problem of diversity.** The lack of diversity in the program is striking and problematic. This is not meant to be critical of the DBB or the BBGP. Efforts have been made to try to address this problem, but the disadvantages germane to a University in rural Oregon are enormous. Efforts have been made to increase diversity, but it is a very difficult thing to achieve. Efforts in this front should continue.

- **Recommendation #2: Improve diversity:** The program has worked hard and succeeded at maintaining a balance of male and female students. The Chair and Graduate Program Director noted the difficulties of identifying students from groups underrepresented in STEM, and agreed with the review panel that accepting students without adequate preparation for their program is problematic. We recommend continuing efforts to recruit from under-represented groups, but we also support the philosophy that the acceptance bar must be kept high for all. The BBGP should try to develop relationships with colleges or universities, perhaps in neighboring California that could be a source of talented graduate students from underrepresented groups.

## **LEVEL OF FINANCIAL SUPPORT**

The biological sciences are undergoing a revolution, spurred by the high throughput experiments (e.g., -omics) and the transformation of biology into a fully quantitative science. The biological sciences are also in a crisis, with funding levels at the lowest point in modern times. Nationwide the funding models for graduate students in the biological sciences reflect the financial reality of the past, in which funds from research grants for funding graduate students were abundant. A new funding model is needed to ensure that graduate students are available so state-of-the-art research can continue even during lean years. Some of the faculty, including the Chair of the DBB, expressed an interest in retaining the status quo in terms of size of the faculty and number of students, but this is probably more a statement about the funding model in place in the DBB and BBGP, and the complacency it breeds. The administration should work closely with the Department to develop a new funding mechanism and to ensure that faculty can remain aggressive in their quest for research dollars.

- **The funding mechanism is not clear.** The funding model for the BBGP described by the Chair of the DBB and by the faculty is not consistent with the model described by the COS administration. It appears that each Department has two sources of funds from which graduate students can be paid. One is their income (i.e. Ecampus, summer income, overhead) and the rest is what they received from the COS. According to the administration, the Department has total freedom to use the funds it has in whatever way it wants, so whatever shortcomings can be identified in funding of graduate students can be traced back to choices made by the Department. The DBB was mentioned as a Department that chooses not to use its funds to support more students. On the other hand, if funds were used to support students, it would be at the expense of funding something else, such as faculty hiring. This committee believes that any funding model in which faculty hiring and support of graduate students are not decoupled is likely to lead to strain. In such a model it is easy to avoid the imperative for increased funding by always proposing a shift in emphasis rather than an actual increase in funding. The senior faculty thought the Chair of the DBB has done an excellent job managing funds to maximize support of graduate students (e.g. mixing Ecampus funds and half TAs to cover the stipends for

graduate students who tutor undergraduate students). The faculty were under the impression that DBB is not well supported by the COS, and that other science Departments are better supported in other colleges. The reality is that the DBB does not have TAs in standard courses, such as the biophysics course, which can have enrollments larger than 40 but without a TA. The majority of 1<sup>st</sup> year students get paid for teaching biochemistry to non-premedical undergraduates, and many 2<sup>nd</sup> year students are funded by research grants.

There are other ways in which things seemed confusing to the review committee. Apparently, when graduate students are paid with state funds their tuition is waved but these tuition remissions are going to disappear. Similarly, there is no tuition reduction plan for years after successful completion of the preliminary exams. In general, it is extremely important to have clear policies and to have rules that minimize the burden of tuition on research grants. It should be clear to the administration that when the costs of graduate students become too high, for example because full tuition is charged even after students have passed their preliminary exams and are engaged in research full time, everybody loses. When it becomes more expensive to house a graduate student than a postdoctoral fellow in a laboratory, the faculty loses all incentives for growing their research programs. Alternatively, faculty opt out of training graduate students and instead use postdoctoral fellows for their research. It does not appear that OSU currently incentivizes graduate education. This needs to change if OSU aspires to be recognized as an important research institution, as it should.

- **Discretionary funds are not encouraged.** One of the problems that was identified by the committee is the drive towards an increasingly centralized funding model in which the income to the Departments is minimized, leaving them without discretionary accounts for various needs, including start-up packages. This would be OK if the slack were picked up by the administration. As it is, Departments have to stay nimble to stay competitive and unless the Administration is committed to stepping in regularly, a situation in which the administration is in full control of accounts and finances works against this necessary agility. Department Chairs working closely with Program Directors need to be able to have reserves that can be carried over from year to year so faculty can be helped as needed, so research can be stimulated, so faculty can be encouraged to be aggressive in submission of grants and performance of research even during lean years. This needs to be part of the funding model and not something decided on an ad hoc basis. This is the new reality that all bioscience programs work with and the programs and departments that learn how to sustain research during lean years are the ones that will succeed. A funding model that is too centralized is simply not nimble enough to allow programs and departments to adjust to their changing realities. The funding model for BBGP does not acknowledge the vagaries of the current funding climate nor the fiscal reality of science research at a research university such as OSU.

- **The BBGP relies too heavily on external research funding.** After the 2<sup>nd</sup> year in graduate school most students in the BBGP depend on funds from research grants. This places the faculty at OSU at a great disadvantage relative to programs where graduate students are funded by their universities for three and even four years. This model also works against success in research, against renewal of grants, or securing of new research grants. The more money that gets taken out of grants to fund graduate students the harder it is to thrive. This extreme reliance on grant funds to support graduate students is a disincentive to obtain more grants, and it undermines the success of the research mission central to the well being of both the DBB and the

BBGP.

- **A safety net is needed.** The current funding climate is extreme. The success rate for funding across the main federal agencies is hovering at around 10%. In this climate every investigator will, at some point, be without research funding. Research cannot stop under those circumstances, and to this end, a safety net has to be in place to be able to retain graduate students in the laboratories experiencing dry years. This is an imperative for ensured success of research laboratories in top research universities throughout the country, OSU not the exception. At present the discretionary funds that can be used to sustain students from the BBGP comes mostly from Ecampus, summer tuition and research overhead returns. A centralized funding model in which discretionary funding is removed from Departmental control would leave graduate programs without the ability to support faculty in periods of transition. Without a safety net the faculty have no incentive to be aggressive in their research and in their efforts to obtain funding. In this sense, the BBGP is underfunded. It is a program that lives day-to-day, in synchrony with the financial capabilities of its faculty, but also in a sense of complacency that will hurt the DBB and the BBGP in the long term. The pot has to be stirred, faculty need to be more aggressive in their attempts to remain funded, and this should be jumped started by creating a mechanism that ensures funding for graduate students independent of whether their lab is funded or not.

- **A new funding model will eventually pay for itself.** The resistance by the Chair and by the senior faculty of the Department to consider growing the DBB and the BBGP even slightly to adapt to changes in the discipline reflects the mindset of a Department that is underfunded. OSU should capitalize on the excellence of the DBB and the BBGP to have its positive aura influence other units of OSU. Modest growth will move the DBB away from its comfort zone and stir the pot in a positive way. The question should not be whether funds should be prioritized for growth of the faculty or for growth in the number of students. Modest changes in both areas are necessary to be able to capitalize on the strengths of this excellent program. A small investment at this time will yield profits in the long terms. Biochemistry and biophysics are areas of great growth and there are plenty of jobs for the graduates. With modest investment at this time the DBB and the BBGP will thrive. The faculty have taken a defensive position to protect themselves during these lean and hard times. Increased support for graduate students would ease the tension and prompt the faculty in their efforts to act aggressively to obtain external funding.

- **Recommendation #3: Increase support for graduate students:** The continued vitality and success of the BBGP depends on increased financial support for its graduate students. The goal is to allow for a larger number of students to be recruited and to decrease the number of years that students need to be paid from research grants. Graduate students should be encouraged to seek support from NSF and NIH pre-doctoral fellowships. This should be done in an organized manner and with close faculty supervision to maximize chances of success.

- **Recommendation #4: Identify new sources of funding for research/graduate students:** A task force should work to identify non-federal sources of funding (e.g. industry, private foundations) to fund graduate student fellowships and research projects. These interactions might require the presence of the COS to protect freedom to publish and a discussion of patent rights, etc. Alumni of the DBB should also be tapped, especially for targeted fund raising for

graduate student fellowships, as suggested by A. Karplus.

• **Recommendation #5: Create a safety net with a new funding model.** There is confusion as to how students in BBGP are funded. A centralized mechanism for funding of the BBGP should be avoided so Departments can retain as much financial autonomy as possible. This is necessary to protect BBGP from the vagaries of our current funding climate, and to allow the program to stay nimble and strong. Separate handling of budgets for graduate student support and for other expensive endeavors (e.g. start up packages) are recommended; otherwise the situation will lead into an unproductive zero sum game.

## **CURRICULUM STRENGTHS**

The curriculum of the BBGP is a broad and strong, time-tested curriculum in both biochemistry and biophysics, taught at the highest level by the DBB faculty. This is no small achievement given that the students that join the BBGP have very different backgrounds and levels of understanding and one of the unique challenges of the curriculum is to get every student to the same level in short order. The administration acknowledged that the faculty of the DBB is deeply committed to the graduate program and that the program and its curriculum is deemed as being very successful. This review committee concurred.

• **Areas of concern and room for growth:** No significant areas of concern were found, save for relatively minor issues concerning, for example, the need for a consistent style and format of the syllabi for the graduate courses, which is highly variable. Program competencies are not readily accessible. The procedure for monitoring student success during and after graduate studies could also be more clearly spelled out. But these are all relatively minor things that do not detract from the strength of the curriculum.

One area of concern is related to the “slash” courses that are supposed to serve a dual function as graduate and undergraduate courses, simultaneously. The graduate students noted some benefits, but they also noted a negative aspect: sometimes the course is more undergraduate than graduate (i.e. biochemistry), and sometimes it is more graduate than undergraduate (i.e. biophysics). A better balance or a better model should be explored.

Another problem that is strictly administrative has to do with how credit hours are used. A credit hour model is used in which credit hours are counted to make budgetary decisions and this seems counterproductive. Forcing students to take courses just to meet a mandated credit hour requirement is folly and not in the best interest of your students. In fact, the committee felt that fewer courses (credits) beyond the three required courses in biochemistry and the three required courses in biophysics should be required from the students so they can focus on their research as early as possible during their time in graduate school

The courses are continuously being updated. The core courses are in flux and they appear to be moving in the right direction. Yet, the biological sciences are changing, and there is room for growth and for more radical change in the curriculum. For example, biology is in the process of being transformed into a fully quantitative science. The students in the BBGP are inherently more quantitative than students in other biological science programs. They are ahead of the pack. In this sense the BBGP could play an increasingly important role fomenting more

quantitative thinking in related programs.

One area that deserves special attention is computation. It is in the BBGP's best interest to include computation as a requirement, and to offer courses in computing that students in other programs can take. This might create new opportunities for TAs, thus opening a new avenue for funding revenue to flow to the DBB and the BBGP. Introduction to computing need not involve anything beyond scripting with Unix, Python, Matlab or Mathematica, and introduction to the concepts of modeling and simulation. This could be done both at the graduate and undergraduate level, not just in one Department but across OSU. This would not be in lieu of the introduction to computing that students are exposed to in a more applied many in the research laboratory.

- **Recommendation #6: Standardize syllabi.** A standard format based on the minimum syllabus requirements outlined by OSU's Office of Academic Planning and Assessment should be used. (<http://oregonstate.edu/admin/aa/apaa/syllabus-minimum-requirements>).

- **Recommendation #7: Program competencies.** Program competencies should be listed on the BBGP website with web links to syllabi.

- **Recommendation #8: Assessment.** The committee recommends a more formal evaluation mechanisms, including the delivery of written assessments and recommendations to the students on a yearly or a biyearly basis.

- **Recommendation #9: Fix slash courses.** The utility and success of the slash courses should be examined to make sure that they work as intended.

- **Recommendation #10: Greater emphasis on computing.** The DBB is encouraged to develop courses in introduction to computing, to enhance the student's comfort level with computational and quantitation. If done right, the utility of these courses could expand beyond the boundaries of DBB and BBGP and become courses useful to students in other programs. This might provide a source of TAship revenue that would allow the BBGP to increase the number of graduate students in the program.

- **Recommendation #11: Minimize the number of courses required of graduate students.** In a Ph. D. program the real learning takes place in the research laboratory. The number of required courses should be kept in check, and under no circumstances should the number of credit hours be used to give shape to programmatic requirements. This is not in the student's best interests.

- **Recommendation #12: Course-sharing across OSU.** It was not obvious that the graduate students are taking full advantage of courses offered across OSU. This ought to be encouraged.

## PERSONNEL

- **Overview of the faculty.** The BBGP has a strong and productive faculty, many with high H-

index scores. The DBB has had 3 University Distinguished Faculty in the last 10 yrs. The role of the faculty varies depending on research support. Faculty with little or no external research support handle a major portion of teaching in the Graduate Curriculum, while research intensive faculty have reduced teaching loads. This is a reasonable distribution of effort but this is also a model that can diminish the ability of faculty to recover from a period without funding, so it should be kept in check. A recent review of NIH REPORTER list 6 of the BB as having NIH support totaling \$4.2M; some of these grants are for EHSC, equipment (NMR); while others are for RO3 and RO1 type grants.

• **The crisis in research funding:** The Chair and several DBB faculty indicated concerns with the level of research funding. Indeed, the greatest threat to the BBGP is the difficulty faced by some of its faculty to compete at a national level for extramural research support. The research in biochemistry and biophysics is capital intensive and despite a desire to obtain training grants to support graduate students, training grants would not allow the purchase of equipment or supplies or promote biochemical/biophysical research except by funding graduate students. The concerns with sustainability of research efforts are real and they are a nation-wide problem. It is estimated that in the last 10 years there has been a 25% reduction in inflation adjusted research dollars available to the NIH. This has had a significant impact on the number and size of grants funded (Rescuing US biomedical research from its systemic flaws, Alberts et al., PNAS 111, 5773-5777 (2014)). According to the U.S. Bureau of Labor Statistics the job market for Ph. D. graduates with training in biochemistry and biophysics was projected to grow by 19% between 2012 and 2022 (<http://www.bls.gov/ooh/life-physical-and-social-science/biochemists-and-biophysicists.htm>). This is a growth area and all expectations are that graduates of this program will be employed and able to practice their craft. We must not let the crisis in research funding interfere with our ability to train Ph. D. students in these areas.

• **Size of the faculty:** The administration believes that a Department is what it wants to be. Departments are given the choice between, for example, not replacing retiring faculty and using the funds instead to fund more graduate students. This feels like a zero sum game in which the faculty has to choose either to expand its ranks or to attract the necessary manpower to fulfill its research mission. The faculty does not believe the situation is as flexible as described by the administration. It does perceive it as a zero sum game.

The Chair and the senior faculty do not believe that the size of the faculty has to increase, but this might be simply a reflection of the fiscal reality the DBB lives in. However, the faculty feels very strongly that the size of the faculty has to be protected against dips in numbers. Apparently, retirees are often not replaced. The faculty felt that faculty who retire should be replaced through immediate hires, and this panel agreed with that position. If the administration is serious about wanting to enable growth and change to enrich and preserve its successful programs in one of its core units, then it must ensure that the personnel is available to allow the DBB and BBGP to fulfill its vision. It is not fair to ask whether to invest in faculty positions or in slots for graduate students to get the most out of investment. This should not be an either/or situation. The uncertainty with funding, the lack of funds, the lack of stability in the administration (vice-presidents change frequently) make planning into the future a problem. This is precisely why the Department should articulate a vision and a 10 year plan, and that plan should consider carefully what the size of the faculty should be. Modest growth should be

considered.

- **Pressures on the faculty:** In addition to the pressures inherent to the deplorable funding climate, faculty also have to deal with the increasing number of onerous and distracting administrative tasks, often the result of cost-saving cuts in other units of the University. When administrative duties increase alongside an increase in teaching loads and on training responsibilities, something has to give. The faculty feel that at OSU training is not rewarded, or not recognized for what it is. There are few incentives for the faculty to go the extra mile in search of research funding. Even banking in the form of 201 accounts, where excess grant support or overhead returns can be saved for a rainy day, is being discouraged as the administration views the 201 accounts as idle money that is not being used productively. The faculty do not feel well supported in other ways. The perception is that the University is shedding administrative support and passing on to the faculty secretarial duties that eat at their precious time. The faculty feel their time is being consumed by minutiae. This review panel thinks that the faculty need better, basic administrative support so they can focus more on the success of their research programs.

- **The young faculty:** The young faculty feel that the BBGP and the DBB are doing well and are very strong. The Department is very democratic and welcoming. Things work by consensus, with great openness about courses and general directions of the BBGP. They feel empowered in all important aspects of hiring and direction of courses and of the graduate program. They are aware that the level of funding was higher in the past and that there is pressing need to increase success in this area. They are burdened with the recruitment of the graduate students, an appropriate task given that its in their best interests, but one that can consume a great deal of time. They embrace the possibility of broader interactions with other programs so long as it is not at the expense of the sense of community. Seed money to get projects off the ground would buy a great deal of goodwill from the younger set.

- **Ranking and visibility:** There is no better way to increase the ranking and visibility of the BBGP than by strengthening the DBB by slight expansion of its faculty to colonize key areas of strategic interest, by a couple of high profile hires, by enabling the faculty to remain active in research even during years without funding, and by incentivizing them to be very aggressive in their search for research funding.

- **Recommendation #13: Stability and Size:** The size of the faculty in the DBB should be maintained or even allowed to grow modestly. Under no circumstances should it be allowed to become a smaller Department. Retirements should be handled with immediate replacement of the faculty. OSU needs to be very aggressive on this front. Even a one year hiatus on replacement can have a deleterious effect that lasts for years. Growth of the faculty cannot happen at the expense of an increase in the number of graduate students.

- **Recommendation #14: Impact hires:** To improve national visibility and stability, the next set of hires should focus on high profile and high impact hiring. Scientists with a strong national reputation need to be hired. It is initially expensive but it pays off by improving research support for the Department, enhancing overhead for the university, and increasing national prestige. This high level hiring should be guided by the 10 year strategic plan for the

Department.

• **Recommendation #15: Growth and synergy through increase in collaborations within OSU and beyond:** An organizational model that brings departments and graduate programs closer together should be promoted, perhaps with seed funding from COS. These collaborative interactions could lead to new research grants. Collaborations should not be limited to within OSU. U of O and OHSU might be available for partnerships. This should be explored, especially for growth in areas that require expensive instrumentation.

• **Recommendation #16: More aggressive attempts to raise research funds:** The faculty should be given incentives to be more aggressive in procuring research funds. 201 accounts are an example of the incentive that might be useful, but only so long as they are embraced by the administration as a saving device that is not held against the Department of individual. A reduction on the load on grants by graduate student stipends would be another type of incentive.

## INFRASTRUCTURE

With a few notable exceptions, the facilities for science research are very good and the faculty are pleased with the level of support. The campus has done well with capital campaigns and with the creation of new facilities. However, the faculty noted that vice presidents, not deans, manage the centers and institutes where much of the research infrastructure facilities are located; therefore, these facilities often do not receive the attention they deserve. There are some notable cases of core facilities that have to be better supported. Specialized and sophisticated core facilities essential for biophysics and structure biochemistry, such as X-ray crystallography and NMR spectroscopy, are not supported well by the administration. The faculty are pretty much on their own when it comes to support of these facilities, and that is certainly not the norm in the country. The faculty also noted that other core facilities get limited support. Others, like the CGRB, have state support, but that is not the norm. In general, during the discussion about research infrastructure, the faculty expressed the sentiment that the lack of support for some forms of research infrastructure is a strong message that research is not a priority at OSU, and that the administration is not really interested in stimulating research and success at the highest level.

On a minor note, it is also worth noting that the building has poor internet coverage making communication difficult, an unacceptable situation in this day.

• **Recommendation #17: Develop research infrastructure:** The creation of research infrastructure centers can help protect faculty from fluctuating income from grants and ensure their productivity even during dry years. The visibility of the BBGP, the DBB and OSU depends on the success of its research mission. One cannot perform state-of-the-art research without state-of-the-art research infrastructure and increasingly the cost of supporting research infrastructure will have to fall on the administration.

• **Recommendation #18: Improve internet access:** The internet in ALS does not work well in many locations. Fixing this relatively small problem should be made a priority.

## **ORGANIZATION SUPPORT**

- **Dean and College of Science Issues:** The Review Panel met with Professor Doug Keszler (Associate Dean of Research and Graduate Studies-COS) and Professor Sastry Pantula, Dean of COS. COS views the BBGP as a small but successful program. BB has the lowest number of graduates/year among COS graduate programs. The COS strategic plan (in progress) may involve increasing the size of BB. It is unclear if this involved increasing the undergraduate or graduate programs. The Associate Dean indicated that extramural support in BBGP was better than the College average. The Dean's office, however, takes income (overhead) and distributes to all programs in COS, rather than to the source of the money. This is viewed by the Chair, Prof. Merrill as a disincentive for putting in the large effort required to increase extramural funding level. The situation is exacerbated by the fact that other COS Departments receive more TAs per faculty than BBGP, for what appear to be purely historical reasons. There appears to be no systematic mechanism for savings, or bridge funds, or safety net for student support. Decisions appear to be done mostly in an ad hoc basis. Unlike other OSU-colleges, COS also does not provide Web support or help with grant writing, e.g., construction of the budget, help with Cayuse, etc.

We observed that the COS Deans and DBB leadership contradicted each other with respect to the role of returned overhead and with general funding models for BBGP. Dean Pantula's idea of growing the program (i.e. more students) is not fully consistent with the fact that faculty are having a particularly hard time obtaining extramural funding, that is, unless COS resources will be used to make BBGP grow. Given that this program has an above average funding level and is still small and needing more funding might suggest that 'growing the program' means either self-funding MS students or some kind of online program. Neither idea fits well within the current BBGP ethos.

- **Recommendation #19: Improve administrative support:** COS and BBGP need to work together to develop a strategic plan moving forward. This plan should focus on program quality and on a scientific vision and not numbers of students or number of faculty. But COS also needs to invest in administrative support. An office that focuses on grant writing and grant preparation, including preparation of budgets, is urgently needed. This is particularly valuable for large multi-investigator grants, but it is standard even for individual PI proposals at most universities. Dedicated administrative support to help submit proposals will increase the willingness of faculty to seek funding more aggressively.

- **Recommendation #20: Acknowledge and increase the visibility of research:** The standing, the ranking, and the perception about science programs, departments and research universities is determined primarily by the quality of the research activities and the success and visibility of its faculty. Training and teaching are essential components to success, but on their own they are not sufficient. COS has to be more pro-active about protecting the faculty from the increase in workload that comes from decreasing university support for administrative matters so they can dedicate more quality time to their research. It also has to keep the balance between teaching and research at the right level. The COS has to do everything it possibly can to ensure the success of its research-active faculty, and to encourage and support the faculty who are not funded but who are trying to stay active in hopes that they will become funded. The budgetary priorities suggest that many decisions are being made without acknowledging what it takes to

support research at the highest level.

## **PRODUCTIVITY**

The data provided in the self-study show clearly that in terms of metrics related to success in training, the BBGP is very successful. The students publish their work in top peer-reviewed journals and they go on to successful careers in science

The faculty is clearly very involved with training. This shows in the quality in the accomplishments and in the way the graduate students feel about the program. It shows in their ability to attract top students to the BBGP. The issues that work against faculty productivity have already been described. Perhaps the single most important thing is to encourage the faculty to submit more grant proposals, and to protect faculty who are not funded from having to pay for their situation through a heavy teaching load or administrative responsibilities.

• **Recommendation #21: Improve ranking through research:** An increase in research productivity will increase visibility and ranking. More efforts should be dedicated towards acknowledging the role of research as an important component of education. There is no other more effective or permanent way of effecting change in ranking. The teaching loads have to be reasonable else the research mission will suffer. It is especially important to protect young faculty who are having a difficult time getting funded. Weighing them with an unreasonable teaching or administrative load will minimize their chances of ever being funded.

## **STUDENT SATISFACTION**

The Review Committee met with a large number of BBGP students (>15). This was an extremely positive and uplifting meeting. The graduate students were unanimously and strongly positive about the program. They described the program as “a welcoming place”, as a closely knit community in which the small size of the laboratories enabled many one-on-one interactions, enough that they felt they knew everything about the program and even what went on behind the scenes. Without exception they were happy with their choice and happy with the expected outcomes. They were satisfied with the oral preliminary exam process and they found to be well prepared for the exam. They very much enjoy their interactions with the faculty and the opportunity to work with them. Many (if not all) graduate students have read the BBGP handbook. The students are aware of each other’s research. They know each other well. There is free communication amongst students and faculty regarding research. There is also communication with students from other programs. They have ample opportunities to talk informally with faculty and to give presentations. The BBGP students are involved in recruiting and their positive and enthusiastic outlook is the likely reason behind the recent recruiting success. The Program has had some success with recruiting more minority students, but not enough, and although the students are aware of the situation, they understand that it is not easy to recruit students from under represented minorities to rural Oregon (i.e. OSU). The Department is also working very hard to increase the diversity of its faculty. The students do not enjoy taking courses with undergraduates (the problems with the slash courses were described elsewhere). They also were disappointed with the absence of enzymology in the curriculum, something that can be remedied easily if it fits within the scope of what the training faculty deem essential. Students have to go out of the Program to take some upper level courses but they did not seem to

be as aware of opportunities outside the Department as they should be. Many thought that they have to take too many courses. Many are not fans of the journal club because they get to present work unrelated to their research, but that opinion was not unanimous. They responded favorably to the suggestion that a course in Introduction to Computing should be instituted.

The high graduation rates (> 90 graduate within 5.7 years of entering the program), the rate at which they publish in peer-reviewed journals, and the ease with which they find postdoctoral positions in top labs demonstrate that the BBGP students are very successful. It was surprising, however, that no information was provided about the student's attendance/presentation at national meetings in biochemistry or biophysics although the students did mention in the interview that they have opportunities to attend meetings. Equally surprising was the absence of information on student membership in key discipline-specific national societies, such as American Society of Biochemistry and Molecular Biology, and the Biophysical Society. Involvement in societies can play an important role in professional development, including networking, and students should be encouraged to become society members. The students expressed concern that they do not receive adequate information on career planning.

The faculty has very good interactions with the students, and that probably contributes to the positive and friendly atmosphere of the Program.

Many of Recommendations #1 - #21 will impact the graduate students in a very positive manner. Two additional ones:

- **Recommendation #22: Be more proactive with career planning:** Students need to be helped with career planning in a more organized manner. New directives from NIH requirements for Individual Development Plans should help the faculty figure out what type of guidance might help the students..

- **Recommendation #23: Encourage students to join professional societies:** Professional societies need to be stronger than ever so they can be an effective voice in support of research and education. Students should be encouraged to play a bigger role in science beyond the confines of OSU and joining a society is a good starting point.

## **OUTCOMES AND IMPACTS**

Of the 92 students who entered the program in the last 10 years, 23 are current students, 20 are professors, senior scientist or instructors, 25 are post-docs or faculty research assistants; 12 are in industry and 12 are in other positions. This is outstanding and comparable to the outcomes of the top graduate programs in the biological sciences in the country.

The graduates of the BBGP and the current students are extremely satisfied with their educational experience at OSU and they are very well prepared for future employment.

The BBGP ranks 92 out (50.27%) of 182 programs in biochemistry (Academic analytics). This ranking is a comparison to programs in land grant as well as biomedical/medical schools. Rankings are based mostly on faculty productivity.

- **Recommendation #24: Raise the profile of the DBB and the BBGP:** A regular symposium at OSU should be organized to raise the profile of the program nationally and within OSU. A two day symposium with high profile national speakers would bring immediate attention to the Department. It is worth emphasizing again that the Department has a very good reputation and it is recognizable owing to some of the past and current faculty. This can be taken to the next level with an annual symposium. Oregon is beautiful in the Spring, at a time in which large swaths of the country are shrouded in winter. Capitalize on that. Bringing scientists to campus will have a very positive impact on students and will even help with student recruiting. This could be done in collaboration with the Pauling Center. Industrial funding would be ideal.

#### **4. CONCLUSION AND RECOMMENDATIONS FOR IMPROVEMENTS.**

The administration, the faculty and the students believe the DBB and BBGP are strong and doing well. Biochemistry and biophysics are areas of knowledge that are growing and central to the main scientific questions of our time. The Department and the Program can play an increasingly important role in science at OSU. They are poised to do just that. But a little bit of tweaking will be necessary. The Department has to develop a long-term strategic plan. The plan has to be centered on the DBB and on the BBGP, but it must acknowledge linkages to other units of OSU. The plan should guide potential growth of both the DBB and the BBGP. The Department's desire not to grow much should be respected as there is much to be said about the intellectual and social cohesion that comes from being relatively small. But some growth, guided by the vision articulated in their long term plan, would allow it to be stronger, to be better protected against the vagaries of the funding climate, to be more directly connected with the most pressing questions in the field, and to be protected against the fluctuations related to retirements and funding dry spells. Hiring high profile faculty is recommended because it will help raise the visibility and profile of the DBB and of OSU. It might seem expensive, but it can pay off handsomely. A funding mechanism has to be put in place that reduces the load from graduate student stipends and tuition on research grants. The model should maximize the way in which funds are spent to sustain research activities at the highest level possible. The BBGP appears to be underfunded and increased support from the administration for graduate student stipends without this coming at the expense of, for example, growth of the faculty, seems unavoidable. The faculty needs to be given incentives to be more aggressive in their search for research funding. The Department and the Program can play an important role in bringing down the barriers and boundaries between programs without starting turf wars. The COS should enable this process by getting the faculty on board and begin by contributing resources to jump start collaborative projects that can lead to new research programs and research grants. The BBGP is as good as any of the best training programs in the biological sciences in the country and OSU should capitalize on what the faculty in DBB have achieved with this program.