

**Utah System of Higher Education
New Academic Program Proposal
Cover/Signature Page - Abbreviated Template**

Institution Submitting Request: University of Utah
Proposed Program Title: BS/BA in Biology with emphasis in Microbiology
Sponsoring School, College, or Division: College of Science
Sponsoring Academic Department(s) or Unit(s): School of Biological Sciences
Classification of Instructional Program Code¹ : 26.0502
Min/Max Credit Hours Required of Full Program: Min Cr Hr / Max Cr Hr
Proposed Beginning Term²: Fall 2019
Institutional Board of Trustees' Approval Date:

Program Type:

☐	Certificate of Proficiency	☐	Entry-level CTE CP	☐	Mid-level CP
☐	Certificate of Completion				
☐	Minor				
☐	Graduate Certificate				
☐	K-12 Endorsement Program				
☒	NEW Emphasis for Regent-Approved Program <i>Credit Hours for NEW Emphasis Only:</i> Min Cr Hr / Max Cr Hr <i>Current Major CIP:</i> 26.01 <i>Current Program Title:</i> Biology <i>Current Program BOR Approval Date:</i>				
☐	Out of Service Area Delivery Program				

Chief Academic Officer (or Designee) Signature:

I, the Chief Academic Officer or Designee, certify that all required institutional approvals have been obtained prior to submitting this request to the Office of the Commissioner.

Please type your first and last name _____ Date: _____

☐ I understand that checking this box constitutes my legal signature.

¹ For CIP code classifications, please see <http://nces.ed.gov/ipeds/cipcode/Default.aspx?y=55>.

² "Proposed Beginning Term" refers to first term after Regent approval that students may declare this program.

**Utah System of Higher Education
Program Description - Abbreviated Template**

Section I: The Request

University of Utah requests approval to offer the following Emphasis: BS/BA in Biology with emphasis in Microbiology effective Fall 2019. This program was approved by the institutional Board of Trustees on .

Section II: Program Proposal/Needs Assessment

Program Description/Rationale

Present a brief program description. Describe the institutional procedures used to arrive at a decision to offer the program. Briefly indicate why such a program should be initiated. State how the institution and the USHE benefit by offering the proposed program. Provide evidence of student interest and demand that supports potential program enrollment.

This proposal for a new emphasis in Microbiology is the outcome of a three-year effort to reform the undergraduate curriculum in the School of Biological Sciences. The initial organization of the reform effort was carried out by a task force that included members from all divisions within the School (previously department), and its goals were to assess (and remediate, if needed) the freshman-year experience and to make it easier for undergraduates to navigate the major in four years.

Discussions were held among faculty in each of the departmental divisions as well as groups of faculty representing specific teaching areas (e.g. Cell Biology or Ecology). There was strong participation among both tenure-line and career-line faculty, and the discussions identified three major problems. First, biology students were not offered laboratory classes, nor being exposed to the full breadth of the biological sciences, during their first year. Second, biology has grown enormously in the 20+ years since the last curriculum reorganization, and this explosive growth has also led potential employers of our undergraduates to seek more specialized training. Third, the diversity of course offerings make it challenging for many undergraduates to identify the set of course choices that best meets their interests and career goals.

To address the first of these challenges, a new first-year Biology curriculum has been developed. This course sequence, Fundamentals of Biology, includes two 3-credit lecture-type courses, and two 1-credit inquiry-based labs (8 credits total). The wide-ranging content of these courses was developed in consultation with the entire biology faculty. This course sequence is being offered now (Fall 2018) with limited enrollment (~100 students), and will be available to all the students beginning Fall 2019.

To address challenges two and three, the growth of biology and difficulty for undergraduates to identify coherent sets of courses, the school proposes expanding the number of emphases. In addition, the school proposes allowing both increased flexibility and greater specialization by making changes in the required biology core courses. The proposed new core will include the BIOL 1600 sequence (8 credits), BIOL 2020 (Cell Biol, 3 cr), and BIOL 2030 (Genetics, 3 cr), which will be accompanied by emphasis-specific requirements and emphasis-specific electives.

This proposed emphasis in Microbiology is one of four new emphases being proposed by the school, with the others being Genetics & Genomics, Plant Biology, and Neuroscience. These emphases were approved by the school's Curriculum Committee, presented to the faculty on October 22nd, 2018, and won near unanimous approval (29 for, one abstention).

The proposed emphasis would be the first and only undergraduate curriculum program on campus in the broad area of Microbiology. Although two undergraduate courses with some microbiology content are offered through the Department of Pathology in the School of Medicine (Intro to Medical Microbiology and Mechanisms of Bacterial Pathogenesis), these have a primarily medical focus. The proposed emphasis within the School of Biological Sciences is organized around material that is more broadly relevant to biology at all scales, including substantial exploration of microbial cell structure, physiology, and ecosystem functioning. One of the required courses for the proposed emphasis (BIOL 3370 Microbial Biology) currently enrolls ~65 students each year, and we anticipate offering it both semesters each year after it becomes a required component of the emphasis.

The University of Utah is unusual among large universities in lacking an option for a degree or major in Microbiology, so this proposed emphasis would be one small but significant step toward matching our peer institutions. As the only curriculum specific to Microbiology on campus, there will be no overlap with other emphases or degrees, and we expect the emphasis to immediately attract as many as ~10% of the current 1,200 Biology majors each year, with the potential for growth in future years.

Labor Market Demand

Provide local, state, and/or national labor market data that speak to the need for this program. Occupational demand, wage, and number of annual openings information may be found at sources such as Utah DWS Occupation Information Data Viewer (jobs.utah.gov/jsp/wi/utalmis/gotoOccinfo.do) and the Occupation Outlook Handbook (www.bls.gov/oco).

Microbiology is an important sector of the economy in Utah. There are estimated to be 222 Microbiologists in the state, working in diverse fields, as described below, and this number is expected to increase by 3% per year. Important, microbiology is an essential skill for many jobs that lack the word Microbiology in their title. These are jobs such as nurses, wastewater managers, biochemists, and technicians in medical and clinical laboratories, and these have similar projected employment growth.

The field of Microbiology has experienced a rapid spike in public attention thanks to recent discoveries in the importance of non-pathogenic and potentially beneficial microbial communities in human health. The "human microbiome" now receives considerable federal funding and has been targeted as a market growth area by both traditional biotechnology firms and many new start-up companies. The intense interest in human microbiome research was encapsulated by the 2016 announcement by President Obama of the National Microbiome Initiative, which "will focus on comparative study of microbiomes across different ecosystems to seek organizing principles that shape all microbiomes." In addition to human health, the study of natural microbial populations has been recently recognized as essential for understanding the functions of all ecosystems on Earth, including soils, forests, and aquatic systems, with additional applications for agriculture and civil and environmental engineering. Thus, a wide range of employers will be seeking workers trained in Microbiology in the near future, including the burgeoning biotechnology sector in Utah.

Therefore, this emphasis will assist with the Governor's vision of a well-educated workforce. We expect this emphasis to increase the rates at which young adults earn a BS/BA in Biology because its core requirements allow greater flexibility than the standard BS/BA in Biology at the University of Utah. In addition, the emphasis will help undergraduates to enroll in a coherent set of courses that emphasizes Microbiology. As described above, this area is important to the Utah economy, and a degree carrying this emphasis should help to meet the demands of our current and future workforce.

Consistency with Institutional Mission/Impact on Other USHE Institutions

Explain how the program is consistent with the institution's Regents-approved mission, roles, and goals. Institutional mission and roles may be found at higherutah.org/policies/policyr312/ . Indicate if the program will be delivered outside of designated service area; provide justification. Service areas are defined in higherutah.org/policies/policyr315/ .

Central to the mission of the University of Utah is to provide students of diverse backgrounds with a foundation for future success, including becoming leaders and engaged citizens, and including promotion of education, health and quality of life. The Department of Biology contributes to this mission by providing broad training in the biological sciences. Graduates with a BS/BA in Biology pursue a diversity of careers both in the public and private sectors. Many seek to continue their education with additional postgraduate training in health-related or academic fields. While Biology majors have a high success rate in these endeavors, this emphasis will help students in several ways. First, it guides students along a cohesive intellectual path toward an in-depth yet broad exposure to Microbiology, while also providing excellent preparation for postgraduate careers and professional schools. Second, because this emphasis will be featured on their transcript and diploma, it will help the students to convey the depth of their preparation to other educational institutions and to potential employers. The program will not be delivered outside of the designated service area, but instead will be delivered within our designated service area at the University of Utah, in Salt Lake County, Utah.

Broad learning objectives for the Microbiology Emphasis in Biology

Evolution: Students will be able to understand the role of genetic mechanisms in evolution and apply the principles of natural selection and mechanisms of genetic change, including trait variation and heritability, to explain the observed diversity of microbial life.

Transmission, flow and interpretation of biological information

Students will understand the chemical basis of heredity and apply knowledge of genetics, gene expression, growth, signal perception and transduction, to explain how information is stored, transmitted and utilized in microbes.

Structure and function

Students will be able to apply knowledge of molecular, cellular, and organismal structures to explain the diverse set of functions – ranging from the sub cellular to ecological – that underlie the remarkable diversity of microbes.

Systems: Students will be able to explain how biological units interact to give rise to emergent properties at multiple levels of microbial life. These interactions range from the cellular level to interactions between microbes in a biofilm to interdependency of microbes with their environment.

Ability to apply the process of science.

Students will be able to apply the process of science to identify knowledge gaps, formulate hypotheses, and test them against experimental and observational data to advance an understanding of the microbial world, and execute experiments in microbial model systems.

Ability to use quantitative reasoning.

Students will be able to use mathematical and computational methods and tools to describe microbial systems and be able to apply quantitative approaches, such as statistics, quantitative analysis of dynamic systems, or mathematical modeling.

Ability to participate in the interdisciplinary nature of science through clear communication and collaboration with other disciplines

Students will be able to use and apply concepts in microbiology to communicate microbiology research data to broad audiences, write research articles and/or grant proposals, and present posters at meetings or symposia.

Ability to explain the relationship between science and society

Students will be able to evaluate the interactions between microbes and society, including the societal impacts of microbiology research and technology on human health, biotechnology, ecology and the environment. Students will also evaluate public perception and decision-making about science relevant to microbes, and clearly communicate their implications to broad audiences.

Assessments

Assessments and grades in courses. Assessments (formative and summative) and grades in the emphasis-required and emphasis recommended elective courses will be used to evaluate student performance in the various targeted learning outcomes. For example, presentations in the seminar course will be used to evaluate communication skills and grades in laboratory courses will be used to evaluate the ability to apply the process of science. These data will be used by the school to interpret trends and as needed address curricular changes to improve certain outcomes.

Exit surveys. Graduating students will be encouraged to fill out an on-line survey that asks for self-assessment in emphasis-specific learning outcomes.

Feedback from alumni and tracking students after graduation. Alumni will be periodically surveyed to ask how well their training in the Microbiology emphasis has helped them in their careers. The program will also collect data on the first position taken by graduates after completing their emphasis. The assumption being made is that successfully obtaining professional positions/admissions is a measure of our graduates achieving the desired learning outcomes.

Finances

What costs or savings are anticipated in implementing the proposed program? If new funds are required, indicate expected sources of funds. Describe any budgetary impact on other programs or units within the institution.

This new emphasis in Microbiology will have no impact on the finances of the University of Utah. All courses in the emphasis are already being taught.

Section III: Curriculum

Program Curriculum

List all courses, including new courses, to be offered in the proposed program by prefix, number, title, and credit hours (or credit equivalences). Indicate new courses with an X in the appropriate columns. The total number of credit hours should reflect the number of credits required to receive the award. **For NEW Emphases, skip to emphases tables below.**

For variable credits, please enter the minimum value in the table below for credit hours. To explain variable credit in detail as well as any additional information, use the narrative box below.

Course Number	NEW Course	Course Title	Credit Hours
General Education Courses (list specific courses if recommended for this program on Degree Map)			
General Education Credit Hour Sub-Total			
Required Courses			
Add Another Required Course			
Required Course Credit Hour Sub-Total			
Elective Courses			
Add Another Elective Course			
Elective Credit Hour Sub-Total			
Core Curriculum Credit Hour Sub-Total			0

Are students required to choose an emphasis for the already-existing degree?	Yes or	No
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Course Number	NEW Course	Course Title	Credit Hours
Name of Emphasis:		Microbiology	
Required		BIOL 3370 Microbial Biology	3
Required		BIOL 3410 Ecology & Evolution	3
Select 3 of 7		BIOL 3205 Microbiology lab	1
Select 3 of 7		BIOL 3210 General and Pathogenic Microbiology	3
Select 3 of 7		BIOL 3270 Microbial Ecosystems	3
Select 3 of 7		BIOL 3510 Biological Chemistry I	3
Select 3 of 7		BIOL 5255 Prokaryotic Genetics	3
Select 3 of 7		BIOL 5275 Microbial Diversity, Genomics and Evolution	4
Select 3 of 7		BIOL 5425 Mycology	4
Add Another Emphasis Course			
Emphasis Credit Hour Sub-Total			14
Total Number of Credits to Complete Program			14

Propose a NEW Emphasis to an existing Regent approved program

Program Curriculum Narrative

Describe any variable credits. You may also include additional curriculum information, as needed.

Note that the precise number of credits earned from the "Select 3 of 7" category will vary depending on choices. The minimum number of credits that can be taken for the emphasis is 14, and the maximum is 17.

Degree Map

Degree maps pertain to undergraduate programs ONLY. Provide a degree map for proposed program. Degree Maps were approved by the State Board of Regents on July 17, 2014 as a degree completion measure. Degree maps or graduation plans are a suggested semester-by-semester class schedule that includes prefix, number, title, and semester hours. For more details see <http://higheredutah.org/pdf/agendas/201407/TAB%20A%202014-7-18.pdf> (Item #3).

Please cut-and-paste the degree map or manually enter the degree map in the table below

BS in Biology with an emphasis in Microbiology

Year 1, Fall

WTRG 2010 3cr

MATH 1210 or MATH 1170 4cr

BIOL 1610 3cr

BIOL 1615 1cr

BIOL 2870 1cr

University Credits 3cr

TOTAL 15cr

Year 1, Spring

BIOL 1620 3cr

BIOL 1625 1cr

CHEM 1210 4cr

CHEM 1215 1cr

MATH 1220 (or MATH 1180) 4cr

General Education-AI 3cr

TOTAL 16cr

Year 2, Fall

CHEM 1220 4cr

CHEM 1225 1cr

BIOL 2020 (or BIOL 2021 4cr) 3cr

General Education-AI 3cr

Bachelor Degree IR 3cr

TOTAL 14-15cr

Year 2, Spring

CHEM 2310 4cr

BIOL 2030 3cr

General Education-BF 3cr

Biology Science Elective 3cr

General Education-HF 3cr

TOTAL 16cr

Year 3, Fall

PHSY 2010 (or PHYS 2110 or 2210 or 3210) 4cr

BIOL 3210 3cr

General Education-FF 3cr

Bachelor Degree DV 3cr

Biology science elective 3cr

TOTAL 16cr

Year 3, Spring
PHSY 2020 (or PHYS 2120 or 2220 or 3220) 4cr
BIOL 3410 3cr
General Education-FF 3cr
Bachelor Degree-CW 3cr
BIOL 3370 (Emphasis required) 3cr
TOTAL 16cr

Year 4, Fall
BIOL 3510 3cr
General Education-HF 3cr
Bachelor Degree QI 3cr
BIOL 5495 [L1] 4cr
TOTAL 13cr

Year 4, Spring
BIOL 5255 [L2] 3cr
Bachelor Degree QI 3cr
Upper division electives 3cr
University credits 3cr
TOTAL 12

BA in Biology with an emphasis in Microbiology

Year 1, Fall
WTRG 2010 3cr
MATH 1210 or MATH 1170 4cr
BIOL 1610 3cr
BIOL 1615 1cr
BIOL 2870 1cr
Bachelor Degree-Language 4cr
TOTAL 16cr

Year 1, Spring
BIOL 1620 3cr
BIOL 1625 1cr
CHEM 1210 4cr
CHEM 1215 1cr
MATH 1220 or MATH 1180 4cr
Bachelor Degree-Language 4cr
TOTAL 17cr

Year 2, Fall
CHEM 1220 4cr
CHEM 1225 1cr
BIOL 2020 (or BIOL 2021 4cr) 3cr
General Education-AI 3cr
TOTAL 11-12cr

Year 2, Spring
CHEM 2310 4cr
BIOL 3410 3cr
General Education-BF 3cr

Bachelor Degree-Language 4cr
General Education-HF 3cr
TOTAL 17cr

Year 3, Fall
PHSY 2010 (or PHYS 2110 or 2210 or 3210) 4cr
BIOL 2030 3cr
BIOL 3210 3cr
General Education-HF 3cr
Bachelor Degree-DV 3cr
TOTAL 16cr

Year 3, Spring
PHSY 2020 (or PHYS 2120 or 2220 or 3220) 4cr
BIOL 3370 (emphasis required) 3cr
Upper division General elective 3cr
Bachelor Degree-CW 3cr
Bachelor Degree-IR 3cr
TOTAL 16cr

Year 4, Fall
BIOL 3510 3cr
BIOL 5495 [L1] 4cr
General Education-HF 3cr
Upper division General elective 3cr
TOTAL 13cr

Year 4, Spring
BIOL 5255 [L2] 3cr
Biology -3000+elective 3cr
Upper division General electives 3cr
General Education-FF 3cr
General Education-BF 3cr
TOTAL 15cr