

New Graduate Minor  
Biological Data Science

Status: Pending Review - Graduate Council Chair

1. Review - College Approver - Graduate School

Approved by [Jennifer Dennis](#) Vice Provost & Dean / Graduate School Admin, June 13, 2016 12:28pm

2. Review - Curriculum Coordinator

Approved by [Cheryl Hagey](#) Administrative Program Assist / Acad Prgms/Assess/Accred, July 21, 2016 2:22pm

Comments

*Cheryl Hagey (Curriculum Coordinator) July 21, 2016 2:22pm*

SUMMARY: This proposal seeks to add a new Graduate Minor to the Graduate School.

New CIP number 261101 has been added to the proposal. This number needs to be added to STVCIPC and STVMAJR in Banner, please.

All Components are met per the Faculty Senate Curriculum Council guidelines.

3. Review - Graduate Council Chair

Pending Review

More Queued Reviews (4)

CC Rep - Graduate School; Curriculum Council Chair; Academic Programs; Catalog Coordinator

Proposal

Proposal ID: 96213

Type: New Option/Minor

Submission Date: May 31, 2016 11:26am

Effective Term: Fall 2016

Justification: Big data, in all its aspects including analytics, is rapidly transforming life sciences research at all levels of scale from molecules to the ecosystems. This includes areas as diverse as protein chemistry, genomics, systems biology, medical informatics, bioengineering, ecology and environmental sciences. As a result, researchers trained at the intersection of the life sciences and data sciences (mathematics, statistics and computer sciences), are increasingly needed by industry, government, and academia. For example, a recent report from the Coalition of State Bioscience Institutes<sup>1</sup> stated that there was exceptional demand for knowledge workers with "Advanced/specialization degrees, such as bioinformatics, biostatistics and computational biology".

A key requirement for effective research and training at the intersection of life and data sciences is the ability of researchers to communicate across disciplinary boundaries. Thus a life scientist needs sufficient familiarity with the concepts and tools of computer science and statistics to communicate effectively with specialists in those areas. The large majority of undergraduate and graduate programs do not provide the necessary breadth of training to students to enable effective cross-disciplinary communication.

The graduate minor in Biological Data Science will familiarize M.S. and Ph.D. graduate students in the life sciences with research concepts and methodologies in quantitative sciences, and those in the quantitative sciences with research concepts and methodologies in life sciences. Students will extend their ability to participate in cross-disciplinary collaborations, and will obtain a foundation for more advanced training in the diverse areas of computational biology. The minor is expected to strengthen the training of students in a wide variety of existing M.S. and Ph.D. programs including (but not limited to): Molecular and Cellular Biology; Biochemistry and Biophysics; Bioengineering; Botany and Plant Pathology; Comparative Health Sciences; Computer Science; Earth, Ocean and Atmospheric Sciences; Fisheries and Wildlife; Integrative Biology; Mathematics; Microbiology; Public Health; and Statistics. The curriculum of the minor is flexible in order to facilitate integration with the curricula of diverse M.S. and Ph.D. programs, and ensure educational development that is appropriate to individual student success.

<sup>1</sup> Booz & Company. Demand for Talent: Current & Projected Workforce Trends in the Life Science Industry. (Coalition of State Bioscience Institutes, 2014).

Comments: This graduate minor was recommended by the Task Force on Curriculum Coordination in Bioinformatics and Computational Biology. The task force included 20 faculty from the Colleges of Science, Agricultural Sciences, Pharmacy, Veterinary Medicine, Forestry, Engineering, Public Health and Human Sciences, and Earth, Ocean and Atmospheric Sciences. Feedback was obtained from three town hall meetings and from meetings with representatives of 21 interested departments and programs in 8 Colleges. This category II

NAME	TITLE	DEPARTMENT/SCHOOL
proposal was authored by the curriculum committee of the minor.		
<p>The minor will be administered by the Graduate School. The Director of the minor will be Brett Tyler. The role of Director is to coordinate and promote the program. The Curriculum Committee will be a standing committee of the minor, and will be responsible for regularly updating the course listings and requirements for credit in the minor.</p> <p>By leveraging a wide range of existing classes, the curriculum is largely resilient to occasional changes in course offerings by departments and instructors.</p> <p>It should be emphasized that the intent of the minor is to provide graduate students with sufficient familiarity with disciplines complementary to their major in the arena of biological data science that they can effectively enter into collaborations with specialists (e.g. a biology student would be able to effectively collaborate with a statistician). In contrast to specialist programs, such as the "Data analytics" graduate certificate, it does not aim to make the student proficient in any complementary discipline. Some students who enter the minor with sufficient prerequisites might be able to attain a higher level of proficiency.</p>		

## Originators

NAME	TITLE	DEPARTMENT/SCHOOL
<a href="#">Lorenzo Ciannelli</a>	Associate Professor	Earth, Ocean & Atmo Sci
<a href="#">Brett Tyler</a>	Director-CGRB	VP for Research
<a href="#">Thomas Sharpton</a>	Assistant Professor	Microbiology (Science)
<a href="#">Yuan Jiang</a>	Assistant Professor	Statistics (Science)
<a href="#">Stephen Ramsey</a>	Assistant Professor	Vet Biomedical Science
<a href="#">Molly Megraw</a>	Assistant Professor	Ag Botany / Plant Path
<a href="#">David Hendrix</a>	Assistant Professor	Biochem / Biophysics
<a href="#">Eugene Houseman</a>	Associate Professor	Sch of Bio/Pop Hlth Sci
<a href="#">Vrushali Bokil</a>	Associate Professor	Mathematics

## Contacts

No contacts

## Liaisons

LIAISON	STATUS	REQUIRED
Daniel Arp - Dean/Director-CAS / College of Ag Admin	Expired	No
Scott Ashford - Head-Sch Civil & Constr Engr / Sch of Civil/Constr Engr	Expired	No
Jerri Bartholomew - Department Head / Microbiology (Science) I support this proposal (Responded on May 16, 2016)	Responded	No
Luiz Bermudez - Department Head / Veterinary Medicine	Expired	No
Bella Bose - Assoc Dir-Academic Affairs / Sch Elect Engr/Comp Sci Fine with EECS.  -Bella Bose (Responded on May 6, 2016)	Responded	No
Lynda Ciuffetti - Department Head / Ag Botany / Plant Path I have had multiple conversations with Brett Tyler on the proposed graduate minor in Biological Data Science. Botany and Plant Pathology supports this proposal.  Lynda Ciuffetti (Responded on May 24, 2016)	Responded	No
Jennifer Dennis - Vice Provost & Dean / Graduate School Admin	Expired	Yes
Dee Denver - Associate Professor / Integrative Biology MCB supports the proposal for this Minor. It will offer students in diverse graduate programs a great context to gain skills in 'big data' analysis. The minor also does a good job of leveraging existing coursework available across the OSU graduate curriculum landscape.  There are features of this endeavor, however, which warrant further consideration. With all of the strengths in genomics, bioinformatics, and quantitative biology across the OSU landscape, it is a shame that this could not be an exciting new Major rather than just a Minor. Why can't OSU graduate programs in the life sciences work together (rather than in parallel/competition) to develop and move forward exciting and timely new programs, and allow them to reach their fullest potential (rather than just as a Minor)?  If this is indeed to just be a Minor, then it seems weird to have it as a stand-alone entity in the Graduate School. Is there precedent for stand-alone Minors	Responded	No

<p>administered in the Grad School? Might the Minor benefit from administrative alliance with another program? Or, administration in a College where it might receive more support? All other Graduate School-administered interdisciplinary programs have struggled a lot over recent years. Why might we expect this program to have a different experience?</p> <p>MCB supports this proposal for the Biological Data Science minor, but encourages further consideration of a Major in this area and the administration model.</p> <p>(Responded on May 19, 2016)</p>		
Anita Grunder - Assoc Dean-Academic Programs / Earth, Ocean & Atmo Sci	Expired	No
<p>Roy Haggerty - Associate Professor / Geosciences</p> <p>Please contact Anita Grunder, Associate Dean for Academic Programs, to manage CEOAS liaison. Thanks. grundera@geo.oregonstate.edu</p> <p>-- Roy Haggerty</p> <p>(Responded on May 6, 2016)</p>	Responded	No
<p>S Marie Harvey - Assoc Dean-Res &amp; Grad Programs / Public Hlth/HumanSci Adm</p> <p>Approve. Marie</p> <p>(Responded on May 17, 2016)</p>	Responded	No
<p>Selina Heppell - Associate Professor / Fisheries and Wildlife</p> <p>looking forward to advertising this option to our students! Approved.</p> <p>(Responded on May 6, 2016)</p>	Responded	No
<p>Adam Higgins - Assistant Professor / Sch of Chem/Bio/Envr Eng</p> <p>Looks good to me.</p> <p>(Responded on May 6, 2016)</p>	Responded	No
<p>Andy Karplus - Department Head / Biochem / Biophysics</p> <p>This proposal has been circulated for feedback before submission, and I support the formation of this minor. A thought that occurred to me reading through the requirements this time was regarding students from a math/stats/CS background and needing exposure to life science topics. They might be well served not just taking advanced life science courses that focus on topics with clear relevant big data questions included in them, but also by taking some more foundational courses such as general evolutionary biology, MCB, Biochemistry, BPP or Micro core courses, cell biology, epigenetics, etc. No need to change anything, but wanted to be sure this was considered.</p> <p>(Responded on May 6, 2016)</p>	Responded	No
<p>John Killefer - Department Head / Animal &amp; Rnglnd Sciences</p> <p>Animal and Rangeland Sciences supports this proposal. This minor should be extremely valuable to students pursuing degrees in systems level science.</p> <p>(Responded on May 20, 2016)</p>	Responded	No
<p>Virginia Lesser - Director-Survey Research Cntr / Statistics (Science)</p> <p>Ok</p> <p>(Responded on May 18, 2016)</p>	Responded	No
Thomas Maness - Dean / College of Forestry Adm	Expired	No
V John Mathews - Administrator 1-School Head / Sch Elect Engr/Comp Sci	Expired	No
Sastry Pantula - Dean-COS / College of Science Admin	Expired	No
<p>Enrique Thomann - Professor / Mathematics</p> <p>This proposal has been discussed and supported by faculty in Mathematics. Creation of this minor will provide students with interest in mathematical modeling in life sciences with an opportunity to develop skill in a unified way. I support this proposal.</p> <p>(Responded on May 19, 2016)</p>	Responded	No
<p>Susan Tornquist - Dean / Veterinary Medicine</p> <p>I have no concerns about this proposal.</p> <p>(Responded on May 6, 2016)</p>	Responded	No
Virginia Weis - Professor / Integrative Biology	Expired	No
T Mark Zabriskie - Dean / Pharmacy Professnl Instr	Expired	No

## Program Information

Program Title: Biological Data Science  
 CIP Code: 261101  
 College/Department or College/School: Graduate School / No Department  
 Program Type: Graduate Minor  
 Description:

FILE NAME	FILE SIZE	COMMENT	DATE ADDED
<p>The graduate minor in Biological Data Science will familiarize M.S. and Ph.D. graduate students in the life sciences with research concepts and methodologies in quantitative sciences, and those in the quantitative sciences with research concepts and methodologies in life sciences. The disciplinary learning goals of the minor are by nature foundational. Thus, for example, students with advanced expertise in life sciences would receive foundational training in computer science, statistics and mathematics. Students with advanced expertise in computer science would receive foundational training in life science, statistics and, if needed, mathematics. A capstone collaborative problem-solving course will be required by all students. Students may complete all the coursework in a single year (encouraged), or may choose spread the courses out of several years. With approval by the Director of the minor, students may receive credit for courses taken for their major.</p>			

Requirements:

The minor is open to both M.S. and Ph.D. students. Ph.D students must complete at least 18 credit hours for the minor and M.S. students must complete 15 credit hours.

Students must select courses from at least two disciplinary focal areas outside their undergraduate and graduate majors. For example a life sciences student might take courses in mathematics and computer science, while a statistics student might take courses in computer science and life sciences. Some courses span more than one focal area; these courses may not be counted towards two focal areas simultaneously.

Some courses that are electives in an M.S. or Ph.D. major may also be counted towards the BLDS minor. For example, a Ph.D. student in Molecular and Cellular Biology (MCB) may select "MCB 576 Introduction to Computing in the Life Sciences" as an elective for their MCB requirements, and also as computer science credit for the BLDS minor.

Required by all students:

BOT 599. Special Topics (Collaborative problem-solving in biological data science) (3)<sup>N</sup>

Documents

FILE NAME	FILE SIZE	COMMENT	DATE ADDED
<a href="#">Jennifer Dennis approval.pdf</a>	73.99 Kb	Jennifer Dennis' approval is attached. No revisions were requested by the liaisons.	May 31, 2016 11:25 am

The minor is open to both M.S. and Ph.D. students. Ph.D students must complete at least 18 credit hours for the minor and M.S. students must complete 15 credit hours.

Students must select courses from at least two disciplinary focal areas outside their undergraduate and graduate majors. For example a life sciences student might take courses in mathematics and computer science, while a statistics student might take courses in computer science and life sciences. Some courses span more than one focal area; these courses may not be counted towards two focal areas simultaneously.

Some courses that are electives in an M.S. or Ph.D. major may also be counted towards the BLDS minor. For example, a Ph.D. student in Molecular and Cellular Biology (MCB) may select “MCB 576 Introduction to Computing in the Life Sciences” as an elective for their MCB requirements, and also as computer science credit for the BLDS minor.

Required by all students:

BOT 599. Special Topics (Collaborative problem-solving in biological data science) (3)N

Students who do not complete an ethics and professionalism class as part of their Ph.D. major must take

MCB 557. Scientific Skills and Ethics (3) or an equivalent course.

Students are recommended to choose their courses from the following lists, depending on their prior preparation as an undergraduate. Equivalent or more advanced courses may be substituted after consultation with the BLDS director. Some courses require pre-requisites.

#### Life Sciences Focal Area

BI 592. Theoretical Ecology (4)

BOT/MCB 575. Comparative Genomics (4)

BOT 599. Special Topics (Introduction to Genome Biology) (3)N

MB 668. Microbial Bioinformatics and Genome Evolution (4)

Z 594. Community Ecology (5)

#### Mathematics Focal Area

MTH 527. Introduction to Mathematical Biology (3)

MTH 528. Stochastic Elements in Mathematical Biology (3) †

MTH 563, MTH 564. Probability I, II (3,3)

or MTH 563. Probability I (3)

and ST 522. Introduction to Mathematical Statistics (4)

or ST 521. Introduction to Mathematical Statistics (4)

and MTH 564. Probability II (3)

VMB 631. Mathematical Modeling of Biological Systems (3)

#### Statistics Focal Area

H 524. Introduction to Biostatistics (4)  
 H 566. Data Mining in Public Health (3)  
 H 580. Linear Regression and Analysis of Time to Event Data (4)  
 H 581. Generalized Linear Models and Categorical Data Analysis (4)  
 ST 521, ST 522. Introduction to Mathematical Statistics (4,4)  
     or MTH 563, MTH 564: Probability I, II (3,3)  
     or MTH 563. Probability I (3)  
         and ST 522. Introduction to Mathematical Statistics II (4)  
     or ST 521. Introduction to Mathematical Statistics (4)  
         and MTH 564. Probability II (3)  
     or ST 511, ST 513. Methods of Data Analysis (4,4)  
 ST 599. Topics in Data Visualization (3)  
 ST 599. Special Topics (Introduction to Quantitative Genomics) (3)  
 ST 599. Special Topics (Statistical Methods for Genomics Research) (3)

### Computer Science Focal Area

BB 585. Applied Bioinformatics (3)  
 CS 519. Topics in Computer Science (0–5)  
     or BB 599. Special Topics (Algorithms for Computational Biology) (3)  
 CS 534. Machine Learning (4)  
 CS 546. Networks in computational biology (3)  
 ECE 560. Stochastic Signals and Systems (4)  
 ECE 564. Digital Signal Processing (4)  
 FW 599. Special Topics (Machine Learning Topics in Species Distribution Modeling) (3)  
 MCB 576. Introduction to Computing in the Life Sciences (3)  
 MCB 599. Special Topics (Introduction to Linux and the Command Line) (2)  
 MCB 599. Special Topics (Introduction to Python I and II) (2)  
 VMB 670. Introduction to Systems Biology (2)

N New planned course

†currently offered as MTH 599

Note: All of the 599 classes here represent classes that are in transition to becoming regular offerings.