December 22, 2016

TO: Sarah Mangelsdorf, Provost
    William Karpus, Dean, Graduate School

FROM: James P. Blanchard, Executive Associate Dean

RE: Proposed Doctoral Minor in Quantitative Biology

At its December 21, 2016 meeting, the College of Engineering Academic Planning Council (APC) unanimously supported the proposed developmental of a doctoral minor in Quantitative Biology.

The proposed minor will provide an opportunity for students to obtain a broader knowledge of the subject area as well as provide interdisciplinary interactions, which will benefit the students in their research and careers. The minor program will be hosted in the Department of Biomedical Engineering, however, as an interdisciplinary program, it will be managed by a steering committee of faculty from across the university.

On behalf of the College of Engineering, I accept the recommendation of the APC and support the proposal for the doctoral minor in Quantitative Biology.
March 6, 2017

Dear Graduate Faculty Executive Committee,

On behalf of my colleagues across the UW-Madison campus, it is my pleasure to submit this proposal to create a doctoral minor for Quantitative Biology. Outlined in the proposal are information on the minor’s purpose, governance, curriculum, and assessment plans as requested from preliminary discussions with Marty Gustafson, Assistant Dean of Academic Planning and Assessment. The proposal was approved by the home department of Biomedical Engineering, and reviewed and provided a letter of support by 12 additional departments/graduate programs. Through this process the courses included in the curriculum have been refined to reflect the diversity of opportunities in graduate training at UW-Madison. The proposal was also reviewed and approved by four college Academic Planning Councils (please note that the request by CALS for consultation with the Biometry program has occurred, and a letter from Biometry is included in this final proposal).

Please let me know what further information you need – through my conversations during this past year, it has become clear that many faculty see this as a need for graduate training and recruitment.

Sincerely,

Pamela K. Kreeger, Ph.D.
Department of Biomedical Engineering, UW-Madison
Proposal for Doctoral Minor in Quantitative Biology

Prepared by: Pamela Kreeger
Associate Professor
Dept. of Biomedical Engineering
kreeger@wisc.edu
890-2915

1. Minor Name: Quantitative Biology
Sponsoring Department: Department of Biomedical Engineering
Sponsoring College: College of Engineering
Initial faculty advisor: Pamela Kreeger
Key program faculty:
- Audrey Gasch (Genetics)
- Anthony Gitter (BMI)
- Katie Henzler-Wildman (Biochemistry)
- Megan McClean (BME)
- Julie Mitchell (Biochemistry/Mathematics)
- Sushmita Roy (BMI)
- Srivatsan Raman (Biochemistry)
- Alessandro Senes (Biochemistry)
- Kalin Vetsigian (Bacteriology)

2. Timeline for implementation – to be offered Fall 2017

3. The proposal has been reviewed favorably at these APCs:
   - CALs
   - CoE
   - L&S
   - SMPH

   Letters of support have been obtained from:
   - Bacteriology
   - Biochemistry
   - Biomedical Engineering
   - Biometry
   - Biostatistics and Medical Informatics
   - Chemical and Biological Engineering
   - Computer Science
   - Genetics
   - Mathematics
   - Microbiology Doctoral Training Program (MDTP)
   - Statistics
   - Zoology

4. Governance – The minor program will be hosted in the Department of Biomedical Engineering; however, as a inter-disciplinary program it will be managed by a steering committee of one faculty member serving as the program director and four additional faculty from across the university. Faculty will be recruited from the graduate programs that conduct quantitative biology research – e.g., BME, CBE, iPiB, CMB, Genetics, MDTP, BMI, Statistics. The steering committee members will serve four-year renewable terms (starting on a staggered basis so that at most one-two members change per year). The program director will also serve
in four-year renewable terms and will provide an annual report to the Chair of the Department of Biomedical Engineering detailing the number of students who have completed the minor. New program directors must have served at least one year as a member of the steering committee and will be approved by the Department of Biomedical Engineering Executive Committee. The program director will be responsible for signing the warrant of students who complete the minor and advising students to insure that they are getting cross-disciplinary training. The steering committee will vote on any requested coursework substitutions (through e-mail to allow for a quick decision to be provided to the student).

5. Purpose, rationale, justification – Technological innovations have revolutionized the scale and detail with which biological systems can be explored. With that revolution has come a demand for scientists who can develop and analyze quantitative and predictive models of biological systems. The curriculum outlined in this minor is designed to complement the depth of training in biological or quantitative sciences that a student achieves through existing graduate programs with the breadth that is needed to conduct research under this paradigm. The courses selected for this minor come from traditional biological and quantitative courses, as well as courses that integrate the two fields. Additionally, students from these different backgrounds will be required to take a seminar course together which will help to prepare them for research that crosses these boundaries. We expect that this cross-disciplinary training will prepare students for careers in academic and industrial settings, where the ability to cross boundaries and work in teams with diverse expertise is critical.

The need for quantitative biology as an area of emphasis is clearly demonstrated by the National Academy of Engineers’ Grand Challenges, which include engineer better medicine and engineer the tools of scientific discovery. Additionally, NIH has several major initiatives that reflect the importance of quantitative biology, including the Precision Medicine Initiative, the Cancer Moonshot Blue Ribbon Panel recommendations, and the BRAIN Initiative. Quantitative Biology has been identified as a strategic opportunity by the Department of Biomedical Engineering, which is the home of an integrated course and the research seminar; therefore, hosting this minor aligns with the department’s mission.

While many faculty members at UW-Madison are active in the area of Quantitative Biology, there are currently no graduate programs that incorporate a curriculum requiring both biological and quantitative sciences outside of the Biometry MS and Biostatistics doctoral options in the Statistics PhD program and the planned Quantitative Data Science PhD program from the Department of Biomedical Informatics. These programs are relatively small and target students that are primarily interested in statistics/informatics rather than the experimental or mechanistic modeling aspects of quantitative biology; therefore, there is a clear need for a broader training opportunity. Additionally, these programs do not incorporate classes the explicitly integrate the two fields; this integrated approach accounts for 4 credits of the 10 credit Quantitative Biology minor.

6. Curriculum - Students who are candidates for the Ph.D. degree in any department or program may obtain an interdisciplinary minor in Quantitative Biology by earning a minimum of 10 credits from the courses listed below. The coursework is divided into one course from a quantitative science, one course from a biological science, one course from an integrated course, and a one-credit research seminar. Courses may be taken in any sequence, although it is strongly advised that the research seminar is taken during the first year of graduate school. It is expected that this coursework can be completed during the first two years of graduate school, consistent with the coursework timeline of many of the graduate programs that are represented.
Courses taken credit/no credit, pass/fail, or audited may not be counted towards the completion of the minor. At least half (50%) of credits for the minor must be earned while enrolled at UW-Madison as a degree-seeking graduate/professional student; consistent with other policy, credits earned in distance-delivered UW-Madison courses count as credits earned in residence.

### Quantitative Science (one course, courses with numbers lower than 600 are recommended for students who do not have a strong quantitative background)

<table>
<thead>
<tr>
<th>Primary Department</th>
<th>Cross-listing Departments</th>
<th>#</th>
<th>Course Name</th>
<th>Approval Status; Frequency</th>
<th>Letter from Primary Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>Stat</td>
<td>541</td>
<td>Introduction to biostatistics</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>CBE</td>
<td>--</td>
<td>660</td>
<td>Intermediate problems in chemical engineering</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>Stat</td>
<td>431</td>
<td>Introduction to the theory of probability</td>
<td>Yes; 2-3x/year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>--</td>
<td>443</td>
<td>Applied linear algebra</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>Comp Sci</td>
<td>513</td>
<td>Numerical linear algebra</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>Comp Sci</td>
<td>514</td>
<td>Numerical analysis</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>--</td>
<td>519</td>
<td>Ordinary differential equations</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>--</td>
<td>531</td>
<td>Probability theory</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>--</td>
<td>605</td>
<td>Stochastic methods for biology</td>
<td>Yes; e/o year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>--</td>
<td>608</td>
<td>Mathematical methods for continuum modeling in biology</td>
<td>Yes; occasionally</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>--</td>
<td>619</td>
<td>Analysis of partial differential equations</td>
<td>Yes; e/o year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>ISyE, OTM, Stat</td>
<td>632</td>
<td>Introduction to stochastic processes</td>
<td>Yes; 2x/year</td>
<td>X</td>
</tr>
<tr>
<td>Math</td>
<td>Comp Sci</td>
<td>714</td>
<td>Methods of computational mathematics I</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Comp Sci</td>
<td>--</td>
<td>760</td>
<td>Machine learning</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Stat</td>
<td>F&amp;W Ecol, Hort</td>
<td>571</td>
<td>Statistical methods for bioscience I</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Stat</td>
<td>F&amp;W Ecol, Hort</td>
<td>572</td>
<td>Statistical methods for bioscience II</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Stat</td>
<td>--</td>
<td>609</td>
<td>Mathematical statistics I</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Stat</td>
<td>--</td>
<td>610</td>
<td>Introduction to statistical inference</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
</tbody>
</table>

### Biological Science (one course, courses with numbers lower than 600 are recommended for students who do not have a strong biological background)

<table>
<thead>
<tr>
<th>Primary Department</th>
<th>Cross-listing Departments</th>
<th>#</th>
<th>Course Name</th>
<th>Approval Status; Frequency</th>
<th>Letter from Primary Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochem</td>
<td>--</td>
<td>501</td>
<td>Introduction to biochemistry</td>
<td>Yes; 2x/year</td>
<td>X</td>
</tr>
<tr>
<td>Department</td>
<td>Course Code</td>
<td>Title</td>
<td>Frequency</td>
<td>Offered</td>
<td>Notes</td>
</tr>
<tr>
<td>------------</td>
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<td>-------</td>
</tr>
<tr>
<td>Biochem</td>
<td>601</td>
<td>Protein and enzyme structure and function</td>
<td>Yes; 1x/year</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Biochem</td>
<td>Genetics, MD Genetics</td>
<td>620</td>
<td>Eukaryotic molecular biology</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Biochem</td>
<td>Botany</td>
<td>621</td>
<td>Plant biochemistry</td>
<td>Yes; e/o year</td>
<td>X</td>
</tr>
<tr>
<td>Biochem</td>
<td>--</td>
<td>625</td>
<td>Coenzymes and cofactors in enzymology</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Biochem</td>
<td>--</td>
<td>660</td>
<td>Methods in biochemistry</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Biochem</td>
<td>Chem</td>
<td>704</td>
<td>Chemical biology</td>
<td>Yes; occasionally</td>
<td>X</td>
</tr>
<tr>
<td>Genetics</td>
<td>--</td>
<td>466</td>
<td>General genetics</td>
<td>Yes; 2x/year</td>
<td>X</td>
</tr>
<tr>
<td>Genetics</td>
<td>--</td>
<td>701</td>
<td>Advanced genetics</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Microbio</td>
<td>Genetics</td>
<td>607</td>
<td>Advanced microbial genetics</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Microbio</td>
<td>Biochem, Genetics</td>
<td>612</td>
<td>Prokaryotic molecular biology</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Microbio</td>
<td>--</td>
<td>625</td>
<td>Advanced microbial physiology</td>
<td>Yes; occasionally</td>
<td>X</td>
</tr>
<tr>
<td>Microbio</td>
<td>Botany, Genetics, MM&amp;I, PI Path</td>
<td>655</td>
<td>Biology and genetics of filamentous fungi</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Microbio</td>
<td>BMolChem</td>
<td>668</td>
<td>Microbiology at atomic resolution</td>
<td>Yes; occasionally</td>
<td>X</td>
</tr>
<tr>
<td>Microbio</td>
<td>Biochem</td>
<td>726</td>
<td>Regulation of gene expression in prokaryotes</td>
<td>Yes; occasionally</td>
<td>X</td>
</tr>
<tr>
<td>Zoo</td>
<td>--</td>
<td>570</td>
<td>Cell biology</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>Zoo</td>
<td>Biochem</td>
<td>630</td>
<td>Cellular signal transduction mechanisms</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
</tbody>
</table>

**Integrated Science (one course)**

<table>
<thead>
<tr>
<th>Department</th>
<th>Course Code</th>
<th>Title</th>
<th>Frequency</th>
<th>Offered</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>--</td>
<td>556</td>
<td>Systems biology: mammalian signaling networks</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>BMI</td>
<td>Comp Sci</td>
<td>576</td>
<td>Introduction to bioinformatics</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>BMI</td>
<td>Comp Sci</td>
<td>776</td>
<td>Advanced bioinformatics</td>
<td>Yes; 1x/year</td>
<td>X</td>
</tr>
<tr>
<td>BMI</td>
<td>Stat</td>
<td>877</td>
<td>Statistical methods for molecular biology</td>
<td>Yes; e/o year</td>
<td>X</td>
</tr>
<tr>
<td>CBE</td>
<td>BME</td>
<td>782</td>
<td>Modeling biological systems</td>
<td>Yes; e/o year (alternates with CBE 783)</td>
<td>X</td>
</tr>
<tr>
<td>CBE</td>
<td>BME</td>
<td>783</td>
<td>Design of biological molecules</td>
<td>Yes; e/o year (alternates with CBE 782)</td>
<td>X</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td>Genetics</td>
<td>--</td>
<td>885</td>
<td>Advanced genomic and proteomic analysis</td>
<td>Yes; e/o year</td>
<td>X</td>
</tr>
<tr>
<td>Biochem</td>
<td>Math, BMolChem, BMI</td>
<td>606</td>
<td>Mathematical methods for structural biology</td>
<td>Yes; e/o year</td>
<td>X</td>
</tr>
<tr>
<td>Biochem</td>
<td>Math, BMolChem, BMI</td>
<td>609</td>
<td>Math methods for systems biology</td>
<td>Yes; e/o year</td>
<td>X</td>
</tr>
</tbody>
</table>

**Research Seminar (one credit)**

| BME  | -- | 780 | Methods in quantitative biology | In approval; 1x/year | X |

Students seeking exceptions to the outlined courses must present a course syllabus for the substitution and a justification for approval to the faculty director, who will present the request to the steering committee for a vote (at least 3 yes votes are needed). Any substitution or exception that is made will be made available to all students.

7. Overlap limits – At least three credits of the coursework to fulfill this minor must be beyond the required courses in the primary doctoral program (courses that are selected to fulfill electives may be used to satisfy this requirement).

8. Assessment and program review – The major learning goal for this minor is for students to develop expertise in both quantitative and biological science, and how to integrate these two fields. It is expected that most students gain substantial depth in either quantitative or biological science through their PhD major program; therefore, this minor will provide for breadth by having the student take coursework in the complementary field. Additionally, the curriculum requires two courses that integrate these fields – a lecture course and a one-credit research seminar, where students from the two fields will work together to analyze the current literature.

To assess that these learning goals are being met, the steering committee will annually evaluate the progress of students who have completed the minor. Included in this evaluation will be an analysis of the student’s coursework, performance, and responses to a survey assessing if they feel they have gained competence in the complementary field and integrating the fields. These results will be used to determine if courses in the curriculum should be changed. Additionally, the committee will consider the addition of new courses to augment the current curriculum during this review based on substitutions granted in the past year and the introduction of new courses.

Additionally, every five years the steering committee will review the long-term impact of the minor by reviewing the abstracts of theses from students who have completed the minor. Abstracts will be assessed for evidence of integration of quantitation and biology in the dissertation research. The committee will also monitor the enrollment to determine the continued need for this minor. The faculty program director is responsible for the reporting of which students have completed minor requirements to the school/college dean’s office and the Registrar’s Office.
10. Enrollment - Based on current research group sizes in quantitative biology at UW-Madison, we expect there will be approximately 10 students per year who elect to complete the Quantitative Biology minor. To insure a robust enrollment, members of the steering committee will communicate with the appropriate departments to come speak to prospective or newly-enrolled graduate students. Additionally, the minor will be advertised on the website for the Quantitative Biology Initiative (qbi.wisc.edu) and through emails to this group which includes approximately 60 faculty. The required one-seminar course will allow us to monitor enrollment and determine if more targeted advertising is necessary (e.g., we get more students from biological vs. quantitative sciences). Several of the core courses are offered as 'service' courses and are expected to have capacity; additionally, there are multiple courses listed for each sub-category and we therefore expect that students will not face enrollment limitations (see letters of support from each of the departments who have course offerings listed). The required course for Methods in Quantitative Biology will have a priority enrollment for students intending to complete the Quantitative Biology minor; should this course reach capacity it will be offered in both semesters.
30 January 2017

Prof. Pam Kreeger
Dept. of Biomedical Engineering
<via email>

Dear Pam,

Thank you for sharing the proposal to develop a doctoral minor in Quantitative Biology with the CALS APC for review. Dean VandenBosch has recommended that you also consult the members of the Biometry program, which is jointly offered between CALS and L&S. Please let me know if you need connections or introductions there. That suggestion was not deemed to require a postponement of the CALS vote, and at the Council’s meeting on 17 January, the members voted strongly in support of your proposal, noting that many CALS doctoral students are likely to find the minor of interest.

Sincerely,

Sarah K.A. Pfatteicher, Ph.D.
Associate Dean for Academic Affairs
College of Agricultural & Life Sciences
Research Professor, Civil & Environmental Engineering
College of Engineering
8 February 2017

TO: James P. Blanchard, Executive Associate Dean, College of Engineering

FROM: John Karl Scholz, Dean

RE: Request for L&S Support, Proposed Doctoral Minor in Quantitative Biology

CC: Marty Gustafson, Assistant Dean, Graduate School
    Mark Hill, Professor and Chair, Computer Sciences
    Jeff Hardin, Professor and Chair, Zoology
    Elaine Klein, Assistant Dean for Academic Planning, L&S
    Pamela Kreeger, Associate Professor, Biomedical Engineering
    Sarah Kuba, Academic Planner, Academic Planning and Institutional Research
    Gloria Mari-Beffa, Professor and Chair, Mathematics
    Jocelyn Milner, Associate Provost and Director, Academic Planning and Institutional Research
    Yazhen Wang, Professor and Chair, Statistics
    Eric Wilcots, Associate Dean for the Natural and Mathematical Sciences, L&S

On February 7, 2017, the L&S Academic Planning Council considered the attached request to create a new doctoral minor in Quantitative Biology. Each of the L&S departments that contribute courses to the long list of electives supporting this program have signaled their support for the program, and that the L&S courses are regularly offered and have sufficient capacity to absorb the enrollment of these students in them without the addition of new resources. The L&S APC approved unanimously a recommendation that the college support creation of this new program.
January 23, 2017

Sarah C. Mangelsdorf, Ph.D.  William Karpus, Ph.D.
Provost and Vice Chancellor for Academic Affairs  Dean of the Graduate School

Sent electronically

Re:  Proposed doctoral minor in Quantitative Biology

Dear Provost Mangelsdorf and Dean Karpus:

On behalf of the School of Medicine and Public Health, I endorse a request to establish a doctoral minor in Quantitative Biology.

After discussion at the January 18, 2017 meeting of the SMPH Academic Planning Council, APC members unanimously approved this request.

Thank you for your consideration. If you require additional information, please do not hesitate to contact Andrea Poehling.

Sincerely,

Robert N. Golden, M.D.
Robert Turell Professor in Medical Leadership
Dean, School of Medicine and Public Health
Vice Chancellor for Medical Affairs
University of Wisconsin-Madison

Copies to:
Pam Kreeger, Ph.D., Department of Biomedical Engineering
Paul Rathouz, Ph.D., Department of Biostatistics and Medical Informatics
Richard L. Moss, Ph.D., School of Medicine and Public Health
Andrea Poehling, M.S., School of Medicine and Public Health
Kelly Lee, School of Medicine and Public Health

Marty Gustafson, M.S., Graduate School
Emily Reynolds, M.A., Graduate School
Jocelyn Milner, Ph.D., Academic Planning and Institutional Research
Sarah Kuba, Ph.D., Academic Planning and Institutional Research
December 6, 2016

Dear Academic Planning Council –

This letter is to express support for the proposed doctoral minor in Quantitative Biology. The faculty in the Department of Bacteriology feel that this minor will be of significant interest to some of our current students and will enable us to recruit students in this area of research in the future. Members of our department including Assistant Professor Kalin Vetsigian were involved in the early planning of this program and are available to serve on the steering committee as needed.

We have examined the list of courses included in the minor (courses with the Micro prefix) and provided suggestions to the steering committee for specific courses that would be useful to prepare students for advanced topics in their research. Given the projected number of students and courses available to these students, this new program will not impact the ability of students to enroll in these classes. We expect the Micro courses will have the capacity to accommodate students in the QBio program.

Sincerely,

Charles W. Kaspar
Chair and Professor
Department of Bacteriology
cwkaspar@wisc.edu
Date: November 16, 2016

To: College of Engineering Academic Planning Council

From: Brian G. Fox, Chair
Department of Biochemistry

Quantitative Biology is an emerging area of research that operates at the interface between the biological disciplines (including biochemistry) and those broadly defined as “mathematical” (math, physics, computer science, statistics, engineering). It is an area of rapid growth, fueled by the opportunities created by the accessibility of high-performance computing, experimental advances enabling quantitative measurements of complex biological systems, and by the development of high-throughput methods that generate enormous amounts of data (‘-omics’). As a result, there is a pressing need to integrate large-scale data analysis, statistics, theoretical simulations and other computational approaches with traditional laboratory research.

As Quantitative Biology research grows in our department and across campus, the need for formal graduate education in this area is imperative. There is currently no graduate program on campus that truly incorporate this sort of multidisciplinary approach, particularly among the biological programs. The doctoral minor in Quantitative Biology will provide a useful mechanism for interdisciplinary training of students from a variety of biological and quantitative PhD programs, including the Integrated PhD Program in Biochemistry (IPiB). The required seminar course will also serve also as an opportunity for community development. Finally, the Quantitative Biology minor will be important as a recruiting tool to attract a growing pool of talented PhD candidates who have interests in interdisciplinary training to our graduate program.

Consequently, the Biochemistry Department strongly supports this proposal for the development of a doctoral minor in Quantitative Biology as evidenced by the vote of our faculty on November 11, 2016.

Several Biochemistry faculty (Henzler-Wildman, Mitchell, Senes, Raman) have been involved with the process that led to the creation of this proposed minor, and would be willing to serve on the steering committee that will administer the minor. It is also noted that the Biochemistry courses listed in the proposal (Biochem 501, 601, 606, 609, 612, 620, 625, 660, 704) have capacity to accommodate students from other PhD programs who may wish to enroll in these course to fulfill their Quantitative Biology minor requirements.

Respectfully submitted.

Brian G. Fox
Chair, Biochemistry Department
October 26th, 2016

Dear Academic Planning Council –

On behalf of the Department of Biomedical Engineering (BME), I am writing in support of the proposal for the development of a doctoral minor in Quantitative Biology, which will be administratively housed in BME. The BME Department faculty voted unanimously in favor of this proposal at our faculty meeting on October 11, 2016.

Quantitative Biology is the use of computational and mathematical modeling in combination with experimental approaches to understand the complexity of biology. In our discussion of this proposal, BME faculty noted that this is an area of research growth, with regular calls for quantitative biology approaches to problems from NIH, NSF, and DoE. While many faculty members at UW-Madison are active in the area of Quantitative Biology (including faculty in BME), there are currently no graduate programs that incorporate this integrated approach outside of the Biostatistics option in the Statistics PhD program and the planned Quantitative Data Science PhD program from the Department of Biomedical Informatics. Both of those programs are relatively small and target students that are primarily interested in statistics/informatics rather than the experimental or mechanistic modeling aspects of quantitative biology; therefore, there is a clear need for a broader program.

Currently, students that apply to UW-Madison and pursue this area of research will enroll in a traditional discipline-centric PhD program. The department felt that a key strength of this proposal is that it will direct students towards the appropriate classwork for greater expertise in quantitative biology, rather than those students having to self-direct to appropriate classes through a distributed minor. Additionally, the 1-credit seminar course that is required to earn a minor in Quantitative Biology will provide a unique opportunity for cross-disciplinary training and community development, which may prove to be an attractive recruiting tool for these students. Indeed, this kind of ‘cohort’ class is a key feature of the training programs in Quantitative Biology at our academic peers.

It is our hope that by improving the training options for students in this field, we will better prepare them for their research while at UW-Madison and have a positive impact on their careers. In addition, we expect that the development of this minor will enable recruiting of top students in this field who are looking for cross-disciplinary educational opportunities. Ultimately, we expect that our ability to recruit top students will positively impact our ability to recruit top faculty candidates and enrich the academic environment of UW-Madison. We appreciate your consideration of this proposal.

Sincerely,

Justin Williams, PhD
Department Chair and Vilas Distinguished Achievement Professor
Department of Biomedical Engineering
Co-Director: Clinical Neuroengineering Training Program
jwilliams@engr.wisc.edu
Pamela Kreeger, Ph.D  
Associate Professor  
Dept. of Biomedical Engineering  
University of Wisconsin-Madison  

Dear Pam –

I am writing on behalf of the Biometry Program to enthusiastically support the proposed doctoral minor in Quantitative Biology. We believe that this minor will serve graduate students in the biological sciences at UW very well and the Biometry program would benefit from this minor as it has the potential to attract talented quantitative biology students to further their training in biometry and statistics.

At UW, biometry refers to the development and application of statistical methods to biological studies in plant, animal, and agricultural biology. The Biometry Program is an MS degree program that is interdisciplinary, providing formal coursework in statistics and biology, consulting experience, and supervised research combining the two areas. Students completing the Biometry Program will understand biological processes and have the ability to apply and extend a broad range of statistical concepts and techniques to biological problems. This integration of statistics and biology is the distinguishing feature of this program. Students who complete the MS in Biometry and the PhD in a biological science are at the forefront of quantitative biological research. Students who stop with the MS in Biometry, possibly obtaining another MS in a biological science concurrently, will be well suited for positions with industry or government focused on quantitative biological research.

The Biometry Program is distinct from the Quantitative Biology minor in that Biometry focuses on statistical techniques while Quantitative Biology incorporates a broader array of quantitative tools including statistics. On the other hand, the statistical training in Biometry will be more comprehensive and deeper than a Quantitative Biology PhD minor. For example, the Quantitative Biology minor requires a 3-credit quantitation/biology integration course, whereas Biometry Program requires a project in the integration of statistics and biology, presented in a publishable manuscript.

To help interested students determine which programs are appropriate for them, we are happy to see that a description of Biometry and the two core courses of Biometry, Statistics/Forestry/Horticulture 571-572 “Statistical Methods for Bioscience I & II”, are to be included in the umbrella Quantitative Biology Initiative website https://qbi.wisc.edu/education/overview/. We also appreciate the possibility for a biometry/statistics faculty to serve on the steering committee and are pleased that Professor Brian Yandell is willing to serve in this capacity. Please feel free to contact him.

We wish you the very best in launching this exciting new degree program.

Yours sincerely,

Jun Zhu, PhD  
Professor, Department of Statistics and Department of Entomology  
Director, Biometry Program
December 2, 2016

Dear Academic Planning Council –

On behalf of the Department of Biostatistics & Medical Informatics (BMI), I am writing in strong support of the attached proposal for the development of a doctoral minor in Quantitative Biology. Members of our department including Assistant Professors Sushmita Roy and Anthony Gitter were involved in the early planning of this program and are both willing to serve on the steering committee as needed.

Our department would benefit from this minor because we expect it will attract additional students interested in quantitative biology to UW-Madison. We are currently developing a small graduate training program in Quantitative Data Science; however, the expected class size of this program will be only five per year. Therefore, faculty in our department will continue to recruit students from other programs and would benefit from those students having access to this minor. Additionally, the Quantitative Data Science program will target students who are primarily interested in statistics/informatics rather than the experimental or mechanistic modeling aspects of quantitative biology; therefore, there is a clear need for a broader program.

We have examined the list of courses included in the minor and provided suggestions to the steering committee for specific courses that would be useful to prepare students for advanced topics in their research. Given the number of students that are anticipated and the variety of courses that are included, the new program should have no major impact in terms of the enrollment of these classes. We expect that all courses will have the capacity to accommodate students in the QBio program.

Sincerely,

Paul J. Rathouz, PhD
Professor and Chair
November 21, 2016

Pamela Kreeger, Ph.D.
Associate Professor
Department of Biomedical Engineering
University of Wisconsin-Madison
CAMPUS

Dear Professor Kreeger:

At a recent faculty meeting (November 2, 2016), the faculty of our department voted unanimously to support the course proposal for the new doctoral level cross-campus minor in Quantitative Biology that you have spearheaded. The consensus of our faculty was that the proposed minor has great value and may be of interest to many of our graduate students. There is no significant overlap with existing programs in the Department of Chemical and Biological Engineering. Additionally, we confirm that the CBE courses included in this minor can accommodate the expected demand from students in the Quantitative Biology minor. We appreciate the efforts of you and the steering committee.

Sincerely,

Manos Mavrikakis, PhD
Department Chair
Paul A. Elfers Professor
Vilas Distinguished Achievement Professor of Chemical Engineering
Editor-in-Chief, *Surface Science*
December 6, 2016

Dear Academic Planning Council:

This letter is to express support from the Department of Computer Science for the proposed doctoral minor in Quantitative Biology. We feel that this minor will be of interest to some of our current students. We have examined the Computer Science course included in the minor. Given the number of students that are anticipated and the variety of courses that are included, we expect that this course will have the capacity to accommodate students in the QBio program.

Sincerely,

Mark D. Hill
John P. Morgridge Professor
Gene M. Amdahl Professor of Computer Sciences
Computer Sciences Department Chair
Dr. Pam Kreeger  
Department of Biomedical Engineering  
University of Wisconsin-Madison  

November 18, 2016  

Dear Pam,  

This letter is to express support and enthusiasm from the Laboratory of Genetics for the proposed ‘QBio’ doctoral minor in quantitative biology at UW-Madison. The faculty of the Laboratory of Genetics voted unanimously in support of the Qbio doctoral minor and the sentiment outlined below.  

The proposed QBio doctoral minor would be of significant interest to many of our current students, and it would strengthen our ability to recruit the best and brightest students to our program. Many students recognize the changing face of biological research and the importance of incorporating approaches in the physical sciences – including statistics, computation, and engineering – into their research and training. In response to this wave of student interest, many other institutions have recently created integrated PhD programs in the quantitative sciences. UW-Madison is losing students to these programs, since there is no comparable integrative training program in this area at UW-Madison, certainly not one to which biology students on campus have access.  

The Laboratory of Genetics strongly supports the Qbio doctoral minor. First and foremost, many of the students who apply to our program are keenly interested in attaining training in statistical and computational genetics. In the last two years, several applicants to the UW Genetics program stated that they applied to the program specifically because of the recently created Quantitative Biology Initiative (qbi.wisc.edu), a portal that highlights the quantitative biology community on campus. A defined doctoral minor would be attractive to many of our applicants and in turn would likely strengthen our applicant pool. The proposed QBio minor would also significantly strengthen the training interested students would receive, by providing a student cohort, a new methods course covering approaches in quantitative biology, and defined curriculum.  

Several trainers in the UW Genetics PhD Training Program have participated in the development of the proposed QBio program on campus, including Audrey Gasch who will serve on the QBio steering committee. This letter also confirms that Genetics courses
listed as meeting QBio requirements (including Genetics 466, 660, and 701) can accommodate additional students who would take the courses are part of the QBio doctoral minor requirements, assuming those students meet the course prerequisites.

Sincerely,

Audrey P. Gasch, PhD
Professor of Genetics
Director of Graduate Studies in Genetics
Laboratory of Genetics & Genome Center of Wisconsin
University of Wisconsin-Madison

John Doebley, PhD
Chair and Professor of Genetics
Laboratory of Genetics
University of Wisconsin-Madison
November 17, 2016

Dear Academic Planning Council –

On behalf of the Department of Mathematics, we are writing in support of the proposal for the development of a doctoral minor in Quantitative Biology. We feel that this minor will be useful for the students in our program who are interested in research in Math Biology and that the opportunity to interact with students from across campus through the seminar course could stimulate new avenues of research. Further, we expect that this program will be useful to attract additional graduate students in Math Biology.

We have examined the list of courses that are suggested for the quantitative and integrated portions of the minor, and provided suggestions to the steering committee for specific courses that would be accessible to students from a less quantitative background. Given the number of students that are anticipated and the variety of courses that are included, the new program should have no major impact in terms of the enrollment of these classes. We expect that all courses will have the capacity to accommodate students in the QBio program.

Sincerely,

Gloria Mari-Beffa
Professor and Chair
Department of Mathematics
maribeff@math.wisc.edu
December 6, 2016

Dear Academic Planning Council –

On behalf of the Microbiology Doctoral Training Program, I am writing in support of the proposal for the development of a doctoral minor in Quantitative Biology. Research in bacteriology and microbiology has become increasingly quantitative; specific examples include the analysis of genomic data, characterization of protein dynamics, and evaluation of how interactions between members of the microbiome influence population-level events. Therefore, we expect that access to quantitative training will be an asset to our students as they prepare for their future careers.

We are also excited by the opportunity for students in our program to interact with students from across campus through the seminar course, as this could stimulate new avenues of research. We expect that this program will be useful to attract additional graduate students interested in the use of quantitative sciences in the study of microbial questions.

Sincerely,

Nancy P. Keller
Professor and Chair,
Microbiology Doctoral Training Program
npkeller@wisc.edu
November 29, 2016

Pamela Kreeger, Ph.D
Associate Professor
Dept. of Biomedical Engineering
University of Wisconsin-Madison
Email: kreegerlab.org

Dear Academic Planning Council,

I am writing on behalf of the Department of Statistics to support the proposed doctoral minor in Quantitative Biology. We feel that this minor will be of significant interest to some of our current and future students and are excited by the opportunity for our students to interact with others from campus through the outlined curriculum. Further, we expect that the proposed minor will strengthen our ability to recruit the best and brightest students to our program.

After checking the proposal of the minor program including the list of courses in the minor we have provided our feedback and suggestion to the steering committee for more statistical courses that would be useful to prepare students for advanced topics in their research. Given the number of students that are anticipated and the variety of courses that are included, we anticipate no major negative impact of the new program on our class enrollments, and we think that our courses should have the capacity to accommodate students in the
Quantitative Biology program.

In closing, the proposed program is wonderful and I look forward to being a part of it. I strongly support the minor program.

Sincerely,

Yazhen Wang
Professor and Chair
Department of Statistics
University of Wisconsin-Madison
Email: yzwang@stat.wisc.edu
December 9, 2016

Pamela Kreeger
Associate Professor
Department of Biomedical Engineering
1111 Highland Ave, WIMR 4553
CAMPUS

Dear Pam,

This letter is to express support from the Department of Zoology for the proposed doctoral minor in Quantitative Biology (QBio). Our faculty voted in unanimous support of the proposal at our meeting on December 6, 2016. We feel that this minor will be of interest to some of our current students and are excited by the opportunity for students from different backgrounds to interact across campus. In addition, we expect that the proposed minor will strengthen our ability to recruit students interested in quantitative aspects of our research.

We have examined the list of courses included in the minor. Given the number of students that are anticipated and the variety of courses that are included, the new program should have no major impact in terms of the enrollment of these classes. We expect that all courses will have the capacity to accommodate students in the QBio program.

Thanks for your efforts to serve graduate students on the UW campus.

Best regards,

Jeff Hardin
Professor and Chair
Department of Zoology