DATE: January 17, 2011
FROM: Rodney A. Erickson
TO: Daniel J. Larson
SUBJECT: Core Council Recommendations Regarding the Eberly College of Science

The Academic Program and Administrative Services Core Council ("the Core Council") has discussed the recommendations received from Susan Welch, Chair, on behalf of the University Park Academic Review Coordinating Committee (UPARCC) regarding the Eberly College of Science (ECoS) programs and operations, and the background information you have provided about the College, its successes, and its challenges. The Campus Academic Program Review Coordinating Committee (CAPRCC) also reviewed curricular and operational matters that might affect one or more campuses and these comments were taken into consideration in the formulation of the UPARCC recommendations to the Core Council. The purpose of this memo is to share with you the response of the Core Council to various Eberly College of Science organizational, operational, and curricular issues and initiatives, and to make recommendations for such further changes based on the analysis and deliberations of UPARCC and the Core Council. I should also state for the record that you did not participate in the deliberations of the Core Council regarding recommendations for the Eberly College.

The Core Council commends the College for its overall academic excellence. We note the phenomenal strides the College has made over the past decade in the quality of its graduate programs as reflected in the recent National Research Council evaluations. It is clear that most ECoS doctoral programs are among the most elite in the nation. The Council also recognizes the substantial contribution of the College to the undergraduate instructional and research mission of the University, with high enrollments and a broad array of science, mathematics, and statistics courses delivered as a foundation for a wide range of baccalaureate majors and general education requirements.

By our measures, the College is relatively efficiently organized, with a low administrative cost relative to instructional cost. The faculty are highly successful in securing external funding, and the College’s research expenditures are over $90 million annually. ECoS has made a significant investment in World Campus programming and begun to generate a significant revenue stream. As we elaborate below, we think the College can move further and more quickly along the path to streamlining.
Recommendations:

1. Greater Coherence in the Biological Sciences Areas

Despite the outstanding ratings of Biology and the improved ones for Biochemistry and Molecular Biology (BMB), Penn State still underperforms in the life science areas. For example, we are 51st in federal funding for the life sciences compared to our overall science and engineering expenditures ranking of 11th and ratings in the top 15 in Chemistry, Physics, Engineering, Agricultural Sciences, Earth Science, and many of the social sciences. Furthermore, the organization of our graduate programs in this area can appear confusing to an outside observer. There are a number of reasons for this. Although several of the causes lie outside the Eberly College, the College is in a position of strength to play a major role in improving our standing in this important area, an essential step given that attracting excellent graduate (and undergraduate) students is necessary for building a top research program.

UPARCC did discuss whether it would improve quality or efficiency to merge the departments of Biology and BMB, a move that you did not support. The Core Council concluded that there was not a lot to be gained by merger of the departments themselves, but much to be gained by rethinking the organization of biology degree programs inside and outside the College.

Both BMB and Biology have large undergraduate enrollments and carry a large general education load. The Biology major, with six different options, has fluctuated between 430 and 610 majors during the past 20 years, and now has 500 majors. BMB enrolls about 150 majors in its baccalaureate degree, with two separate options. BMB also offers the Biotechnology degree, a growing area of interest with about 110 current majors, and Microbiology, a shrinking area of interest with less than 60 majors, about half its peak enrollment. BMB and Biology have similar numbers of tenure line faculty (32 and 35, respectively) and a much smaller number of fixed term faculty members on instructional budgets (9 and 8, respectively).

Both BMB (and its graduate program BMMB) and Biology award a significant number of Ph.D. degrees. Within the past four years, BMMB awarded 46 doctorates and biology 36. In addition, however, each was responsible for other Ph.D.s awarded through the intercollege graduate degree programs (IGDP), programs in Plant Physiology, Ecology, Genetics, Plant Biology, and Neuroscience, among others. In total, there were 16 such degrees supervised by BMB faculty and 33 by Biology faculty. These numbers seem quite robust, and yet, in Fall 2009, 33% of BMB’s graduate courses were under enrolled; in Fall 2008, 50% of Biology’s graduate courses and 40% of BMB’s were under enrolled.

While roughly the same size in terms of faculty numbers, BMB teaches far few students than Biology and has many fewer majors, though its faculty bring in more external funding.

The Core Council recommends that you charge the Departments of Biology and BMB to critically and collaboratively examine their array of undergraduate majors, options, and courses with the goals of rationalizing, modernizing, and streamlining the curriculum, and enhancing opportunities for students in these two departments as well as for the many students in other majors who take these courses. Given that Plant Science is one of the options in the Biology major, there should also be some communication with those involved in the restructuring of the plant science major in the College of Agricultural Sciences (the Dean has recently launched those conversations among plant scientists there).

2. Life Sciences at Penn State

The graduate programs in Life Sciences pose a bigger challenge and reach well beyond the Eberly College of Science. As you know, about a decade ago, in response to the rather outdated and mostly stand alone biological science graduate programs across the university, the Huck Institute (or the Life Science Consortium, as it was then known) developed a program of Integrative Biological Science graduate degrees, called IBiOS. Spurred by new Consortium funding for graduate students, interdisciplinary faculty groups (including faculty from ECoS, the College of Medicine, Agricultural Sciences, and Health and Human Development primarily, but also including Engineering, Liberal arts, and Earth and Mineral Sciences) launched new IBiOS degrees in numerous fields including Bioinformatics, Immunology, Chemical Biology, Neuroscience, and other specialized areas. These new programs were a major step forward in breaking through disciplinary silos, encouraging cross-college collaboration, and highlighting developing biological science expertise at Penn State. On the other hand, not all the programs were strong programs or had significant faculty engagement, and there was some overlap with existing departmental programs.

In the years since, some programs have been moved to academic departments where they have met different fates. Some have been colonized by their home department and no longer are interdisciplinary or even functioning. For example, the interdisciplinary Neuroscience program, has given only two University Park degrees in the past five years and recruited no students for the 2010-11 year even though Neuroscience has been identified as a University priority. Other programs have become orphans, existing at the sufferance of a few sympathetic faculty. Some are weak and small, some are strong. Some still duplicate departmental programs or seem to duplicate each other.

In total, the configuration of biological science programs presents a chaotic picture to potential students thinking of Penn State as a place to take a graduate degree. We have three types of life science degrees: those sponsored by departments (e.g., Biology in Biology); those that are intercollege but which are housed in line departments (e.g., Cell and Developmental Biology, Neuroscience, and Molecular Medicine), and those IGDP’s whose home is the Graduate School (e.g., Genetics and Ecology).
Moreover, funding streams for the intercollege programs, even those whose “home” is a department are unclear. Often, departments treat these programs as competitors for resources rather than integrating them into their own graduate support streams.

We need to lift this discussion to a higher level and give it a clear charge and direction. In collaboration with Hank Foley, I will appoint a high level task force to recommend a reorganization of life science graduate programs. Some possible parameters of the charge would be that that duplicative and weak programs should be merged or dropped; that the final array of programs should be understandable to students seeking to matriculate at Penn State in the life sciences; that departments get official credit in enrollment and degree counts for those degrees supervised by their faculty; and that some rationalization of existing central funding for what are now IBIOS and intercollege programs be accomplished. UPARCC tilted toward the belief that that programs are better off located in departments even if they are interdisciplinary and intercollege in terms of faculty participation, but the committee focused on this charge can examine this in a more deliberative manner. Some of these free standing degrees, such as neuroscience, might be better positioned as dual title degrees. Rationalizing these graduate degrees alone will not raise our standing in this vital area, but it should help. We understand that there are initial conversations about potential reorganization of the life sciences graduate programs taking place among the participant colleges, and we encourage this dialogue.

The Council urges you and your colleagues in EcoS to take a strong leadership role in the reorganization of these programs given the acknowledged strength of your faculty and programs that are core to the life sciences. The growing presence of faculty from the College of Medicine at UP in the coming years also represents a unique opportunity to re-envision (and collaborate on) what could be possible in the area of life science graduate education at Penn State.

3. Rationalizing Mathematics and Improving Foundation Course Instruction

Despite the fact that universities continually create new knowledge, academic departments evolve slowly. One outcome of this is that departments that grew to a large size in earlier eras to serve particular needs tend to remain large even when needs and opportunities change dramatically.

Mathematics is an example. The department has 51 FTE tenure track faculty, about one-quarter of the tenure line faculty in the ECoS. Among its peers, it is slightly below average size (within the CIC public institutions, the sizes of mathematics FTE range from 38 to 66, with a modal size of 58 faculty). These departments are large primarily because, in earlier eras, tenure track faculty and their graduate students taught algebra, calculus, and other beginning mathematics courses.

Now, however, while graduate students still play a significant role in instruction, the department employs about 30 full-time fixed-term faculty plus other part-time faculty to teach lower-level math courses. While the Mathematics Department teaches 72,000 student credit hours (SCH) annually (2008-09 data), tenure line faculty teach only about 13,000 of those SCH’s in a department with about 200 undergraduate majors,
100 graduate students, and a funding record that is very good by disciplinary standards but far less than other departments in the College. We imagine that other university review committees are making similar observations.

The academic strength of the Department of Mathematics is confirmed by the recent NRC ranking between 5 and 26 in the dimension of research productivity (Math was fourth of 127 programs in publications per faculty), and we know that reputational rankings can be positively correlated with size. Nonetheless, this is no longer a sufficient rationale for faculty sizes that exceed their workloads relative to other departments in an era of increasingly scarce resources.

There have clearly been much-needed improvements in basic mathematics instruction over the past decade, but a faculty as large and talented as this one should be devoting even more time and resources to the introductory mathematics program. An issue of significant concern is the high failure rate of students in introductory mathematics courses, particularly in algebra and introductory calculus. These are critical courses for beginning students across the University. An appropriate level of mathematical reasoning ability is certainly a foundation for an educated person and a successful career. We recommend that the concepts, aims, and operational designs of these courses be evaluated and their impact on student learning and knowledge be independently assessed. The goal should be to enhance student success while keeping expectations high.

Strategically rationalizing Mathematics, preserving the strong faculty and building in key areas of strength, but de-emphasizing more marginal areas, will improve an already strong department. This would include encouraging the faculty to focus on fewer areas, and more on subfields where Penn State faculty are among the world’s best.

Finally, as noted in Section 7 below, the Core Council recommends that the Department should seek to take advantage of opportunities for providing courses/programs and earning revenue through the World Campus.

### 4. Improve the Quality and Increase the Revenue for Forensic Science.

Forensic Science has emerged from a set of unique opportunities and circumstances. It is now recognized as among the best in a small cohort of such programs nationally. It is a costly program to deliver with substantial laboratory and facilities expenses and small class sizes. A high proportion of its class sections continue to be under-enrolled. In addition, the quality indicators of its undergraduate and graduate students are not as high as those of other programs in ECoS. We recommend that the Forensic Science program be reviewed in 2012 with an eye toward increasing its enrollment, the quality indicators of its students, and ways in which the program can be delivered more cost effectively without compromising program quality. You may also want to explore the feasibility of locating the Forensic Science degrees within an existing academic department. One important opportunity for this unit is online delivery, taking advantage of

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Although the NRC claims the S ratings, cited above, are not very closely related to size.
opportunities for interdisciplinary collaborations. The College is developing an interdisciplinary online certificate program in Forensic Science that is already generating revenue. The certificate targets judges, attorneys, investigators, and other non scientists in the criminal justice system who need some understanding of forensics. You may wish to evolve this certificate program into an online Masters of Professional Studies degree that could generate significant revenues to help offset the high costs of the residential program.

5. Eliminate Small Degrees

Most of the college’s degrees are reasonably well enrolled. Among those that are not, the College is dropping the M.Ed. in Math (which has awarded one degree in the past five years) and the M. Ed. in Physics (which has awarded two) and is working with the College of Education to develop Integrated Undergraduate-Graduate (IUG) programs in these areas.

The College offers a B.A. in Science, with only four degrees awarded since 2004. The M.A. in Statistics, with only two degrees awarded since 2004, and M.S. in Astronomy, with six, are other undersubscribed degrees. We recommend the College drop the B.A. in Science and continue the M.S. in Astronomy, given that the latter is a consolation degree for those who do not proceed to the doctorate, and add no appreciable costs to program delivery. The Council would like more information on the rationale for the tiny M.A. in statistics because it appears that the M.S. there is the consolation degree.

6. Reduce Under-enrolled Courses

The College has one of the best records of any unit in managing under enrollment. In Fall 2009, ECoS under-enrollment of 5.1% was roughly half of the UP-wide proportion, and the same is true of their 8.7% under-enrollment at the graduate level. In Spring 2010, like most colleges, their under enrollment went up slightly overall, but it was still at only one-third of the overall UP-wide proportion; however, under-enrollment at the graduate level increased significantly to more than 15%, only slightly less than the UP-wide 16.7%. The Council recommends that you work with those units already identified to reduce under-enrollment. Reorganization of life science graduate programs should help with this issue.

7. Expand Online Programming

The College is a strong contributor to the World Campus undergraduate portfolio with its natural science and quantification courses. It also offers a Master of Applied Statistics, with an embedded graduate certificate, which is doing very well. As noted above, an online Forensic Sciences certificate is already underway. We encourage the College to move ahead, in conjunction with Smeal College and perhaps the Department of Economics, to explore the development of a M.P.S. in Financial Mathematics, and to work with the World Campus to entertain other ideas that would have a significant market opportunities.
8. Information Technology Consolidation

The College is exploring consolidation of its IT resources that are currently spread widely among its constituent units, presenting considerable overlap, cost inefficiencies, and network security concerns. We strongly urge you to move this initiative ahead expeditiously.

9. Machine Shops

Currently, machine shops operate in three academic colleges: Engineering, Earth and Mineral Sciences, and the Eberly College of Science. This arrangement may be unnecessarily duplicative. You have indicated that you are open to exploring alternative arrangements, and I will ask Vice President Foley to appoint a small task force to explore this issue, which might involve a common organization, shared infrastructure, or elimination/consolidation of one or more machine shops at University Park.

10. Start-up Costs

The College is financially burdened by the rapidly rising costs of start-up packages for new junior and senior faculty appointments. ECoS must, of course, be competitive in the marketplace for top quality faculty. Nonetheless, there are few metrics and follow-up analysis of the return on investment of these considerable resources (this is true in other colleges and their departments as well). We recommend that you, in collaboration with ECoS department heads, examine start-up costs more closely with an eye toward producing some analytics that would help establish more clearly the costs and benefits of various packages and to determine whether start-up costs are appropriately aligned with overall College priorities.

Please report back to the Core Council the actions that have been or will be taken in response to these recommendations by May 1, 2011.