New Academic Program:
Bachelor of Science (BS) in Biological Data Sciences

BACKGROUND

Program Proposed Start Date
Fall 2020

Program Description
The College of Agricultural Sciences, through its Botany and Plant Pathology program, is proposing a BS in Biological Data Sciences (BDS), including a minor.

The proposed BDS undergraduate major and minor combine education and practical training in a new paradigm in the life sciences that couples large-scale data collection with advanced computational and analytical methods for data analyses. The proposed program prepares individuals for careers in newly emerging areas in life sciences.

Data are currently being collected at speeds and scales that were previously unimaginable and modern research programs addressing issues of human health, energy, the environment, and food security are heavily dependent on scientists with the skills to work large and complex datasets. The BDS provides students a program with deep training in the life sciences that is strongly integrated with the quantitative sciences, computer science, statistics, and mathematics. In addition to the breadth of training, the BDS will offer a series of core courses that integrate knowledge across disciplines and leverage cohort learning to teach skills critical for working in transdisciplinary research teams. A minor will be offered to complement various other programs available at the university.

Program Context
The BDS program was proposed in response to the need for improved training of 21st century biologists. In July 2013, an OSU task force that 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 developed a strategic plan for coordinated undergraduate curricula in bioinformatics and computational biology. An intercollege committee, assembled to represent expertise necessary for developing an undergraduate transdisciplinary program, established the foundation for the proposed BDS program, and recommended that Botany and Plant Pathology (BPP), in the College of Agricultural Sciences, develop and deliver the program. The resulting proposed program is designed to be collaborative and to integrate courses and faculty across units representing multiple disciplines, including all of the life sciences departments, Chemistry, the School of Life Sciences, the School of Electrical Engineering and Computer Science, the departments of Statistics and Mathematics, and the College of Earth, Ocean, and Atmospheric Sciences.

The BDS program complements research and teaching efforts of BPP. The department has a large nucleus of faculty that use large-scale data in their research and are responsible for generating a large proportion of the large biological datasets at the university. In addition, BPP faculty provide leadership in biological data sciences and teach biological data sciences in various academic programs. Two of the current faculty members were recruited via the 2005

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Computational and Genome Biology and 2010 Systems Biology Provost Initiatives. Two new tenure-track faculty who depend heavily on big data in addressing biological questions have been recruited into BPP. The newly recruited faculty will each teach at least one course in the proposed BDS program and will also serve as academic advisors to students. One new faculty member, who will be joining the Department of Horticulture, will also be developing one course for the proposed BDS program.

There is currently no BDS or BDS-like undergraduate program at Oregon State University or any other public institution in the state of Oregon. Beyond the state, similar programs for undergraduate students are just beginning to be offered. The proposed program will fill a significant need in the university and state and has potential to attract students from other regions of the United States.

Program Purpose/Relationship to University Mission and Strategic Plan

OSU has set goals to further increase the quality of teaching, research, and outreach to meet the mission of promoting economic, social, cultural, and environmental progress in the three signature areas of sustaining Earth ecosystems, improving human health, and promoting economic growth. The proposed BDS program is directly relevant to these signature areas, as solutions to many of the most complex problems require the integration of large and diverse datasets and the linked development of computational models encompassing multiple levels of scale. At OSU, there are many research programs across the life science departments that generate and use big data to address timely issues in human health, food security, global climate change, and social progress. In mathematics, statistics, and computer science, research programs are innovating approaches for processing, analyzing, and modeling large datasets. As part of the learning experience, students will be required to participate in an experiential learning activity and senior capstone courses. These research programs offer multiple opportunities for students to learn to use large and real-world datasets to address societal issues relevant to OSU's three signature areas.

To provide students a transformative educational experience, the BDS program is structured for cohort learning and promotes the integration of domain knowledge from multiple disciplines and teaches skills necessary for effectiveness in teams. The learned skills will prepare students for careers in research and development in academic, private, and government sectors, which are increasingly seeking graduates who are capable of adapting to and bridging multiple disciplines, and who are comfortable with diverse quantitative and computational methods necessary for success in transdisciplinary collaborations.

Need for the Program

More than 20% of the jobs in Oregon fall into the STEM (science, technology, engineering, and math) categories (https://www.qualityinfo.org/-/10-year-occupational-projections-for-stem-jobs). Based on projected job openings, 55% require a bachelor's degree. The projected growth in career opportunities in biological data sciences has led to recent calls for more transdisciplinary training. The National Science Foundation (NSF), for example, announced a $2M award to design an undergraduate curriculum to teach students how to use tools to visualize big datasets. Similar calls for increased training have been made by the private sector. A recent industry association report from the Coalition of State Bioscience Institutes (Coalition of State Bioscience Institutes CSBI, Booz Company, 2014) stated that workers with "Advanced/specialization degrees, such as bioinformatics, biostatistics and computational biology, as well as engineers with the ability to manage complex biological process scale-up" as

well as "the ability to work across disciplines" are in exceptional demand. A training needs assessment by the Oregon Engineering and Technology Industry Council (ETIC) (Oregon Engineering & Technology Industry Needs Portfolio, 2014) stated that in the area of Big Data "Access to well-trained employees who can generate, manage and analyze big data is vital to the success of Oregon businesses," and recommended undergraduate training focused on developing "Life Science students with computational skills" *and* "Computer science students with a sophisticated understanding of biology". The report further stated, "ETIC encourages Oregon's post-secondary institutions to propose programs that will prepare Oregon students to become the T-shaped professionals increasingly demanded by industry." The T-shape is meant to symbolize an individual that is trained deeply in one discipline and with boundary-crossing competencies.

In response to this national and state demand, the then deans of the colleges of Agricultural Sciences and Pharmacy commissioned the task force that recommended the implementation of an undergraduate BDS major and minor.

Program Financials
The BDS program will leverage many courses currently offered by collaborating units. Financials reflect costs for administrating the program, instruction for courses, teaching assistantships, and two support staff. The director will receive one-month summer salary and OPE. During the implementation of this program the new courses (and related salary/OPE costs) will come on-line gradually. The amount listed for "Faculty, Tenured/Tenure-Track" in Academic Year 2023 has been modified from the original estimates provided in the Category I proposal to include one more quarter of teaching. During the submission process, committees from Electrical Engineering and Computer Science recommended the addition of a second quarter to the proposed senior capstone course (BDS 491 + BDS 492). Changes in this document reflect the response to this recommendation. Two graduate students will be supported to assist with teaching in BDS 311 and BDS 411. Their stipend and graduate fee remission combined are listed. The support staff were estimated at 0.1 FTE each. E&G funds and departmental reserves will be used to support the program and its expenses.

At the end of each academic year, student credit hours will be summed by the faculty and/or unit and communicated to the College of Agricultural Sciences so that units receive appropriate credit and recognition for the student credit hours delivered.

	Academic Year 2020	Academic Year 2021	Academic Year 2022	Academic Year 2023
Personnel				
Faculty, Director	12,160	12,525	12,901	13,288
Faculty, Tenured/Tenure-Track	5,181	9,951	15,003	26,338
GTAs (0.49 FTE; term)		8,299	17,095	17,608
Grad Fee Remission		5,158	10,729	11,158
Support Staff	6,366	6,684	7,018	7,369
OPE	11,876	17,492	23,647	30861
Personnel Subtotal	35,583	60,109	86,393	99,770

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Services and Supplies				
GRAND TOTAL	**35,583**	**60,109**	**86,393**	**106,622**

RECOMMENDATION

All appropriate university committees and the OSU Faculty Senate have positively reviewed the proposed program. The Provost recommends that the Academic Strategies Committee approve the establishment of the BS in Biological Data Sciences, effective Fall 2020, pending the support of the Statewide Provosts Council and the approval of the Higher Education Coordinating Commission.