

Request for Establishment of Emphases for Biology Majors at the University of Utah

Section I: Request

The Department of Biology at the University of Utah proposes to offer 3 emphases for students majoring in Biology: 1. Biochemistry, 2. Cell & Molecular Biology, and 3. Environmental & Organismal Biology. A fourth option (no emphasis) will allow students essentially the same flexibility as that afforded to current Biology majors.

The core requirements for all three emphases and the no-emphasis option will be the same (see attached documentation). The basis for this request is that the emphases will provide guidance to students who wish to focus on a specific area of Biology. The subject of biology is becoming increasingly diverse to the extent that the singular “BS in Biology” no longer has the capacity to accurately convey a student’s training in one sub-discipline or another. The emphasis notation will assist those evaluating a student’s transcript by denoting an interest and pursuit of in-depth biological literacy in a particular area. This will be of utility to potential employers and evaluators for professional and graduate schools. In addition, the proposed introduction of emphases calls for a reduction in the core ancillary science requirements for Biology majors, a change that will permit undergraduate students a degree of flexibility in pursuing areas of interest, particularly those that are interdisciplinary in nature. These cross-cutting areas have usually been excluded by disciplinary (i.e. departmental) boundaries but now, more than ever before, it would be wise to embrace cross-disciplinary training since it is likely to open opportunities for employment. This prospect is precluded by the existing structure of the Biology major, but would be facilitated and encouraged with the proposed restructured Biology major with emphases.

This change is accomplished by reducing the total number of credit hours that are currently required in ancillary science (specifically Organic Chemistry). As it currently stands, Biology majors are now required to take 38 hours of ancillary science distributed as follows: Mathematics (8 hours), Chemistry (22 hours), Physics (8 hours). Reducing the number of hours required in ancillary sciences should also permit Biology majors to start tackling core Biology requirements sooner in their undergraduate careers. This has been a major problem for Biology undergraduates. It is important to note that the additional credit hours that are liberated will **not** be absorbed by requiring students to take additional Biology courses. Instead, students are free to use these elective credit hours in any approved scientific discipline including Chemistry. The number of Biology credit hours required for the major remains the same as the current requirement at 36 hours.

Section II: Need

Biology students previously have had free range over a wide variety of Biology elective courses. While this has made the curriculum robust, it has promoted a culture in which students choose elective courses, in part, as a matter of convenience for their schedule

rather than as a way to satisfy their intellectual curiosity and develop a coherent background in one of the sub-disciplines that make up modern biological science. The faculty wishes to introduce emphases as a way to provide specific guidance to students on the advanced courses that they should take if they are interested in a particular area. The proposed emphases are aligned with the current research organization of the department and are, therefore, well supported in terms of the courses available to students. In addition, the current prerequisites demanded of Biology majors in ancillary science are substantial and prevent many students from taking required Biology classes until their junior or senior years. Reducing this burden should allow students to start taking Biology core classes sooner in their undergraduate careers. Hopefully, this will also help to alleviate problems with students taking classes out of sequence (i.e. without the appropriate pre-requisites).

A program in Biological Chemistry is offered by the Department of Chemistry at the University of Utah. A certain degree of overlap is anticipated between the Biological Chemistry program and the proposed Biology major with Biochemistry emphasis; however, there are important distinctions and a critical need for the Biology option. By making a Biochemistry emphasis available through the Department of Biology, we will provide a unique opportunity for students to study the chemistry of living systems and also obtain a solid foundation in biological science, delivered through the Biology core courses which convey critical concepts in form & function, evolution, diversity, genetics, cell biology and biochemistry.

Section III: Institutional Impact

The reduction in requirement for Biology students to take Organic Chemistry may affect enrollments in those Chemistry classes. However, this will be at least partially offset by students taking the Biochemistry emphasis as well as the expectation that a significant number of majors will continue to take a full suite of organic chemistry in order to remain competitive for admission into medical school (most medical schools require 2 semesters of Organic Chemistry). Furthermore, students will be free to use elective credits to take courses in any approved department which automatically includes all units in the College of Science. We do not anticipate any further institutional impacts.

Section IV: Finances

No financial impact on the department or institution is expected. The introduction of emphases will likely place additional burden on our advising office, this will be dealt with internally.

Biology BS Core Requirements

Students wishing to obtain a BS in Biology must complete at least 72 semester hours of Science courses (same as current major) including the following:

Ancillary Sciences (30 hrs)

Math 1210 and 1220 or 1170 and 1180 (8 hrs total)

Physics 2X10 and 2X20 (8 hrs total)

Chem 1210 and 1220 (8 hrs total) *General chemistry*

Chem 1215 and 1225 (2 hrs total) *General chemistry laboratory*

Chem 2310 (4 hrs total) *Organic chemistry I*

At least 36 hrs of Biology courses including:

Biology core (18 or 19 hrs)

Biol 2010 (3) *Evolution and Diversity*

Biol 2020 or 2021 (3 or 4) *Cell Biology*

Biol 2030 (3) *Genetics*

Biol 3410 (3) *Ecology and Evolution*

Biol 3510 (3) *Biochemistry I*

Form and function: one course from menu below (3 hrs)

Biol 3310 (3) *Comp. Vert. Morph.*

Biol 3320 (3) *Comp. Physiology*

Biol 3330 (3) *Behav. Neurobiol.*

Biol 3350 (3) *Plant Physiology*

Biol 3370 (3) *Microbial Biology*

Biol 5360 (3) *Human Form, Func. & Evol.*

Biol 5365 (4, L1) *Plant Struct.*

These core requirements are consistent for all 3 proposed emphases as well as the no-emphasis option.

Additional Biology electives bringing total Biology to 36 hrs, meeting the following requirements/criteria:

- Courses with numbers <2000 cannot be applied to the 36 hrs of Biology credits
- A max of 6 units of 2000-level electives can be counted towards the 36 hrs of Biology
- At least two courses at the 5000-level or higher
- A max of 3 hours from Biol 5312 - 5316 can be applied to the required 36 hrs of Biology (up to 3 additional hrs from these courses can be applied to science electives)
- A total of 4 approved lab classes totaling 5 lab credits
- Biol 4955 (Independent Research) and 4995 (Honors Research) can only count towards 3 hrs of electives and only 1 lab course (max 2 credits). Honors research in an approved faculty lab can be counted for up to 3 lab classes (6 credits max.) with successful completion of an Honors thesis
- At least 21 hrs of Biology courses must be from the U
- Additional Science electives to fulfill the requirement for 72 hrs of Science may be from any Department in the College of Science (Biology, Math, Physics, or Chemistry) or approved Departments/Programs elsewhere on campus. **Note:** *students fulfilling these "science electives" by taking Chem 2320 and 2315 and 2325, and have taken Biol 3520 or Biol 3525 or Biol 5810 are eligible for a Chemistry minor.*

In general, these criteria as well as being requirements of all Biology BS students (no emphasis) are generally applicable to all 3 emphases. Exceptions are noted as appropriate.

Biology BS: Biochemistry Emphasis

- Ancillary Science and Biology Core requirements (detailed above)
- *Biochemistry* emphasis students will be required to take Organic Chemistry II (lecture), and select courses from each of three menus: Biochemistry (2 courses), Advanced Molecular Genetics (1 course), and Biophysics (1 course). (15-17 hours)
- Laboratory: *Biochemistry* emphasis students will select two biochemistry-focused labs from a Biochemistry Lab menu which includes Organic Chemistry I Lab as a choice. Additional Biology approved lab courses, selected from a General Lab menu will add up to at least 5 lab units, with no more than 2 lab units from independent research, unless the student is involved in Honors research in an approved Biochemistry faculty lab, where up to 3 lab classes (6 credits max.) may be earned.
- Additional Biology Electives bringing total to 36 hours (0-4 hours)
- Additional Science electives to fulfill the requirement for 72 hrs of Science may be from any department in the College of Science (Biology, Math, Physics, or Chemistry) or approved Departments/Programs elsewhere on campus. **Note:** *students that fulfill these "science electives" by taking Chem 2325, and have taken Biol 3520 or Biol 3525 or Biol 5810 as part of the Biochemistry emphasis are eligible for a Chemistry minor.*

Biochemistry emphasis (required course) (4 hours)

Chem 2320 (4) Organic Chemistry II

Biochemistry emphasis electives (11-13 hours)

Biochemistry menu (2 courses)

Chem 3520 (3) Biological Chemistry II

Biol 3515 (2, L1) Biological Chemistry I

Biol 3525 (3, L2) Molecular Biology of DNA

Biol 5540 (3) Biochemistry of Membrane Processes

Advanced Molecular Genetics menu (1 course)

Biol 5120 (3) Gene Expression

Biol 5140 (3) Genome Biology

Biol 5275 (4, L1) Microbial Diversity and Genome Evolution

Blchem 6400 (3) Genetic Engineering

Biophysics menu (1 course)

Biol 3820 (3) Physical Principles in Biology

Biol 5810 (3) Nanoscience

Biochemistry Laboratory menu (2 courses)

Chem 2315 (L2) Organic Chemistry I Lab

Biol 3515 (L1) Biological Chemistry Lab
Biol 3525 (L2) Molecular Biology of DNA Lab

General Laboratory menu (2 courses)

Biol 2115 (L2) Basic Lab Technique
Biol 3215 (L2) Cell Lab
Biol 3245 (L1) Cell Neurobiology Lab
Biol 4955 (L1-2) Independent Research
Biol 4995 (L1-2) Honors Research
Biol 5275 (4, L1) Microbial Diversity and Genome Evolution

Biology BS: Cell and Molecular (C&M) Emphasis

- Ancillary Science and Biology BS Core requirements (detailed above)
- Three C&M electives, at least one at 5000-level or higher (see list of approved electives).
- Of the requirement for 4 lab classes, 2 must be from the list of approved C&M labs. Honors research in an approved C&M faculty lab can be counted for up to 3 lab classes (6 credits max.) with successful completion of an Honors thesis
- Additional Biology electives bringing total Biology to 36 hrs
- Additional Science electives to fulfill the requirement for 72 hrs of Science may be from any department in the College of Science (Biology, Math, Physics, or Chemistry) or approved Departments/Programs elsewhere on campus. **Note:** *students that fulfill their "science electives" by completing Chem 2320 and 2315 and 2325, and have taken Biol 3520 or Biol 3525 or Biol 5810 are eligible for a Chemistry minor*

A. Approved C&M electives - 3 from the following list (at least one at 5000-level or higher):

Biol 3130 (3) Molecular and Cellular Physiology
Biol 3210 (4) General and Pathogenic Microbiology (Path 3010)
Biol 3230 (3) Developmental Biology
Biol 3240 (3) Intro. to Cellular Neurobiology
Biol 3250 (3) Cancer Biology
Biol 3370 (3) Microbial Biology
Biol 3520 (3) Biological Chemistry II
Biol 3820 (3) Physical Principles in Biology
Biol 5030 (3) Basic Immunology (Path 5030)
Biol 5110 (3) Molecular Biology and Genetic Engineering
Biol 5120 (3) Gene Expression
Biol 5130 (3) Plant Biochemistry, Genomics, and Molecular Biology
Biol 5140 (3) Genome Biology
Biol 5210 (3) Cell Structure and Function
Biol 5220 (3) Molecular Neuroscience
Biol 5240 (3) Plant Developmental Biology
Biol 5275 (4, L1) Microbial Diversity, Genomics and Evolution
Biol 5280 (2) Biological Microscopy or Biol 5290 (1) Fundamentals of Biological Microscopy*
Biol 5510 (3) Evolutionary Developmental Biology
Biol 5540 (3) Biochemistry of Membrane Processes
Biol 5810 (3) Nanoscience
Miscellaneous graduate courses at 6000-7000 level approved by Biology advisor.
**Only one of these courses may be counted towards this requirement.*

B. Approved C&M labs - 2 from the following list:

Biol 2115 (2, L2) Basic Technique Lab
Biol 3115 (2, L1) Computer Applications: Cell Biology Lab
Biol 3125 (3, L2) Molecular Tools for Evolutionary and Population Biology
Biol 3215 (2, L1) Cell Biology Lab
Biol 3235 (2, L1) Developmental Biology Lab
Biol 3245 or 3246 (2, L1) Cellular Neurobiology Laboratories*
Biol 3515 (2, L1) Biological Chemistry Lab
Biol 3525 (3, L2) Molecular Biology of DNA Lab
Biol 4955 or Biol 4995 (L1-2) - Independent/Honors research
Biol 5255 (2, L1) Prokaryotic Genetics
Biol 5265 (2, L1) Eukaryotic Genetics
Biol 5275 (4, L1) Microbial Diversity, Genomics and Evolution
Biol 5285 (var.) Biological Microscopy Laboratory
Misc graduate lab courses at 6000-7000 level approved by Biology advisor.
**Only one of these courses may be counted towards this requirement.*

Biology BS: Environmental and Organismal Biology (EOB) Emphasis

- Ancillary Science and Biology Core requirements (detailed above)
- EOB emphasis electives, one class in each of three areas: Ecology/Environmental Biology, Diversity & Evolution, Field/Lab Immersion (9-11 hours)
- Honors research in an approved EOB faculty lab can be counted for up to 3 lab classes (6 credits max.) with successful completion of an Honors thesis
- Additional Biology electives for total of 36 hours (8-14 hours)
- Additional Science electives to fulfill the requirement for 72 hrs of Science may be from any department in the College of Science (Biology, Math, Physics, or Chemistry) or approved Departments/Programs (Geology/Geophysics, Anthropology, Meteorology, or Geography) elsewhere on campus (0-6 hours)

EOB emphasis electives (ca. 9-11 hours)

Students take one class in each of three subject areas: Ecology/Environmental Biology, Evolution/Diversity, and Field/Lab Immersion. Cross-listed offerings can only count for one category.

Ecology/Environmental Biology

Biol 2400 (3) Principles of Wildlife Ecology
Biol 3430 (3) Behavioral Ecology
Biol 3460 (3) Global Environmental Issues
Biol 5420 (3) Advanced Ecology
Biol 5440 (3) Urban Ecology
Biol 5460 (3) Plant Ecology
Biol 5470 (3) Stable Isotopes Ecology
Biol 5490 (3) Ecosystem Ecology
Biol 5495 (4, L1) Biophysical Ecology
Biol 5960 (3) Wildlife Ecology

Diversity and Evolution

Biol 3370 (3) Microbial Biology
Biol 3420 (3) Evolutionary Biology
Biol 3430 (3) Behavioral Ecology (cross-listed w. ecology/environment)
Biol 5221 (4) Human Evolutionary Genetics
Biol 5275 (4, L1) Microbial Diversity
Biol 5320 (2) Biology of Aggression
Biol 5370 (3) Mammology
Biol 5385 (4, L2) Ornithology
Biol 5410 (3) Molecular Evolution and Population Genetics
Biol 5435 (4, L1) Plant Systematics
Biol 5445 (4, L1) Entomology

Biol 5510 (3) Evolutionary Developmental Biology

Field/Lab Immersion (Field-based and/or stand-alone lab courses)

Biol 2355 (2, L1) Field Botany

Biol 3125 (3, L2) Molecular Evolution Lab

Biol 3325 (3, L2) Comparative Physiology Lab

Biol 5395 (2, L2) Advanced Field Ornithology

Biol 5415 (3, L2) Ecology Lab

Biol 5465 (2, L2) Plant Ecology Lab

Biol 5475 (3, L2) Stable Isotope Ecology Lab

Note on Premed students. Premeds will be able to take the EOB emphasis if they wish and still complete their premed requirements without exceeding the 72 science hours. Human Physiology and Human Anatomy would all count as biology electives and total 8 hours (only 6 hours of 2000-level classes can count toward the 36 hours of Biology), within the allotted elective limit. Additional Organic Chemistry hours would count as science electives.