Proposal to Change the Physics Requirement for the B.A. degree in Biochemistry

Introduction/Executive summary: The Biochemistry major leading to either the B.A. or B.S. degree provides excellent preparation for medical and professional programs. Historically, the majority of our majors have pursued the B.S. degree. However, for some students, pursuing the B.A. degree within this major provides a more appealing option because of the reduced emphasis on mathematics and physical biochemistry. However, the requirement for physics within the B.A. program is currently inconsistent with this reduced emphasis since both degrees currently require that same "calculus-based" physics sequence, Physics 1250 and 1251. The proposed program change would allow students pursuing the B.A. degree the option to take either the "algebra-based" physics sequence, Physics 1200 and 1201, or Physics 1250 and 1251. Also, the physics requirement for the Biochemistry B.A. degree is also internally inconsistent with the B.A. option for the Chemistry major which requires more physical biochemistry yet allows either the Physics 1200 and 1201 or Physics 1250 and 1251 sequences. During the advising of our Biochemistry majors, it has often become apparent that some students are concerned with the current physics requirement and, thus, may choose to change majors as a result. The alternative major programs often only require the Physics 1200 and 1201 sequence. Here again, the current physics requirement for the Biochemistry B.A. degree often discourages students from switching from other majors to biochemistry because they would have to retake physics as Physics 1250 and 1251 as well as the additional math prerequisites required. Thus, the proposed change, while bringing the physics requirement in line with other program requirements as well as the Chemistry B.A., also provides a means to encourage more students to major in biochemistry by pursuing the B.A. degree which, again, is an excellent option for admission to many professional programs.

Background information: The Department of Chemistry and Biochemistry (and previously the Legacy Department of Biochemistry) offer both the B.A. and B.S. degree options for the Biochemistry major. Historically, the Legacy Department emphasized and encouraged its majors to pursue the B.S. degree, presumably believing that this program offered superior preparation for graduate and professional schools as well as other career and employment opportunities. However, this perspective has changed with time, especially after the merger to form the current Department of Chemistry and Biochemistry. This merger provides opportunities to consolidate as well as improve internal consistencies.

The Biochemistry B.A. and B.S. degree programs share considerable overlap in course requirements (see attached degree program requirement summaries). The B.A. major must complete all B.S. major requirements with the exception of the third in the calculus series, *i.e.* Mathematics 2153 "Calculus III", as well as Biochemistry 5722, and Chemistry 2550*

> *Although Chemistry 2550 is not required for the B.A., it is commonly used to fulfil the two required elective hours and is required for many pre-health professional programs.

Thus, the B.A. major places less emphasis on mathematics and the physical aspects of biochemistry. However, as for the B.S. degree, the B.A. does require the necessary preparation in mathematics for successful fulfillment of other requirements by requiring the Mathematics 1151-1152 series ("Calculus I" and "Calculus II", respectively). One semester of physical biochemistry is required (Biochemistry 5721

"Physical Biochemistry I") which is an introduction to physical chemistry with emphasis on biological applications and is designed for students in the life sciences. Prerequisites for this course include Math 1152 and Physics 1201. Thus, this proposal would not require any changes to this course requirement.

With the reduction in the core course requirements relative to the B.S. option for the Biochemistry major, the B.A. degree would then offer additional advantages in providing the time and flexibility to use the open credits for other advanced electives that may be required for admittance to professional programs such as Anatomy, Microbiology, Molecular Genetics, Physiology, and Statistics.

Another important consideration for this proposed change is to maintain internal consistency within the Chemistry and Biochemistry majors offered by the Department. For some time, the B.A. degree option for the Chemistry major has allowed the Physics 1200-1201 series as an alternative to Physics 1250 and 1251. Yet, students in that program are required to take both the physical biochemistry courses, Biochemistry 5721 and 5722. There have not been any perceived issues with lack of preparation as a result from taking the Physics 1200-1201 series. Recall, the B.A. option for Biochemistry only requires Biochemistry 5721.

Thus, we believe that the proposed change to the Biochemistry B.A. to allow the algebra-based physics series (Physics 1200-1201) is supported by our own internal experiences and should remove a barrier for students considering a major in biochemistry.

For example, many students may initially consider a Biology major and begin taking the prerequisites. The physics requirement for the Biology B.A. is Physics 1200 or 1250 while that for the B.S. degree is Physics 1200-1201 or 1250-1251. So if a student chooses the Physics 1200 (and 1201) option(s), they would have to retake physics in order to switch to the Biochemistry B.A., thus presenting a significant barrier even though many of the other prerequisites in math, chemistry, and biology overlap.

Comparative data from other institutions with similar programs if available: None compared

Specific actions and any corollary issues:

- **Groups impacted:** Based on comments from students with our academic advisors, it is believed that this change will provide greater incentive for some of students to pursue the B.A. degree in Biochemistry as an alternative to other life science majors. We believe that this degree option can provide superior preparation for medical and other allied medical professional programs.
- **Internal programmatic changes:** None required
- **Effects outside the proposing unit:** There should not be any significant effects outside the Department. The Department of Physics may realize a small increase in enrollment in the algebra-based option, Physics 1200 and 1201 as a result of this proposed change.
- **Overlap in scope or substance with the interests of other units:** None are perceived.

An overview of which committees at the department, college, and university level have reviewed and approved the proposal: The proposed change has been discussed and unanimously approved by the

faculty of the Department's Biochemistry Division (Prof. Richard Swenson, Division Secretary) as well as the Departmental Undergraduate Curriculum Committee (Prof. Jon Parquette, Chair).

A description of the forms and outcomes of interactions with faculty, students, accrediting agencies, alumni, professional organizations, and other interested parties including minutes from meetings, faculty vote results, survey results, letters of support, etc. which offer valuable insight into the nature of the consultative process:

Biochemistry Division vote: 14 for approval; 0 against approval (eligible faculty, 22)

Undergraduate Curriculum Committee vote: 6 for approval; 0 against approval (committee membership, 8)

The proposed change also has strong support from the undergraduate advisory staff who, based on many conversations with students, report that an algebra-based physics requirement will make the B.A. degree option for the biochemistry major more attractive. This change would also facilitate a switch into the biochemistry major since other majors in the life sciences often require the algebra-based physics series which students may have already completed.

The adequacy and availability of resources including but not limited to fiscal impact statements, commitments of funding from any sources, and memoranda of understanding between collaborating units: No additional fiscal resources are required

Supporting documents:

Course descriptions for referenced physics courses (from OSU Course Catalog):

Physics 1200; "Mechanics, Kinematics, Fluids, Waves"; 5 credits

Algebra-based introduction to classical physics: Newtons laws, fluids, waves.

Prereq: A grade of C- or above in Math 1148 (148), or Math Placement Level M. Not open to students with credit for 111. This course is available for EM credit. GE nat sci phys course. NS Admis Cond course.

Physics 1201; "E&M, Optics, Modern Physics"; 5 credits

Algebra-based introduction to electricity and magnetism, simple optics, overview of modern physics including special relativity and quantum mechanics.

Prereq: 1200 (111). Not open to students with credit for 112. This course is available for EM credit. NS Admis Cond course. GE nat sci physical course.

Physics 1250; “Mechanics, Thermal Physics, Waves”; 5 credits

Calculus-based introduction to classical physics: Newton's laws, fluids, thermodynamics, waves; for students in physical sciences, mathematics, and engineering.

Prereq: 1 entrance unit of physics or chem. *Coreq:* Math 1151 or higher; or written permission of instructor. Not open to students with credit for 131. This course is available for EM credit. NS Admis Cond course. GE nat sci physical course.

Physics 1251; “E&M, Optics, Modern Physics”; 5 credits

Calculus-based introduction to electricity and magnetism, simple optics, modern physics including special relativity and quantum mechanics; for students in physical sciences, mathematics, engineering.

Prereq: Physics 1250 (131) or Physics1260 or 1250H; and Math 1151 or higher; or written permission of instructor. *Concur:* Math 1152. Not open to students with credit for 132. This course is available for EM credit. NS Admis Cond course. GE nat sci physical course.

Course Requirements

Course Requirements for Bachelor of Science (BS)

Part A. Required Prerequisites or Supplements to the Major
These courses are required, but do not count toward the 38 credit hour major:

- Biology 1113-1114, 1113H-1114H
- Chemistry 1210-1220 or 1610-1620 or 1910H-1920H
- Mathematics 1151-1152
- Physics 1250-1251

Part B. Core Requirements
A minimum grade of "C-" in each course, and an overall grade point average of "C" (2.00) are required for graduation. The major is planned with an advisor and is tailored to the background and interests of the student.

- Chemistry 2510-2520 or 2610-2620 or 2910H-2920H
- Chemistry 2540, 2550
- Biochemistry 5613, 5614, 5615, 5621
- Molecular Genetics 4500 or 4606
- Physical Biochemistry 5721, 5722
- Mathematics 2153

Total: 38 or more hours at the 2000 level or above

COURSES IN THE MAJOR MUST BE APPROVED BY YOUR ADVISOR

Course Requirements for Bachelor of Arts (BA)

A BA student completes all BS major requirements with the following exceptions:

- Mathematics 2153
- Biochemistry 5722
- Chemistry 2550*

*Although Chemistry 2550 is not required for the BA, it is commonly used to fulfil the two required elective hours and is required for many pre-health professional programs.

*Students may take either Physics 1250-1251 or 1200-1201 to fulfil the physics requirement for the Biochemistry BA.

These exclusions allow students to complete a Biochemistry degree and have flexibility to use the open credits for other advanced electives that may be required for admittance to professional programs, e.g. Anatomy, Microbiology, Physiology, Statistics.

*[*NOTE: This description reads as it would after approval of the proposed change in the BA program requirement.]*

General Education Requirements

The GE is a body of courses designed to ensure that each student becomes acquainted with the basic areas of academic study. To meet the GE requirements, credit hours must be completed from the following areas of academic study: writing, quantitative and logical skills, natural sciences, literature, visual and performing arts, social sciences, historical study, culture and ideas (or second historical study), and foreign language

proficiency. This body of coursework must also include courses designated as “social diversity in the United States” as well as “global studies.”

Attachments:

BS in Biochemistry Sample Curriculum Plan [pdf]

BA in Biochemistry Sample Curriculum Plan [pdf]

The Bachelor of Arts Degree in Biochemistry (B.A.)

The Bachelor of Arts curriculum is designed for students seeking to enter professional programs such as Medicine, Veterinary Medicine, Optometry, or Pharmacy.

- Chemistry 1610–1620 and Organic Chemistry 2610 – 2620 are the recommended sequences for chemistry and biochemistry majors, although qualified students are urged to take the Honors sequences.
- Chemistry 1612 & 1622 are highly recommended. They provide a structure in which students can work actively in groups of 6 to 8 peers to enhance learning.
- Undergraduate Research (Biochemistry 4998/4999) is strongly recommended as an elective course.

Autumn Semester (Year 1)		**Spring Semester (Year 1)**	
General Chemistry 1 (1910H, 1610, 1210)	5	General Chemistry 2 (1920H, 1620, 1220)	5
PLTL in Gen Chem (1612)	1	PLTL in Gen Chem (1622)	1
Calculus 1 (Math 1151)	5	Calculus 2 (Math 1152)	5
GE Elective	3	Introductory Biology 1 (Bio 1113)	4
Freshman Survey	1	GE Elective (*e.g. English 1110*)	3
	16		18
Autumn Semester (Year 2)		**Spring Semester (Year 2)**	
Organic Chemistry 1 (2910H , 2610, 2510)	4	Organic Chemistry 2 (2920H, 2620, 2520)	4
Organic Chemistry Laboratory 1 (2540)	2	Organic Chemistry Laboratory 2* (2550)	2
GE Elective	3	**Biochemistry 1 (5613)**	3
GE Elective	3	GE Elective	3
GE Elective (*e.g. Foreign Language 1101*)	4	GE Elective (*e.g. Foreign Language 1102*)	4
	16		16
Autumn Semester (Year 3)		**Spring Semester (Year 3)**	
Introductory Physics 1 (1200 or 1250)	5	Introductory Physics 2 (1201 or 1251)	5
Introductory Biology 2 (Bio 1114)	4	**Biochemistry 3 (5615)**	3
Biochemistry 2 (5614)	3	Biochemistry Lab (5621)	4
GE Elective (*e.g. Foreign Language 1103*)	4	GE Elective	3
	16		15
Autumn Semester (Year 4)		**Spring Semester (Year 4)**	
Physical Biochemistry 1 (5721)	3	Elective or Undergraduate Research (4998)	2-3
Molecular Genetics (MolGen 4500 or 4606)	3-4	Elective	3
GE Elective	3	Elective	3
GE Elective	3	Elective	3
Elective or Undergraduate Research (4998)	1-4	Elective	3
	13-17		14-15

***NOTE*:** Classes listed in **BOLD** are only offered in those semesters – Autumn or Spring ONLY as shown.

There is some flexibility in course scheduling– please see an undergraduate Biochemistry advisor for more information.

Total Credit Hour Summary: minimum 31-32 semester hours in the major (121 minimum total semester hours). The Data Analysis GE Elective is covered by taking Math 1152. There are 39 upper division hours required of which 31-32 hours are encompassed in the major.

* The Organic Lab 2 is not required for the B.A., however, it is commonly used to fulfill the 2 required elective hours.

The Bachelor of Science Degree in Biochemistry (B.S.)

The Bachelor of Science curriculum is designed for students seeking to become professional biochemists or enter biotechnology fields.

- Chemistry 1610–1620 and Organic Chemistry 2610 – 2620 are the recommended sequences for chemistry and biochemistry majors, although qualified students are urged to take the Honors sequences.
- Chemistry 1612 & 1622 are highly recommended. They provide a structure in which students can work actively in groups of 6 to 8 peers to enhance learning.
- Undergraduate Research (Biochemistry 4998/4999) is strongly recommended as an elective course.

Autumn Semester (Year 1)		Spring Semester (Year 1)	
General Chemistry 1 (1910H, 1610, 1210)	5	General Chemistry 2 (1920H, 1620, 1220)	5
PLTL in Gen Chem (1612)	1	PLTL in Gen Chem (1622)	1
Calculus 1 (Math 1151)	5	Calculus 2 (Math 1152)	5
GE Elective	3	Introductory Biology 1 (Bio 1113)	4
Freshman Survey	1	GE Elective (*e.g. English 1110*)	3
	15		18
Autumn Semester (Year 2)		**Spring Semester (Year 2)**	
Organic Chemistry 1 (2910H , 2610, 2510)	4	Organic Chemistry 2 (2920H, 2620, 2520)	4
Organic Chemistry Laboratory 1 (2540)	2	Organic Chemistry Laboratory 2 (2550)	2
Calculus 3 (Math 2153)	4	**Biochemistry 1 (5613)**	3
GE Elective	3	GE Elective	3
GE Elective (*e.g. Foreign Language 1101*)	4	GE Elective (*e.g. Foreign Language 1102*)	4
	17		16
Autumn Semester (Year 3)		**Spring Semester (Year 3)**	
Introductory Physics 1 (1250)	5	Introductory Physics 2 (1251)	5
Introductory Biology 2 (Bio 1114)	4	**Biochemistry 3 (5615)**	3
Biochemistry 2 (5614)	3	Biochemistry Lab (5621)	4
GE Elective (*e.g. Foreign Language 1103*)	4	GE Elective	3
	16		15
Autumn Semester (Year 4)		**Spring Semester (Year 4)**	
Physical Biochemistry 1 (5721)	3	**Physical Biochemistry 2 (5722)**	3
Molecular Genetics (MolGen 4500 or 4606)	3-4	Elective or Undergraduate Research (4998)	1-3
GE Elective	3	Elective	3
GE Elective	3	Elective	3
Elective or Undergraduate Research (4998)	1-4	Elective	3
	13-17		13-15

***NOTE*:** Classes listed in **BOLD** are only offered in those semesters – Autumn or Spring ONLY as shown.

There is some flexibility in course scheduling– please see an undergraduate Biochemistry advisor for more information.

Total Credit Hour Summary: minimum 38-39 semester hours in the major (121 minimum total semester hours).