

**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 Genetics & Genomics
Sponsoring School, College, or Division: College of Science
Sponsoring Academic Department(s) or Unit(s): School of Biological Sciences
Classification of Instructional Program Code¹ : 26.0803
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:

<input type="checkbox"/>	Certificate of Proficiency	<input type="checkbox"/>	Entry-level CTE CP	<input type="checkbox"/>	Mid-level CP
<input type="checkbox"/>	Certificate of Completion				
<input type="checkbox"/>	Minor				
<input type="checkbox"/>	Graduate Certificate				
<input type="checkbox"/>	K-12 Endorsement Program				
<input checked="" type="checkbox"/>	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>				
<input type="checkbox"/>	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 Genetics & Genomics 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 Genetics & Genomics 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, Fundamental 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 Genetics & Genomics is one of four new emphases being proposed by the school, with the others being Microbiology, 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).

Currently there are approximately 1160 majors in Biology. Of these, about half are enrolled in existing emphases (20% Anatomy and Physiology, 14% Cell and Molecular, 9% Environmental & Organismal, and 5 % Biochemistry), indicating the appeal for students to focus their studies within Biology. The remaining 52% are not pursuing a particular emphasis. We anticipate that ~15% of our students will choose to pursue a new emphasis in Genetics & Genomics.

The University of Utah will benefit in many ways from a Genetics & Genomics emphasis. Genetics is the study of inheritance, and genomics is the study of genome structure and function. As the DNA in genomes harbors the information underlying inheritance, combining "Genetics" with "Genomics" is a natural pairing for an emphasis. Within the biological sciences, there has been an explosion of interest in both in the past decade. For example, developments in these fields are at the forefront of personalized medicine, including the development of so-called "genome-editing techniques" for genetic modification (for instance, to overcome inherited diseases), strategies to reduce the transmission of diseases, and the breeding of more robust animals and plants in agriculture (an outcome of critical importance for human welfare).

The recent advances in these fields have been possible in part because of transformative technological and conceptual advances. As recently observed by Michael Snyder, Chair of the Department of Genetics at Stanford:

"Genetics and genomics are undergoing an unparalleled revolution: our mission is to continue to lead this revolution for a better understanding of biology and human health."

The Department of Genetics at Stanford is just one of many instances of a competing PAC-12 institution that offers genetics/genomics focused degrees. A Genetics & Genomics emphasis in the School of Biological Sciences at the University of Utah is urgently needed, both for attracting and training students interested in these disciplines, as well as to credential them, which will aid in their pursuing diverse career options in these fields (for example, admittance to graduate or other professional schools in the many Genetics, Genomics, or Medical-related departments at PAC-12 institutions and beyond; see also section Labor Market Demand).

In summary, the School of Biological Sciences needs the Genetics & Genomic emphasis to provide appropriate undergraduate training so that we can compete nationally in this major and growing sub-discipline in the biological and life sciences.

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).

Career opportunities in Genetics & Genomics are growing rapidly, both locally and nationally. In the Salt Lake Valley there are

a number of companies and institutions that hire individuals with training in genetics and genomics, including Myriad Genetics, Biofire, AARUP Laboratories and the University of Utah. Careers for individuals with Genetics & Genomics training are also growing across the country, as evidenced by the citations below.

“As the details of the human genome unfold, the variety of opportunities for people with degrees and training in human genetics is continuing to expand. There are opportunities in basic and clinical research, in medical professions, and in interdisciplinary fields, such as patent law. The genetics workforce is not sufficient even now, and demand continues to increase. For example, as genetic testing becomes more commonplace, and a part of many routine medical evaluations, more laboratory geneticists will be needed to perform the tests, and clinicians and counselors will be needed to interpret and explain the results to individuals and families. At the intersection of genetics and computer science, bioinformaticists are in high demand to make sense of complex data. As genetics is recognized to be a basic part of all biological sciences, more and more teachers with expertise in genetics will also be needed. These are just a few examples of the growing demand for professions trained in genetics.”

— American Society for Human Genetics (<https://www.ashg.org/education/careers.shtml>)

“The six most in demand biotech jobs right now: #1. Genetic Counselors; #3. Laboratory Technologists/Technicians”

—Biospace.com, a job site for the Life Sciences Industry, Oct. 26, 2017 (<https://www.biospace.com/article/the-6-most-in-demand-biotech-jobs-right-now/>)

“The overall job outlook for Geneticists Careers has been positive since 2004. Vacancies for this career have increased by 16.23 percent nationwide in that time, with an average growth of 2.71 percent per year. Demand for Geneticists is expected to go up, with an expected 7,170 new jobs filled by 2018. This represents an annual increase of 2.95 percent over the next few years.”

— Recruiter.com (<https://www.recruiter.com/careers/geneticists/outlook/>)

“Top 10 Biotech Jobs Most in Demand over the Next Decade: #1. Medical and Clinical Laboratory Technologists and Technicians (13% growth); #2. Medical Scientists (13% growth); #3. Biological Technicians (10% growth); #9. Genetic Counselors (29% growth)”

—Genetic Engineering and Biotechnology News, April 23, 2018 (<https://www.genengnews.com/the-lists/top-10-biotech-jobs-most-in-demand-over-the-next-decade/77901083>)

“There has been a huge movement in affordable rapid genome sequencing recently and this will produce massive numbers of new genetic data on individuals, as well as populations. The challenge is now on for a new generation of scientists who are able to combine genetics and bioinformatics in an effort to understand how various genomic changes can cause life-threatening diseases such as cancer. This will enable the development of new treatments, through combining drug and gene therapy, along with prevention strategies. Due to the expansion in the numbers of individual genomes now being sequenced, you'll find that this is one of the quickest growing areas of biomedical science.”

— New Scientist / Jobs, Dec. 12, 2017 (<https://jobs.newscientist.com/article/a-career-in-genetics-and-genomics/>)

This emphasis will also assist with the Governor's vision of a well-educated workforce. We expect this emphasis to increasing 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 that emphasizes Genetics & Genomics. 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 Genetics and Genomics, 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, it will only be offered at the University of Utah, in Salt Lake City.

Broad learning objectives for the Genetics and Genomics 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 life.

Transmission, flow and interpretation of biological information

Students will understand the chemical basis of heredity and apply knowledge of genetics, gene expression, development and genomics to explain how information is stored, transmitted and utilized in biological contexts.

Structure and function

Students will be able to apply knowledge of molecular and cellular structures and functions to explain inheritance of traits in populations.

Systems: Students will be able to explain how biological units interact to give rise to emergent properties at multiple levels of organization. These interactions range from gene regulation at a cellular level to genetic networks and interactions at an organismal level.

Ability to apply the process of science.

Students will be able to apply the process of science to synthesize conclusions based on genetic and genomic data and design, and execute genetic experiments in microbial, insect, animal or plant model systems.

Ability to use quantitative reasoning.

Students will apply mathematical and statistical methods to analyze and interpret genetic and genomic data. Students will computationally and mathematically model complex biological systems.

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 genetics and genomics to communicate 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 impacts of genetics and genomics research and technologies on health, biotechnology, ecology and the environment. Students will also be able to evaluate public perception and decision-making about genome science.

Assessment of ELOs

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.

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.

Implementation of this new emphasis can be done with no impact on finances of the University. Students can complete the degree by choosing several options/electives from the existing course catalog. However, the addition of cutting edge laboratory course in Eukaryotic Genetics is highly desirable. In the future, we will attempt to implementing such a course by finding donors willing to assist with the investment in modern laboratory equipment that would be needed, since existing equipment is already oversubscribed or inadequate for this class.

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:		Genetics & Genomics	
required		BIOL 3510 Biochemistry-I	3
required		BIOL 3410 Ecology & Evolution	3
select 2 of 4		BIOL 5140 Genome Biology	3
		BIOL 5255 Prokaryotic Genetics	3
		BIOL 5510 Evolutionary Developmental Biology	3
		BIOL 5920 Advanced Eukaryotic Genetics	3
select 4cr		BIOL 3525 Molecular Biology of DNA	3
		BIOL 5120 Gene Expression	3
		BIOL 5255 Prokaryotic Genetics	3
		BIOL 5275 Microbial Diversity Genomics evolution	4
		BIOL 5221 Human Evolutionary Genetics	4
		BIOL 3215 Cell Biology lab	3
		BIOL 3235 Developmental Biology lab	3
		BIOL 5110 Molecular Biology Genetic Engineering	3
		BIOL 3210 General and Pathogenic Microbiology	3
		BIOL 3205 Microbiology lab	1
		BIOL 3125 Molecular tools for evol/pop bBology	3
		BIOL 3230 Developmental biology	3
		BIOL 3520 Biochemistry II	3
		BIOL 5210 Cell Structure and Function	3
		BIOL 5910 Math Models in Biology	3
Add Another Emphasis Course			
Emphasis Credit Hour Sub-Total			16
Total Number of Credits to Complete Program			16

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.

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

DEGREE MAP, BS IN BIOLOGY with emphasis in GENETICS & GENOMICS

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 15 cr

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 16 cr

Year 2, Fall

CHEM 1220 4cr
CHEM 1225 1cr
BIOL 2020/2021 3-4cr
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 PHYS 2210 or PHYS 3210) 4cr
BIOL 3510 (or CHEM 3510) 3cr
BIOL 5510 (Emphasis specific) 3cr
General Education-FF 3cr
Bachelor Degree DV 3cr
TOTAL 16cr

Year 3, Spring
PHSY 2020 (or PHYS 2120 or PHYS 2220 or PHYS 3220) 4cr
BIOL 3410 3cr
General Education-FF 3cr
Bachelor Degree-CW 3cr
BIOL 5140 (Emphasis specific) 3cr
TOTAL 16cr

Year 4, Fall
Biology Science Elective 3cr
Biology -3000+elective lab (e.g Biol 3525 [L2]) 3cr
General Education-HF 3cr
Bachelor Degree QI 3cr
TOTAL 12cr

Year 4, Spring
Biology -3000(+elective lab [L1]) 3cr
Bachelor Degree QI 3cr
Upper division electives 3cr
University credits 3cr
TOTAL 12cr

DEGREE MAP, BA IN BIOLOGY with emphasis in GENETICS & GENOMICS

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 2021 4cr) 3cr
General Education-AI 3cr
TOTAL 11-12 cr

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 PHYS 2210 or PHYS 3210) 4cr
BIOL 2030 3cr
BIOL 5510 (Emphasis specific) 3cr
General Education-HF 3cr
Bachelor Degree DV 3cr
TOTAL 16cr

Year 3, Spring
PHSY 2020 (or PHYS 2120 or PHYS 2220 or PHYS 3220) 4cr
BIOL 3510 (or CHEM 3510) 3cr
Upper division General elective 3cr
Bachelor Degree-CW 3cr
Bachelor Degree-IR 3cr
TOTAL 16cr

Year 4, Fall
Biology elective-3000+ 3cr
Emphasis 3000+ elective lab [L1] 1cr
General Education-HF 3cr
Upper division General elective 3cr
Emphasis-3000+elective 3cr
TOTAL 13cr

Year 4, Spring
BIOL 5140 (Emphasis specific) 3cr
Biology -3000+elective lab[L2] 3cr
Upper division General electives 3cr
General Education-FF 3cr
General Education-BF 3cr
TOTAL 15cr