THE UNIVERSITY OF ARIZONA.

FORM TO REQUEST SUBSTANTIAL CHANGES TO AN EXISTING UNDERGRADUATE MAJOR

A request for substantial changes to an existing program requires approval from the school director/department head (managing administrator), college academic dean, Curricular Affairs, Undergraduate Council (UGC), and College Academic Administrators Council (CAAC). Additional approvals may be required, depending on the requested changes. Complete this form and submit to Martin Marquez (martinmarquez@email.arizona.edu) no later than October 25, 2019 to be considered for inclusion in the 2020-2021 Academic Catalog.

I. **Requested by (College & School/Department): College of Science--Chemistry & Biochemistry**

II. **Proposer's name, title, email and phone number:**
Deirdre Belle-Oudry
Associate Dept Head for Academic Affairs

dbelle@email.arizona.edu

621-9981

III. **Degree, major and number of students enrolled in the major. If you have emphases (sub-plans), list the number of students enrolled by emphasis:**
Bachelor of Arts, Biochemistry; ~80 majors

IV. **Describe proposed changes to the major. Provide a rationale and explanation for making changes to the major and include any relevant supporting data. Are the changes proposed a result of Annual Program Review (APR) and/or a result from the assessment of programmatic outcomes? If you are requesting a name change, please indicate if the subject code (course prefix) will also change. Include requested new prefix code and description.**

We propose to modify the Biochemistry BA degree requirements as follows. Currently, students are required to take a three-semester lecture series: BIOC 462a *Biochemistry I*, BIOC 462b *Biochemistry II*, and BIOC 466 *Biochemistry of Nucleic Acids.* We propose to eliminate BIOC 466 and move the most foundational material from that course into BIOC 462a/b. BA students will now be required to take the Biochemistry Laboratory course, BIOC 463a. This will ensure that their upper level training will be well rounded, including critical laboratory skills that all Biochemists should have.

Introductory Biochemistry is rarely taught as a three-course series and in fact was a two-course series for many years in our former Biochemistry Department. Moving our foundational series to two semesters will allow flexibility for the students and flexibility in our course staffing. Removing one third of the time allotted to the foundational lecture courses will naturally lead to a loss of some depth of coverage. However, students will gain biochemistry laboratory experience that will serve them well in their future careers. This is especially important for BA students, because these students are not required to participate in the Senior Research project (as the BS students do).

The distribution of topics in the existing curriculum is shown in Table 1; the proposed revised curriculum topic distribution is shown in Table 2. Note that all topics in our curriculum have been retained. However, the depth of coverage will change to some degree.

Table 1. Topic distribution in existing Biochemistry curriculum

BIOC 462a	BIOC 462b	BIOC 466
Chemical and Biological Refresher	Signaling – GPCR, Vision, Insulin	Genes and Chromosomes
Bioenergetics	Redox Reactions, Co-Factors and Common Reactions	DNA Replication and Repair
Amino Acids, Peptides and Proteins	Glycolysis and Gluconeogenesis	Transcription
Protein Structure	Fermentation and Hypoxia	Translation
Bioinformatics and Protein Evolution	Mitochondria / TCA Cycle	Gene Regulation
Protein Purification and Analysis	Oxidative Phosphorylation	
Protein Folding/Unfolding/Aggregation	Photophosphorylation	
Protein Function	Principles in Metabolic Regulation	
Enzyme Kinetics, Mechanism and Regulation	Fatty Acid Catabolism	
Carbohydrates and Glycobiology	Amino Acid Catabolism	
Nucleic Acids	Plant Carbohydrate Synthesis	
Lipids, Membranes and Membrane Proteins	Lipid, Amino Acid and Nucleotide Biosynthesis	
	Hormones / Integration	

Table 2. Topic distribution in proposed revised curriculum

BIOC 462a	**BIOC 462b**
Chemical and Biological Refresher	Glycolysis and Gluconeogenesis
Bioenergetics	Fermentation and Hypoxia
Redox reactions, Co-factors and Common Reactions	Mitochondria / TCA Cycle
Amino Acids, Peptides and Proteins	Oxidative Phosphorylation
Protein Structure	Photophosphorylation
Bioinformatics and Protein Evolution	Principles in Metabolic Regulation
Protein Purification and Analysis	Fatty Acid Catabolism
Protein Folding/Unfolding/Aggregation	Amino Acid Catabolism
Protein Function	Plant Carbohydrate Synthesis
Enzyme Kinetics, Mechanism and Regulation	Lipid, Amino Acid and Nucleotide Biosynthesis
Carbohydrates and Glycobiology	Hormones / Integration
Nucleic Acids	*DNA Replication and Repair*
Genes and Chromosomes	*Transcription*
Lipids, Membranes and Membrane Proteins	*Translation*
Signaling – GPCR, Vision, Insulin or other examples	*Gene Regulation*

V. **Comparison Chart**–complete the chart below using your existing academic advisement report. You may not need to complete all portions. Highlight row(s) indicating the proposed significant changes. You can find course information to help complete the chart below by using the UA course catalog or UAnalytics (Catalog and Schedule Dashboard> "Printable Course Descriptions by Department" On Demand Report; right side of screen). Proposed changes resulting in similar curriculum with other plans (within department, college, or university) may require completion of an additional comparison chart.

	Existing Major Requirements	**Requirements For Modified Major**
Major, emphasis (if applicable) and degree *	BIOC BA	BIOC BA
CIP Code –lookup here or contact Martin Marquez for assistance, if needed	26.0202 Biochemistry	26.0202 Biochemistry
Total units required to complete the degree*	120	120
Upper -division units required to complete the degree	42	42
Total CC transfer units that may apply to this degree*	64	64
Foundation courses		
Math	Substantial Math Strand	Substantial Math Strand
Second Language	Second semester proficiency	Second semester proficiency
General Education		
Tier I GE Requirements (150, 160, 170)	2- Tier 1 150 (INDV) 2- Tier 1 160 (TRAD) 0- Tier 1 170 (NATS)	2- Tier 1 150 (INDV) 2- Tier 1 160 (TRAD) 0- Tier 1 170 (NATS)
Tier II GE Requirements (Arts, HUMS, INDV, NATS)	3 units-Tier II Arts 3 units-Tier II Humanities 3 units- Tier II Individuals and Societies 0-Tier II Natural Sciences	3 units-Tier II Arts 3 units-Tier II Humanities 3 units- Tier II Individuals and Societies 0-Tier II Natural Sciences
Pre-major? (Yes/No)	No	No
List any special requirements to declare or gain admission to this major (completion of specific coursework, minimum GPA, interview, application, etc.)	None	None
Minimum # of units required in the major (units counting towards major units and major GPA)	27	27

Minimum # of upper-division units required in the major (upper division units counting towards major GPA)	18	18
Minimum # of residency units to be completed in the major	18	18
Required supporting coursework (courses that do not count towards major units and major GPA, but are required for the major). Courses listed must include prefix, number, units, and title. Include any limits/restrictions in place/needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.	-MCB 181R and181 L (4) Intro Biology I Lecture and Lab -ECOL 182R and 182L (4) Intro Biology II Lecture and Lab -MATH 122A/B (5) or MATH 125 (3) Calculus I -MATH 129 (3) Calculus II -PHYS 102, 141(4) or 140(3) or 161H (4) Intro Mechanics -PHYS 103(3), 241(4) or 240(3) Intro Electricity and Magnetism -CHEM 151 or 161/163 or 141/143 (4) General Chemistry I -CHEM 152 or 162/164 or 142/144 (4) General Chemistry II	-MCB 181R and181 L (4) Intro Biology I Lecture and Lab -ECOL 182R and 182L (4) Intro Biology II Lecture and Lab -MATH 122A/B (5) or MATH 125 (3) Calculus I -MATH 129 (3) Calculus II -PHYS 102, 141(4) or 140(3) or 161H (4) Intro Mechanics -PHYS 103(3), 241(4) or 240(3) Intro Electricity and Magnetism -CHEM 151 or 161/163 or 141/143 (4) General Chemistry I -CHEM 152 or 162/164 or 142/144 (4) General Chemistry II
Major requirements. List all major requirements including core and electives. If applicable, list the emphasis^ requirements. Courses listed count towards major units and major GPA. Courses listed must include prefix, number, units, and title. Mark new coursework (New). Include any limits/restrictions in place/needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses being added and are not owned by your department. Recommend ordering requirements in the same order as your advisement report.	- CHEM 241a/243a (4) or CHEM 246a (or 242a)/247a (5) Organic Chemistry I lecture/lab - CHEM 241b/243b (4) or CHEM 246b (or 242b)/247b (5) Organic Chemistry II lecture/lab -BIOC 296B (1) Intro to Biochem Research -BIOC 462a (4)	- CHEM 241a/243a (4) or Chem 246a (or 242a)/247a (5) Organic Chemistry I lecture/lab - CHEM 241b/243b (4) or CHEM 246b (or 242b)/247b (5) Organic Chemistry II lecture/lab -BIOC 296B (1) Intro to Biochem Research -BIOC 462a (4)

	Biochemistry -BIOC 462b(4) Biochemistry -BIOC 466 (4) Biochemistry of Nucleic Acids -Science Electives (at least 6 units) Choose from the following: -BIOC 399 or 399H (1-6) Independent Study -BIOC 492 or 492H (1-6) Directed Research -BIOC 498 (3) Senior Capstone -Bioc 498H (3) Honors Thesis -BIOC 499 or 499H (1-6) Independent Study -CHEM 450 (3) Synthetic and Mechanistic Organic Chemistry -CHEE 477R (3) Microbiology for Engineers -BME 486 (3) Biomaterial-Tissue Interactions -ECOL 320 or 320H (4/5) Genetics, -ECOL 326 (3) Genomics -ENVS 474 (4) Aquatic Plants and the Environment -MATH 363 (3) Intro. to Statistical Methods -MCB 304 (4-5) Molecular Genetics -MCB 325 (3-4) The Biology of Cancer - MCB 410 (3-4) Cell Biology -MCB 411 (3-4) Molecular Biology -MCB 425 (3) Cancer Discoveries -MCB 480 (3) Intro. to Systems Biology -MIC 328R (3) Microbial Physiology, -PLP 428R (3) Microbial Genetics	Biochemistry -BIOC 462b(4) Biochemistry -(New):BIOC 463a (4) Biochemistry Lab Techniques -Science Electives (at least 6 units) Choose from the following: CHEM 325 (2) Analytical Chemistry - CHEM 326 (2) Analytical Chemistry Laboratory -BIOC 399 or 399H (1-6) Independent Study -BIOC 492 or 492H (1-6) Directed Research -BIOC 498 (3) Senior Capstone -Bioc 498H (3) Honors Thesis -BIOC 499 or 499H (1-6) Independent Study -CHEM 450 (3) Synthetic and Mechanistic Organic Chemistry -CHEE 477R (3) Microbiology for Engineers -BME 486 (3) Biomaterial-Tissue Interactions -ECOL 320 or 320H (4/5) Genetics, -ECOL 326 (3) Genomics -ENVS 474 (4) Aquatic Plants and the Environment -MATH 363 (3) Intro. to Statistical Methods -MCB 304 (4-5) Molecular Genetics -MCB 325 (3-4) The Biology of Cancer - MCB 410 (3-4) Cell Biology -MCB 411 (3-4) Molecular Biology -MCB 425 (3) Cancer Discoveries -MCB 480 (3) Intro. to Systems Biology

	-MIC 452 (3) Antibiotics – A Biological Perspective -NSC 408 (3) Nutritional Biology -NSC 475 (3) Nutrigenomics for the Study of Disease Prevention & Intervention -NSCS 307 (3-4) Cellular Neurophysiology -NROS 310 (3-4) Molecular and Cellular Biology of Neurons -NROS 430 (3) Neurogenetics -PCOL 410 (5) Medicinal Chemistry -PHCL 412 (3) Intro. to Pharmacology -PLS 312 (4) Animal and Plant Genetics -PLS 340 (3) Intro. to Biotechnology -PLS 359 (3) Plant Cell Structure and Function -PLS 360 (3) Plant Growth and Physiology -PLS 448a (3) Plant Biochemistry and Metabolic Engineering -PSIO 380(4) Fundamentals of Human Physiology -PSIO 404(3) Advanced Topics in Cellular Physiology -PSIO 420(3) Exercise and Environmental Physiology -PSIO 431 (3) Physiology of the Immune System -PSIO 484 (3) Cardiovascular Muscle Biology and Disease -PHYS 431(3) Molecular Biophysics	-MIC 328R (3) Microbial Physiology, -PLP 428R (3) Microbial Genetics -MIC 452 (3) Antibiotics – A Biological Perspective -NSC 408 (3) Nutritional Biology -NSC 475 (3) Nutrigenomics for the Study of Disease Prevention & Intervention -NSCS 307 (3-4) Cellular Neurophysiology -NROS 310 (3-4) Molecular and Cellular Biology of Neurons -NROS 430 (3) Neurogenetics -PCOL 410 (5) Medicinal Chemistry -PHCL 412 (3) Intro. to Pharmacology -PLS 312 (4) Animal and Plant Genetics -PLS 340 (3) Intro. to Biotechnology -PLS 359 (3) Plant Cell Structure and Function -PLS 360 (3) Plant Growth and Physiology -PLS 448a (3) Plant Biochemistry and Metabolic Engineering -PSIO 380(4) Fundamentals of Human Physiology -PSIO 404(3) Advanced Topics in Cellular Physiology -PSIO 420(3) Exercise and Environmental Physiology -PSIO 431 (3) Physiology of the Immune System -PSIO 484 (3) Cardiovascular Muscle Biology and Disease -PHYS 431(3) Molecular Biophysics
Internship, practicum, applied course requirements. (Yes/No). If yes, provide description.	No	No
Senior thesis or senior project required (Yes/No). If yes, provide description.	No	No
Additional requirements (provide description)	None	None
Minor (optional or required)	Optional	Optional

*May require Arizona Board of Regents (ABOR) approval

^Emphases are officially recognized sub-specializations within the discipline. ABOR Policy 2-221 c. Academic Degree Programs Subspecializations requires all undergraduate emphases within a major to share at least 40% curricular commonality across emphases (known as "major core"). Total units required for each emphasis must be equal.

VI. **Peer institution comparison-** describe how your modified major requirements are similar and different from major requirements of two peer institutions. Select peers from (in order of priority) ABOR approved institutions, AAU members, and/or other relevant institutions recognized in the field.

Table 3 shows the upper-level Biochemistry courses required for BA Biochemistry programs at four peer institutions: University of Iowa, University of Kansas, University of Washington, and Rice University. Each of these programs require only two or fewer upper-level Biochemistry lecture courses. One of them, Rice University, requires only one upper-level biochemistry class. The proposed changes will make our program more consistent with peer programs.

Table 3. Biochemistry course requirements for Biochemistry BA programs at peer institutions.

Peer Institution	Program	Web Address	Required Biochemistry Courses
University of Iowa	Biochemistry (College of Med)	https://medicine.uiowa.edu/biochemistry/education/undergraduate-program/undergraduate-curriculum-and-degree-programs	Biochemistry & Molecular Biology I (BIOC 3120) and II (BIOC 3130), Experimental Biochemistry (BIOC 3140)
University of Kansas	Biochemistry	https://catalog.ku.edu/liberal-arts-sciences/biology/ba-biochemistry/#requirementstext	Biochemistry I & II (BIOL 636 & 638), Introductory Biochemistry Lab (BIOL 637) & Advanced Biochemistry Lab (BIOL 639)
Rice University	Biochemistry and Cell Biology	https://ga.rice.edu/programs-study/departments-programs/natural-sciences/biosciences/biochemistry-cell-biology-ba/#requirementstext	Biochemistry I (BIOC 301)
University of Washington	Chemistry	https://depts.washington.edu/biowww/pages/undergraduate.shtml	BIOC 405, 406--Introduction to Biochemistry

VII. **Faculty impact**– indicate if new faculty hires will be required to deliver the proposed modified/new curriculum.

No new faculty hires will be required for this curriculum change. This change will result in a slight increase in the BIOC 463a enrollment each year. However, BA students represent only about 17% of all Biochemistry majors. The increase will be less than ~20 students per year. BIOC 463a is offered in both Fall and Spring semesters. This amounts to ~10 more students in the lab each semester. We therefore may need to offer one more lab section each semester. However, no faculty would need to be hired, as we can simply increase the number of seats in the lecture portion of the class. We would potentially need to add one more TA to support the increased enrollment.

VIII. **Budgetary impact**– indicate new resources needed and source of funding to implement the proposed changes. If reallocating resources, indicate where resources will be taken from and the impact this will have on students/faculty/program/unit.

We would potentially need to add one more 0.5 FTE Graduate Teaching Assistant to support this increased enrollment. This cost (~ $9,200) comes from the College temporary teaching budget. We would see an increase in lab fee revenue to offset the additional costs of supplies for the lab, so those will not be an issue.

IX. Required signatures

Managing unit administrator (print name and title): ___Deirdre Belle-Oudry, Associate Head for Academic Affairs_

Managing administrator's signature: ___Deirdre A Belle-Oudry_____ Date: 10/4/19

Managing unit administrator (print name and title): Andrei Sanov, Dept Head

Managing administrator's signature: A. Sanov Date: 10/8/19

Dean (print name): Elliott Chen

Dean's signature: _____ Date: 10/11/19

Dean (print name): _____

Dean's signature: _____ Date: _____

Note: In some situations, signatures of more than one unit head and/or college dean may be required.

For use by Curricular Affairs:

Committee	Approval date
Academic Programs Subcommittee	
Undergraduate Council	
College Academic Administrators Council	
Arizona Board of Regents (if applicable)	

☐ Notify proposers of approval
☐ Upload proposal documents to relevant UAccess tables
☐ Notify ADVIP team and proposers

If ABOR approval required :
☐ If applicable, create approval memo
☐ Send memo to college/dept and acad_org listserv.
☐ If applicable, create new plan code (secondary too)
☐ If applicable, update emphases
☐ If applicable, add last admit term to prior plan code(s)
☐ Upload proposal docs to relevant UAccess table values
☐ Notify ADVIP team and proposers