

Materials linked from the November 4, 2015 Curriculum Council agenda.

*Undergraduate Program in Biochemistry and Biophysics*

*Action Plan Following 2015 Decennial Review*

*Developed by the faculty of the  
Department of Biochemistry and Biophysics  
with the action plan largely prepared by:*

*Indira Rajagopal, Senior Instructor II*

*[rajagopi@onid.oregonstate.edu](mailto:rajagopi@onid.oregonstate.edu)*

*Andy Karplus, Professor of Biochemistry & Biophysics and Department Head*

*[andy.karplus@oregonstate.edu](mailto:andy.karplus@oregonstate.edu)*

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## **Introduction**

*The undergraduate academic program of the Department of Biochemistry and Biophysics at Oregon State University was reviewed on March 4-6, 2015 by two external reviewers, Dr. Buddy Ullman (Department of Biochemistry and Molecular Biology, Oregon Health and Science University) and Dr. Shelley Copley (Department of Molecular, Cellular, and Developmental Biology, University of Colorado Boulder), and two internal reviewers, Dr. Jeff Gautschi, (Department of Chemistry, OSU-Cascades) and Dr. Tasha Biesinger (Department of Microbiology, Corvallis Campus). Dr. Biesinger also represented the Faculty Senate Curriculum Council.*

*We would like to begin by expressing our appreciation for the work of the review team. Their insights and thoughtful comments will greatly assist in strengthening our undergraduate program, by identifying both issues of concern and new opportunities. Their review document includes some specific recommendations. This Action Plan document describes our plans for addressing these recommendations to improve the quality of our program.*

*The review included six primary recommendations/suggestions for improvements. These were:*

### **Recommendations:**

- A. *The proposed creation of a Biochemistry and Molecular Biology (BMB) major was considered to be an excellent and timely idea. The committee recommends the use of "Biochemistry and Molecular Biology" for the planned Category I proposal for this degree, rather than the current title "Molecular Biology."*
- B. *The attrition of BB majors throughout the curriculum is a rising concern. Although current data are based on the relatively small cohort of students in the current BB major, steps should be taken to assess reasons for the attrition. It would be reasonable to provide resources to address the underlying issues prior to the expansion of the department's degree offerings.*
- C. *The department should maintain its efforts to provide the majority of its undergraduate students with research opportunities even as the new BMB degree program brings additional students to the department. The department's initial efforts to meet this challenge via two alternative, discovery-based laboratory courses that provide independent research opportunities are promising and should be expanded to include additional courses.*
- D. *Teaching assessment for the BB degree needs to be strengthened, and teaching assessment for the proposed BMB degree should be integrated as the department develops the program.*
- E. *The department should provide students with more information about alternative careers in science beyond graduate and medical schools, especially for students who may be interested in job placement immediately following receipt of their bachelor's degree.*
- F. *The current model of governance within the department, including the chair position, committee structure, financial organization, and faculty representation, is effective and is important to the current departmental culture. The current governance model is well-supported by the faculty and touches on all academic missions of the department, including undergraduate education. The department should maintain these qualities and avoid disruption caused by changes to the model.*

## ***Plan of Action to Address Review Panel Recommendations***

*For each recommendation, we quote the recommendation, then provide a response followed by a list of our objectives in addressing the recommendation, the discrete actions we will take and the outcomes we will measure to assess our success.*

### **1. Recommendation A - Biochemistry and Molecular Biology Major**

*The proposed creation of a Biochemistry and Molecular Biology (BMB) major was considered to be an excellent and timely idea. The committee recommends the use of "Biochemistry and Molecular Biology" for the planned Category I proposal for this degree, rather than the current title "Molecular Biology."*

***Response:*** *We agree with and appreciate this recommendation.*

***Objective 1.1:*** *Obtain approval for the new Biochemistry and Molecular Biology (BMB) major*

***Action 1.1:*** *The Category I proposal has incorporated this suggested name change, and will be submitted in AY16. We will also submit as part of the Category I proposal the text from this program review as support for the new major.*

***Success Metric 1.1.*** *The BMB Category I proposal will be submitted for Liaison during the Fall 2015 term and approved by June 2016.*

### **2. Recommendation B – Attrition of Majors**

*The attrition of BB majors throughout the curriculum is a rising concern. Although current data are based on the relatively small cohort of students in the current BB major, steps should be taken to assess reasons for the attrition. It would be reasonable to provide resources to address the underlying issues prior to the expansion of the department's degree offerings.*

***Response:*** *Our advisors interact extensively with our majors and we know from those conversations that some reasons students leave the major are: (a) poor performance or low interest in freshman mathematics courses, and recognition that the BB major requires further advanced math courses. (b) poor performance or low interest in sophomore year calculus-based physics, and (c) recognition that career plans could be better pursued with a different major for a variety of reasons. These include learning more about other majors compatible with students' long-term goals and/or changing personal goals and/or recognizing that another major would allow the taking of more diverse classes and/or would allow them to attain a higher GPA. The report stated that the poor performance in mathematics should not be a major factor for students to leave the major, because other biological science majors also require calculus; however, this reflects a misunderstanding, as the requirement of the Biochemistry and Biophysics major for four terms of calculus is a much larger mathematics requirement than the two terms of calculus required for the Biology, Zoology, and Microbiology majors. Students also are aware that besides simply having to take additional advanced mathematics classes, there are other courses in the BB major, such as physical chemistry and biophysics in which their performance will depend on a strong foundation in mathematics. This is in contrast to the other life sciences majors, in which there is less further need for mathematics after the initial calculus courses.*

*Despite having this feedback from students, we do not fully understand why students leave the major and we agree it is worthwhile for us to assess the reasons. Nevertheless, we will not postpone*

*our work to gain approval to offer the BMB degree, because having the new degree option should actually help the attrition problem by providing an alternate path more suitable from the start for students with certain interests, goals and aptitudes. Our exit surveys of seniors graduating in the BB major have consistently shown that many students who chose the BB major would have preferred a degree in the molecular life sciences that did not focus as heavily on the mathematical and physical sciences as BB. The lack of such a molecular life sciences program has left students with such interests with little choice but to transfer into other available options such as Microbiology or Biology. If we provide such a choice to incoming students in the form of the BMB degree, more students will be able to enter a program that is better aligned with their interests from the start, thus reducing attrition. We have also recently (AY14) instituted a peer mentoring program that we expect will help students have a positive connection with BB students further along in the major, so there is less chance students will transfer out of the major for reasons of lack of community.*

**Objective 2.1:** *Learn about the reasons that students transfer out of the BB major.*

**Objective 2.2:** *Improve advising in ways that we think will enhance positive outcomes for all students.*

**Action 2.1** *Develop and institute, with support of College of Science Head Advisor, an anonymous survey at the end of each academic year to ask all students that have transferred out of the BB major during that academic year about reasons they left. This will be carried out and the results provided to us for 3 years for us to evaluate and decide subsequent actions.*

**Action 2.2:** *Advisors will keep records of all conversations with students who indicate that they wish to change their majors, indicating why the students are changing majors. These will be emailed to the Head Advisor, and at end of year they will be included in our discussion and evaluation process.*

**Action 2.3** *Interview head advisors for Biology and Microbiology majors to learn their impressions of reasons students leave the BB major and transfer to their major.*

**Action 2.4.** *We will obtain and review data as it becomes available from the Student Success Collaborative about how performance in prerequisite courses correlates with success in the BB major. We will incorporate these results into our advising so we can provide factual information that helps students understand what levels of performance are associated success in the major along with encouraging students toward achieving success.*

**Action 2.5.** *Using an assignment in BBIII we will have students articulate their reasons for choosing the BB major. This will help freshmen in their first term at OSU reflect on their choice of the major and how it fits with their long-term goals. Then each Spring before their advising appointment we will have students write a brief statement of current career goals and a self evaluation of the year that is ending.*

**Success Metric 2.1.** *We will have the three years of data from actions 2.1 and 2.2 and 2.4 and records of annual meetings and decisions based on those meetings.*

### **3. Recommendation C – Research Opportunities**

*The department should maintain its efforts to provide the majority of its undergraduate students with research opportunities even as the new BMB degree program brings additional students to the department. The department's initial efforts to meet this challenge via two alternative, discovery-based*

laboratory courses that provide independent research opportunities, are promising and should be expanded to include additional courses.

**Response:** *The additional students associated with the BMB major will indeed provide us a challenge in terms of promoting undergraduate research experiences to the same level we have been able to achieve for BB majors. However, in our view, the greatest limiting factor will be funds to support students to work in labs, and not the small number of BB faculty that could provide a research opportunity. This is because the research opportunities for BB and BMB undergraduates is not limited to BB faculty, but involves life science faculty across campus. Also, since the BMB major will be drawing largely from students who would likely otherwise be in another life science major, many of the students would have been doing research on campus as a part of that major and would not represent a large increase in the need for research opportunities. Regarding internships, we do currently provide by email to undergraduates any internship opportunities of which we become aware and we will continue to do this. We also specifically match students with suitable outside opportunities for which they will realistically be competitive. As not all BMB students will want a long-term research experience as part of their program, it may be that through the on- and off-campus research internships made available, plus the BB/BI315 and BB 494 research-based lab courses that all BMB students will take, we will be able to meet the needs of the BMB majors. For this reason we will not first create new classroom based experiences for which additional personnel and funding will be needed, but we will monitor the number of students who participate in research, and assess after three years if more opportunities are needed.*

**Objective 3.1.** *Gather accurate information about current participation and resources used for undergraduate research experiences of BB majors.*

**Objective 3.2.** *Increase the number and awareness of research opportunities available to students.*

**Objective 3.3.** *Increase funds available to support UG research*

**Objective 3.4.** *Equalize access across URM groups to UG research experiences.*

**Action 3.1.** *We will initiate in AY16 clear quantitative tracking of numbers of BB (and in future years) BMB majors having undergraduate research experiences both in research-based lab courses and in research laboratories, and will include URM status in this tracking.*

**Action 3.2.** *We will look into formal partnerships that already exist with overseas institutions that include research internship opportunities. For those that are suitable for BB/BMB majors, we will advise students of opportunities and encourage them to apply. We will also, per Action 5.3, seek Oregon bioscience industry partnerships that will include new UG research internship opportunities.*

**Action 3.3.** *Prioritize UG research support as an OSU Foundation fund-raising goal so as to expand the pie, and seek to increase E&G funds budgeted for that purpose.*

**Action 3.4.** *As started last summer, having some UG research support funds dedicated for URM students.*

**Success Metric 3.1.** *We will have annual records with accurate numbers of UG research experiences and URM participation. We will also capture faculty, staff and graduate student mentoring time involvement.*

**Success Metric 3.2.** *By Fall 2018 we will have in place five new partner institutions and/or bioscience companies that provide UG research opportunities to BB and BMB students.*

**Success Metric 3.3.** A Department Newsletter will be sent out this academic year that features UG research experiences of students and promotes UG research as a prioritized philanthropy opportunity. By Fall 2017 we will have worked with the OSU Foundation to develop a concrete pitch for UG research support that is being actively communicated to potential donors.

#### **4. Recommendation D - Assessment**

Teaching assessment for the BB degree needs to be strengthened, and teaching assessment for the proposed BMB degree should be integrated as the department develops the program.

**Response:** We recognize the need for more direct assessment methods throughout the BB program. Our undergraduate program was accredited in spring of 2015 by the ASBMB, the major professional society for biochemistry and molecular biology, allowing us to perform a summative assessment by having graduating BB seniors take the accreditation exam administered by the ASBMB. The BB program of study is structured such that students in their freshman and sophomore years do not take any core BB courses, except for the freshman orientation course, instead spending their first two years taking basic chemistry, mathematics, biology and physics. This makes it difficult to implement assessment at every level of the program. It is, however, possible for us to institute better assessment for the BB core courses that are taken starting in the junior year. For direct assessment while students are moving through their junior and senior years, we propose to create pre- and post-tests for each core course taught in both the BB and the new BMB major. This will allow us to measure student learning in the courses and provide us with information that can be used to improve our courses through full-cycle assessment.

**Objective 4.1:** Institute a direct assessment method for every BB and BMB major core course.

**Action 4.1.** Except for those courses already having a benchmarked direct assessment mechanism, develop a pre- and post-test with defined target benchmarks for each core BB/BMB core course. These tests will be developed by the course instructors and the curriculum committee, and the results obtained from administering these tests will be used to carry out full cycle assessment.

**Action 4.2.** Create a one-credit course for all BB majors to take ASBMB Certification exam and have it added as a requirement for the major for subsequently entering students.

**Action 4.3.** Seek ASBMB accreditation for new BMB degree, and when obtained add the certification exam as a one-credit course that is required for the BMB major for subsequently entering students.

**Metric of success 4.1.** All courses have pre-post tests developed by Spring 2016 for starting use in Fall 2016. And "full-cycle" assessments will be carried out and documented for AY17, AY18 and beyond.

**Metric of success 4.2.** ASBMB Certification Course will exist and increasing numbers of BB students will take the ASBMB exam in AY17, AY18, AY19 with all students taking it in future years.

**Metric of success 4.3.** ASBMB accreditation will be achieved within one year of BMB major being approved and certification exam course added as a requirement within one year after that.

## **5. Recommendation E – Increase Awareness of Broader Career Options**

The department should provide students with more information about alternative careers in science beyond graduate and medical schools, especially for students who may be interested in job placement immediately following receipt of their bachelor's degree.

**Response:** *While the majority of students entering the major indicate an interest in further professional training after college, we agree that expanding student knowledge of careers besides research and the health professions is valuable. The College of Science has recently hired an Assistant Director of Career Development, who can help us provide our students with more information in this area. An area of interest to students who wish to enter the workforce directly after college is jobs in the state or federal laboratories and the biotechnology and pharmaceutical industries. Other options include science writing, teaching high school or working in business. We already discuss a range of career options in BB317, and provide students with guidelines on how to create resumes and apply for jobs.*

**Objective 5.1:** *Provide more information to students on career opportunities related to this major, including additional opportunities for students to interact directly with people in those careers.*

**Action 5.1.** *Invite as part of our seminar series or on other occasions, speakers in non-academic positions like biotech industries or state or federal research labs (e.g. USDA, EPA) and hospitals, to schedule time with undergraduates. Also include those in non-research careers such as science writing, law, business, and education.*

**Action 5.2.** *Have the new College of Science Assistant Director of Career Development or designee provide concrete resources to students in the BBIII course, and include one assignment requiring students to explore at least one non-academic/health professional BB-related career possibility.*

**Action 5.3.** *Identify regional industry partners with employees willing to interact with and be resources for our students.*

**Metric of success 5.1.** *At least one seminar per year starting in AY17 involving someone with a non-academic job and including time in their schedule for that speaker to meet for a Q&A with a broad group of undergraduates*

**Metric of success 5.2.** *Starting in AY17, BBIII will each year include specific Career Awareness assignment and at least one speaker in a non-academic career.*

**Metric of success 5.3.** *By Spring 2018 we will have formal partnerships with at least 5 regional bioscience companies, federal/state laboratories, or other potential nonacademic employers of students trained in BB/BMB that include opportunities for internships and/or tours and/or sending a representative to campus to interact with our students.*

## **6. Recommendation F – Departmental Governance**

The current model of governance within the department, including the chair position, committee structure, financial organization, and faculty representation, is effective and is important to the current departmental culture. The current governance model is well-supported by the faculty and touches on all academic missions of the department, including undergraduate education. The department should maintain these qualities and avoid disruption caused by changes to the model.

**Response:** *We agree that the current governance model works well, but we also recognize that some aspects of the formal governance structure are defined by the Dean – such as whether the department is led by a “Head” or a “Chair.” We recognize that the important essence of this recommendation is how we work together to define and accomplish our mission (i.e. the department culture), and not the titles. So we will do what we can to maintain the positive and effective aspects of our department culture. Toward this goal, the newly appointed Department Head (Andy Karplus) committed during the interview process that despite the title change from “Chair” to “Head” he would respect the current by-laws of the department and would not change the way the faculty meetings are run and departmental policy decisions are made. Despite the current structure functioning well, we are also aware that we must always be looking for opportunities to improve how we do our business, and expect that the new School of Life Sciences will allow for some positive new initiatives and collaborative arrangements that serve to build on and improve the positive aspects of our department culture. Most aspects of the department’s financial organization are also decided on at the College level and are influenced by resource availability. We are committed to delivering the best undergraduate program we can given budget constraints as well as working with the college to lobby for policies and structures we think will be most conducive to maintaining a strong undergraduate program.*

**Objective 6.I:** *Maintain well-functioning aspects of department governance structure while adjusting to changes required by the higher administration.*

**Action 6.I:** *Communicate this part of the report to the Dean and the importance of maintaining a collaborative departmental culture and the importance of having some discretionary funds and the academic flexibility that that enables.*

**Metric of Success 6.I.** *Success that we have been able to strengthen our program whatever structures are decided on will be seen indirectly through our performance in achieving the various metrics specified above.*