

Executive Summary

Request for Authorization to Implement BS in Pharmaceutical Sciences

Requested by	Department of Pharmacology and Toxicology in the College of Pharmacy
CIP Code	51.2010-Pharmaceutical Sciences
Purpose of Program	<p>The UA Bachelor of Science in Pharmaceutical Sciences is a traditional, four year degree program that will provide undergraduate students comprehensive coursework, laboratory work, and experiential education in Pharmaceutical Sciences.</p> <p>Currently no Arizona universities offer a BS in Pharmaceutical Sciences, despite the fact that the pharmaceutical industry represents a substantial source of jobs and economic output, representing over 800,000 U.S. employees, 17% of all U.S. research and development, and 1.2 trillion dollars in economic output (biopharmaceutical spotlight, www.selectusa.gov).</p> <p>The University of Arizona College of Pharmacy has a long and successful history of educating and training pharmacists who provide state-of-the-art healthcare. The college also has a robust graduate education and training program in the disciplines of pharmacology, toxicology, drug discovery and development, pharmaceuticals, and health outcomes. The proposed program represents the maturation of those successful programs and their extension to a new undergraduate major. The department and college anticipate producing highly qualified individuals seeking continued education in graduate and professional schools, as well as graduates who will be in demand for pharmaceutical and biotech companies.</p> <p>The BS in Pharmaceutical Sciences degree program requires 120 units, including 33 units of upper division PCOL major coursework, 3 units of Foundations in Biochemistry, and 36 units of required science supporting coursework. Supporting coursework will serve as pre-major requirements. Students are required to complete the supporting coursework with a GPA ≥ 2.0 and complete an application and personal statement in order to declare/admit the major.</p> <p>The overarching goals for the BSPS program are to graduate students who will have the ability to:</p> <ul style="list-style-type: none">a) demonstrate an understanding of chemical-biological interactions as related to current drugs and the discovery and development of new drugs;b) demonstrate an understanding of the governmental regulation of the drug development process, including the demanding requirement for stringently controlled research;c) apply the scientific method to address gaps in knowledge, through hypothesis formulation, data collection/analysis, and rational interpretation;

	d) understand the techniques, skills, and modern tools in use by pharmaceutical science industry; e) communicate effectively in written and oral presentation.				
	5-year projected annual enrollment				
	1 st year	2 nd year	3 rd year	4 th year	5 th year
	30	85	115	115	115
Source(s) of Funding	No new faculty needed to launch. Additional Support Needed: -Program Coordinator -Academic Advisor -Exploring employing graduate TAs Funding Sources: -Initial reallocation of existing college funds -College Tuition				

Approvals:

ABOR	11/18/16
Undergraduate Council	11/7/17
Graduate Council	N/A
CAAC	11/3/17 (e-vote)
Provost's Council	11/20/17
Faculty Senate	12/4/17

College of Pharmacy (COP) Response to Undergraduate Council (UGC) Discussion of Bachelor of Science in Pharmaceutical Sciences Proposal

UGC Comment: Dr. Del Casino (Paraphrased): Required courses are substantial, overall the program has few units that students are free to apply to coursework of their choice.

COP Reply: We edited the proposal to create 10 units of coursework that students can use for any elective course of their choice. Regarding the existing required courses, those courses were arrived at through a series of meetings over this past summer with COP faculty and faculty from other colleges. This fall we further vetted these courses with representatives from the Colleges of Law, Science, Medicine, Agriculture and Life Sciences, and Public Health, as well as with executives in the pharmaceutical and biotech arenas. We feel strongly that the required courses that we have built into this curriculum provide essential components that students need to understand how chemicals that interact with biology can become drugs. We may at some point decide that the curriculum could be streamlined, but this is the curriculum that our faculty have carefully considered and agreed upon for the launch of the program.

UGC Comment: Dr. Del Casino (Paraphrased): There is an insubstantial difference between a 2.5 GPA threshold in required supporting coursework and a 2.0 GPA. If you want a stringent requirement use a 3.0 GPA.

COP Reply: We think that a 3.0 GPA is excessively restrictive. We are willing to defer to Dr. Del Casino's view on this and allow students with the minimum 2.0 GPA admittance to the major (reflected in the edited document), but in the initial cohorts we will closely track the correlation between prereq. course GPA and performance in the major. Should our data support raising the admission threshold GPA, we will request that modification to our program.

UGC Comment: Dr. Burd (Paraphrased): Pre-Majors should not be used.

COP Reply: We discussed this option with several individuals knowledgeable in undergraduate science programs and heard a range of opinions. In fact, among the UGC members discussing our proposal there was a range of opinions on structuring a Pre-Major into the program. We were swayed by programs like Physiology, where the use of this structure seems to have improved the preparedness of students entering the major as well as making their progress to graduation more efficient. We think that retaining the Pre-Major is the best option for our proposed program at this time.

DETAIL ERRORS POINTED OUT BY UGC, CORRECTED IN THIS DOCUMENT

Table 6: Peer Comparison Chart; "Upper division units required to complete degree"

Revised from 50 units to 40 units to reflect 10 units of electives with restrictions removed.

Table 6: Peer Comparison Chart; "List any special requirements to declare or gain admission to this major"

Changed GPA in required supporting coursework from ≥ 2.5 to ≥ 2.0

Section VI-A.

Corrected faculty list to include Biochem 384 (Miesfeld). Now required courses match listed faculty. Added Miesfeld's bio to the CV Appendix material.

General edits

Corrected inconsistencies in text regarding PCOL 195

Corrected PSIO 380 course title

Corrected Tier 2 general education courses listed per UA required Tier 2 areas

Added clarifying text to the Minimum # of units required in the major, and to the Minimum # of upper division units required in the major

Added MATH 125 to the comparison chart (the chart had only listed the 122A/B option).

PCOL 460 course listing corrected to PHCL 460 (new courses list)



NEW ACADEMIC PROGRAM –REQUEST FORM

I. PROGRAM NAME, DESCRIPTION AND CIP CODE

- A. PROPOSED PROGRAM NAME AND DEGREE(S) TO BE OFFERED** – for PhD programs indicate whether a terminal Master’s degree will also be offered.

Bachelor of Science in Pharmaceutical Sciences (BSPS)

- B. CIP CODE** – go to the National Statistics for Education web site (<http://nces.ed.gov/ipeds/cipcode/browse.aspx?y=55>) to select an appropriate CIP Code or contact Pam Coonan (621-0950) coonan@email.arizona.edu for assistance.
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- C. DEPARTMENT/UNIT AND COLLEGE** – indicate the managing dept/unit and college for multi- interdisciplinary programs with multiple participating units/colleges.

Department of Pharmacology and Toxicology
College of Pharmacy

Campus and Location Offering – indicate by highlighting in yellow the campus(es) and location(s) where this program will be offered.

UA South Campus

Sierra Vista
Douglas
Mesa
Pima CC East
Pinal County
Santa Cruz
UA Science and Tech Park

UA Main

Tucson
UA Downtown

Phoenix Biomedical Campus

Phoenix

UA Online

Online

Distance Campus

Chandler
Paradise Valley
Yuma

II. PURPOSE AND NATURE OF PROGRAM—Please describe the purpose and nature of your program and explain the ways in which it is similar to and different from similar programs at two public peer institutions. Please use the attached comparison chart to assist you.

The pharmaceutical sciences have evolved to include discovery, development, evaluation, monitoring and marketing of drugs to benefit patients and public health. Individuals trained in pharmaceutical sciences work across the globe in industry, for drug regulatory authorities, biotech companies, and clinical research organizations to name just a few. Pharmaceutical science has often been interpreted to be a foundation of medical pharmacy training, but it is emerging as a discrete field with a dedicated curriculum that is foundational to new drug design, development, and delivery to safely treat human disease.

The UA Bachelor of Science in Pharmaceutical Sciences (BSPS) is a traditional, four-year degree program that will provide undergraduate students comprehensive coursework, laboratory work, and experiential education in Pharmaceutical Sciences. Currently no Arizona universities offer a BSPS, despite the fact that the pharmaceutical industry represents a substantial source of jobs and economic output, representing over 800,000 U.S. employees, 17% of all U.S. research and development, and 1.2 trillion dollars in economic output (biopharmaceutical spotlight, www.selectusa.gov).

The University of Arizona College of Pharmacy has a long and successful history of educating and training pharmacists who provide state-of-the-art healthcare. The college also has a robust graduate education and training program in the disciplines of pharmacology, toxicology, drug discovery and development, pharmaceuticals, and health outcomes. This proposal represents the maturation of those successful programs and their extension to an exciting new undergraduate major. We anticipate that the BSPS program will matriculate highly-qualified individuals who will seek continued education in graduate and professional schools, as well as graduates who will be in demand for pharmaceutical and biotech companies.

Taking advantage of the collaborative relationships that our faculty maintain with pharmaceutical /biotech companies, drug regulatory agencies, and the broader research community, the BSPS program also offers interested students an internship in the summer of their junior year. Alternatively, students can participate in directed research locally and/or complete a mentored capstone project at the UA.

III. PROGRAM REQUIREMENTS – list the program requirements, including minimum number of credit hours, required courses, and any special requirements, including subspecializations, subplans, theses, internships, etc.

Bachelor's of Science in Pharmaceutical Sciences Curriculum

GENERAL EDUCATION

*Natural Sciences requirement fulfilled in major coursework

ENGL 101 and 102—Writing/Composition	6
Substantial Math Strand	3
Tier 1 Gen Ed	12
Tier 2 Gen Ed	9
Second Semester Language Proficiency	8
TOTAL	38

REQUIRED SUPPORTING COURSEWORK

PHYS 102 and PHYS 181	Introductory Physics I and Introductory Laboratory I	4
CHEM 151	General Chemistry I	4
CHEM 152	General Chemistry II	4
CHEM 241A/243A	Lectures in Organic Chemistry and Organic Chemistry Laboratory I	4
CHEM 241B/243B	Lectures in Organic Chemistry and Organic Chemistry Laboratory II	4
MCB 181R/L	Introductory Biology I and Introductory Biology Laboratory I	4
ECOL 182R/L	Introductory Biology II and Introductory Biology II Lab	4
MIC 205A/L	General Microbiology and Biology of Microorganisms Laboratory	4
PSIO 380	Human Anatomy and Physiology I	4
	TOTAL	36

REQUIRED MAJOR COURSES

BIOC 384	Foundations in Biochemistry	3
PCOL 305	Scientific Writing: Papers to Proposals to Drug Information	3
PCOL 310	Drug Approval: The 3 Billion Dollar Bet	2
PCOL 350	ADME: How the Body Changes Drugs	3
PCOL 360	Pharmacology: How Drugs Change the Body	5
PCOL 390	Biomarkers: Analysis of Drug Effect and Toxicity	3
PCOL 410	Integrated Medicinal Chemistry & Lab	5
PCOL 440	Rigor and Reproducibility: Bridging Academia and Pharma	2
PCOL 455	Drug Delivery Systems	3
PHCL 460	Designing Drugs: From Chemistry to Cure (Lecture & Lab)	3
PCOL 470	Pharmacogenomics: Predicting a Patient's Future	4
	TOTAL	36

PROGRAM-RELATED ELECTIVE COURSES AVAILABLE TO STUDENTS (NOT REQUIRED)

BIOC 565*	Proteins and Enzymes	3
MCB 425	Cancer Discoveries	4
MCB 573*	Recombinant DNA methods and applications	4
PHPM 310	Health Care in the U.S.	3
IMB 567*	Cancer Immunology and Immunotherapy	3
LAW 452	Health Law	3
PCOL 301	Bioethics in Drug Clinical Trials	1
PCOL 395	The Chemical Environment, Environmental Exposures, and Human Disease	1
PCOL 430	Proteins and Nucleic Acids as Drug Targets	3
PCOL 493	Internship in Pharmaceutical Sciences	6
PCOL 498	Senior Capstone Project	1-3
PCOL 499	Independent Study	1-6
PHCL 442	Human Performance Pharmacology	3
PHCL 445	Drugs of Abuse	3

* A senior may register for a graduate course for either undergraduate or graduate credit with approval from the course instructor and the major advisor. Students may use a graduate course to meet undergraduate requirements. However, students cannot enroll in a 500-level course and receive 400-level credit for it. The Registrar will not process the graduate course enrollment unless the senior has a [grade-point-average \(GPA\)](#) of 3.0 or better on all [University Credit](#) and is proceeding toward graduation as directly as possible.

PEER COMPARISON CHART OF MAJORS

*Note: comparison of additional relevant programs may be requested.

Table 6 Peer Comparison Chart of Majors			
Bachelor of Science in Pharmaceutical Sciences (BSPS) at the University of Arizona			
	Proposed UA BSPS	Peer 1: The Ohio State University	Peer 2: U. California Irvine
Currently enrolled students		468	700
Description of major	<p>The Bachelor of Science in Pharmaceutical Science (BSPS) is a traditional, four-year degree program that will inform students about the underlying biology of disruptions in health that cause disease; mechanisms of drug action; drug and drug product design; and pharmaceutical evaluation with a heavy emphasis on US regulatory aspects of manufacturing and controls, drug discovery, clinical research, and post-approval drug surveillance. We will also provide instruction in pharmacology including pharmacokinetics and toxicology, which are essential for drug or new compound exploration and analysis. Because healthcare and pharmaceutical products will soon consume nearly one-fifth of the US economy, and because it is one of the most highly-regulated industries, graduates of our rigorous and relevant program will be in high demand, representing a specific and desired talent in the science sector.</p>	<p>The Bachelor's of Science in Pharmaceutical Sciences (BSPS) is a highly unique undergraduate degree program that delivers unsurpassed preparation for careers in a variety of biomedical professions. In the program, students are able to pursue this degree through one of two pathways, enabling them to focus in areas that would be most relevant to their post-baccalaureate goals. There are two pathways—healthcare and drug discovery and development. In learning the disciplines of medicinal chemistry, pharmaceuticals, pharmacology, and pharmaceutical administration, BSPS students will study the areas of drug discovery, delivery, action and therapy. Students will also have the opportunity to engage in clinical-, laboratory-, and community-based research experiences..</p>	<p>The Department of Pharmaceutical Sciences offers undergraduate students unparalleled training for future careers in pharmacy, medicine, and biomedical research. Our innovative, rigorous curriculum integrates concepts from biology, chemistry, chemical engineering, pharmacology and physiology. Alumni pursue exciting professional opportunities that improve our society's health and well-being. Pharmaceutical scientists are rapidly changing the field of drug discovery and development. Graduates of our program are well qualified to seek employment in the public and private sectors, or to pursue graduate degrees such as a PhD, MD, or PharmD.</p>

Table 6 Peer Comparison Chart of Majors			
Bachelor of Science in Pharmaceutical Sciences (BSPS) at the University of Arizona			
Target careers	Pharmaceutical industry (research, quality control, sales/marketing), Biotechnology, Government (FDA, CDC), Health insurance providers Or Post-bacc. education at the professional or graduate level.	Graduates of the BSPS program will be prepared for graduate education, graduate professional education or a health-related career. The pharmaceutical industry offers career opportunities in sales and marketing, drug research and development, quality assurance, and professional services.	Research facilities Pharmaceutical and biotechnology companies Universities Government agencies (FDA/NIH) Drug analysis, drug manufacturing, medicine marketing, or pharmaceutical sales Or Subsequent graduate training
Total units required to complete degree	120	121	167 (academic quarter-based credits)
Upper-division units) required to complete degree	42	(Starting fall, year 3: OSU has no 300/400 numbering system) 33 major units; 27 general ed requirements	(Starting fall and winter , year 3: UCI has no 300/400 numbering system) 63 major units and 16 gen ed requirements (academic quarter-based credits)
Foundation courses			
English composition	ENGL 101— Writing/Composition I (3 units) ENG 102— Writing/Composition II (3 units)	NO course numbers given Writing I, II (6 units)	NO course numbers given Writing or Humanities (8 units)
Foreign language	Language (8 units total)	NO course numbers given Foreign Language I, II, III (9 units total)	Not required/mentioned
Math	Substantial Math Strand	MATH 1150 and 1151 (10 units total)	MATH 2A, B, D or Stats (12 units total)
General education requirements	Tier 1 Gen Ed (12 units) as follows— Individuals & Societies (two 150 courses from 150 A, B and C) Traditions & Cultures (two 160 courses from 160 A, B, C, and D)	NO course numbers given Historical Study (3 units) Arts (3 units) Literature (3 units)	NO course numbers given/no course titles specified Gen Ed Course (35 units, academic quarter-based credits)

Table 6 Peer Comparison Chart of Majors			
Bachelor of Science in Pharmaceutical Sciences (BSPS) at the University of Arizona			
	Natural Sciences <i>(satisfied by curriculum)</i> Tier 2 Gen Ed (9 units) Individuals & Societies (one course) Humanities (one course) Natural Sciences <i>(satisfied by curriculum)</i> Arts (one course; 3 units) Diversity (one course from Tier 1 or 2 that satisfies this requirement)	Cultures and Ideas (3 units) Social Science (6 units total)	
Pre-major? (y/n). If yes, indicate coursework.	Yes. Completion of Required Supporting Coursework (See Table above).	No	No
List any special requirements to declare or gain admission to this major (completion of specific coursework, minimum GPA, interview, application, etc.)	Completion of required supporting coursework with GPA ≥ 2.0 . Completion of application.	Freshmen admitted to the university directly enroll in the major. Transfer students wishing to major in pharmaceutical sciences must first apply to and be accepted to Ohio State as an undergraduate student. Upon successful completion of the prerequisite courses and requirements, a student may then request a transfer to the College of Pharmacy.	Cumulative GPA of 2.5 Most recent quarterly GPA of 2.5 Course Grades 3.0 minimum GPA for all UCI courses taken that count toward the major requirements. 3.0 minimum GPA for all transfer courses taken that count toward the major requirements. Lower division science and math coursework must be completed with a C- or better. PHRMSCI 42 and 76 require a D- and a C- or better, respectively.

Major requirements			
Minimum # of units) required in major	72 units : 36 pre-major and 36 major	121	167–173 (academic quarter-based credits)
Minimum # of upper-division units required in the major	40, includes pre-major 36, without pre-major	38	47 (academic quarter-based credits)
Minimum # of residency units to be completed in the major	Minimum 30 residency units to be completed; minimum 18 residency units within major courses	N/A	N/A
Required supporting coursework (courses that do not count towards major units) and major GPA, but are required for the major). Courses listed must include subject code, units), and title.	MATH 122 A/B or MATH 125 Functions for Calculus/First-Semester Calculus (3-5 units) PHYS 102 & 181 Introd. Physics I and Introd. LAB (4 units) CHEM 151 General Chemistry I (4 units) CHEM 152 General Chemistry II (4 units) CHEM 241A/243A Lectures in Organic Chemistry and Organic Chemistry Laboratory I (4 units) CHEM 241B/243B Lectures in Organic Chemistry and Organic Chemistry Laboratory II (4 units) MCB 181R/L Introductory Biology I and Introductory Biology Laboratory I (4 units) ECOL 182R/L Introductory Biology II and Introductory Biology II Lab (4 units) MIC 205A/L General Microbiology and Biology of	CHEM 1210 GEN CHEM I and LAB (5 units) CHEM 1220 GEN CHEM II and LAB (5 units) CHEM 2510/2540 ORGANIC I and LAB (6 units) Biology 1113 GEN BIOLOGY I (4 units) CHEM 2520/2550 ORGANIC II and LAB (6 units) Biology 1114 GEN BIOLOGY II (4 units) PHY 1200 PHYSICS I and Lab (5 units) EEOB 2520 PHYSIOLOGY and Lab (3 units) Physics 1201 PHYSICS II (5 units)	BIO SCI 93,94 GEN BIOLOGY I (8 units) CHEM 1A,1B GEN CHEM I (8 units) CHEM 1C, 1LC GEN CHEM II and LAB (6 units) BIO SCI 97,98,99 GEN BIOLOGY II (12 units) CHEM 51A, 51B, 1LB,1LD ORGANIC I and LAB (12 units) CHEM 51C, 51LC ORGANIC II and LAB (6 units) BIO SCI 194S Ethics/Safety—(1 unit) PHYSICS 3A PHYSICS I (4 units) PHYSICS 3A,3B,3C 3LB, 3LC PHYSICS I and Lab (15 units)

	Microorganisms Laboratory (4 units) PSIO 380 Fundamentals of Human Physiology (4 units)		
Major/Degree requirements	BIOC384 Foundations in Biochemistry (3 units) PCOL 305 Scientific Writing—Papers to Proposals to Drug Information (3 units) PCOL 310 Drug Approval: The 3 Billion Dollar Bet (2 units) PCOL 350 ADME: How the Body Changes Drugs (3 units) PCOL 360 Pharmacology: How Drugs Change the Body (5 units) PCOL 390 Biomarkers: Analysis of Drug Effect and Toxicity (3 units) PCOL 410 Integrated Medicinal Chemistry & Lab (5 units) PCOL 440 Rigor and Reproducibility: Bridging Academia and Pharma (2 units) PCOL 455 Drug Delivery Systems (3 units) PHCL460 Designing Drugs: From Chemistry to Cure (Lecture & Lab) (3 units) PCOL 470 Pharmacogenomics: Predicting a Patient's Future (4 units)	Pharmacy 1100 Survey course (1 unit) Pharmacy 2100 Careers in Pharmaceutical Sciences (0.5 units) Pharmacy 2101 Career Development in Pharmaceutical Sciences (0.5 units) Pharmacy 2500 Drug Discovery, Development, and Delivery (3 units) Pharmacy 3200 Biochemistry for the Pharmaceutical Sciences (5 units) Pharmacy 3500 Ethics and Professionalism in the Pharmaceutical Sciences (2 units) Pharmacy 4000 Integrated Pharmaceutical Sciences I (5 units) Pharmacy 4010 Integrated Pharmaceutical Sciences II (5 units) Pharmacy 4600 Pharmaceutical Sciences Laboratory (2 units) Pharmacy 4610 Experimental Techniques in Drug Discovery (3 units) Major Electives Minimum: 11 units	BIOSCI 100 Scientific Writing (3 units) PHARMSCI 120, 120 L Human Physiology and Lab (7 units) PHARMSCI 170A Molecular Pharmacology I (4 units) PHARMSCI 170B Molecular Pharmacology II (4 units) PHARMSCI 171 Physical Biochemistry (4 units) PHARMSCI 172 Topics in Pharmaceutics (2 units) PHARMSCI 173 Pharmacotherapy (4 units) PHARMSCI 174, 174L Biopharmaceutics and Nanomedicine and Lab (4 units) PHARMSCI 177, 177L Medicinal Chemistry and Lab (7 units) Major Electives Minimum: 8 units
Internship, practicum, applied course	Optional: If chosen, complete 6 units at selected industry partner.	Not required.	Offered at various sites but not required.

requirements. (Yes/no. If yes, provide description.)			
Senior thesis or senior project required (Yes/No)	No	No	No
Additional requirements (provide description)	None.	None.	None.
Minor (specify if optional or required)	None required	None required	None required
*Note: comparison of additional relevant programs may be requested.			

PROGRAM REQUIREMENTS –Use the comparison chart to explain how your requirements are similar to and different from the two programs at the two public peer institutions to which you compared your program in Section II.

Required Supporting Coursework:

The core of pharmaceutical sciences is an understanding of how interactions between chemicals and biological molecules can alter biology and physiology. This core is reflected in the supporting coursework from the UA BSPS and the two comparison programs. With an emphasis on chemistry, physics, biology, and physiology, the required supporting courses were structured to provide a foundation for the pharmaceutical science-intensive coursework. One difference in the UA program is the requirement for a basic microbiology course, reflecting our view that finding better drugs to fight increasingly drug-resistant and newly emerging infectious diseases will be an increasingly important global challenge for the pharmaceutical and biotech industries.

Required Major Coursework:

Content shared among the three comparison programs also includes the basic approach to chemical design and formulation (e.g. liquid, solid, oral, injectable, carriers, etc.) of drugs. The UA program covers this in three courses: a survey drug design and development course, a pharmaceuticals course, and an advanced drug design and development course.

A second common content area details:

- How the body acts as a selective redistribution system to relocate a drug from its initial administration site in the body to various human tissues and compartments.
- How the body acts as a chemical reactor system to perform chemical reactions on drugs, creating new chemical structures that can have dramatically different therapeutic activities.

- How the body acts as a chemical removal system, clearing drug and drug derivative molecules out of the body into waste liquids and solids that are discharged from the body.

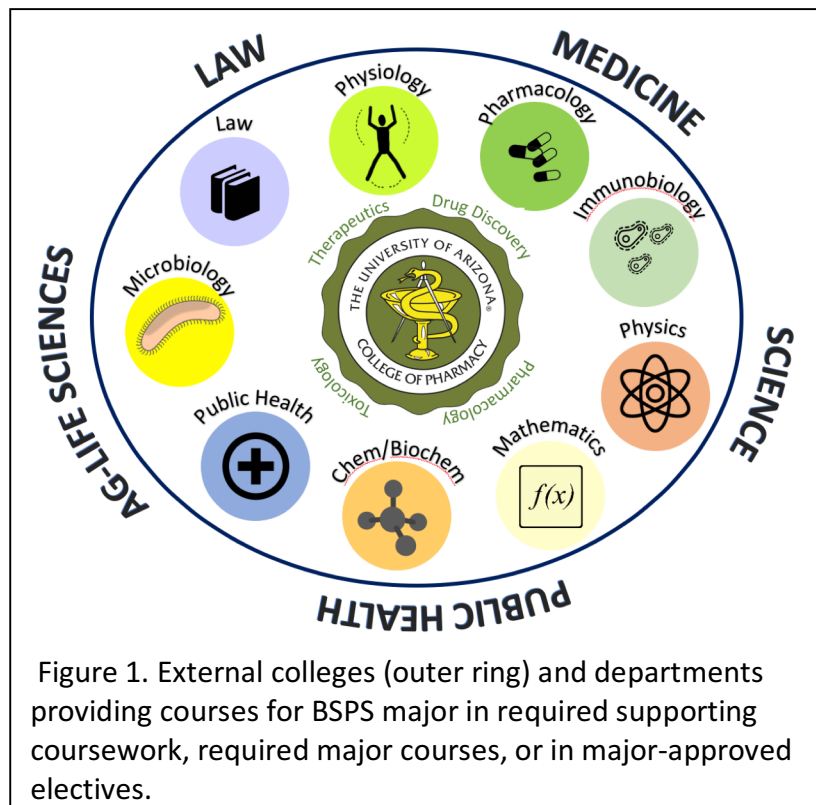
All three programs also include pharmacology, the science that integrates the drugs, their underlying chemistry, the perturbed physiology within diseases, the mechanism through which drug molecules change that physiology for the better, and how intervening with drugs can sometimes result in unintended harmful effects.

Contrasting the programs: Distinguishing the UA BSPS

In our assessment of existing BSPS programs in the U.S. we concluded that most programs provide a reasonably good healthcare pre-professional major/degree. Beyond that, however, we found that many pharmaceutical sciences degrees fall short in preparing graduates for the demands of working in the pharmaceutical industry or biotechnology related to drug discovery and development. Specifically, coursework in other programs does not address the demands of science and laboratory work in an environment of exacting standards under intensive governmental regulation. We think that our content to address this gap will make UA graduates more attractive to companies who work in this demanding environment. The UA program integrates this content throughout the curriculum, but with a particular focus in three courses, *Drug Approval: The 3 Billion Dollar Bet*, *Biomarkers: Analysis of Drug Effect and Toxicity*, and *Rigor and Reproducibility: Bridging Academia and Pharma*. An additional distinguishing area of content in the UA program is in the growing field of precision therapeutics, sometimes referred to as “...choosing the right drug, for the right person, at the right dose, ahead of time”. One example of this is decoding a person's DNA sequence to identify markers in their blueprint that predict which drugs are likely to fail or to produce a harmful effect. That information can then guide the *a priori* choice of drugs to use and drugs to avoid (in today's current clinical world, often the patient has to experience the harmful effect before the decision to discontinue that drug is made). The UA program covers this rapidly-evolving area in the course, *Pharmacogenomics: Predicting a Patient's Future*.

To summarize the comparison, key foundational concepts are maintained within the three programs, including a foundation in basic sciences, drug design and associated chemistry, pharmacology, and pharmacokinetics (ADME). Distinguishing elements of the UA BSPS program include a contemporary focus on the drug-regulatory environment, and on the rapidly evolving area of precision healthcare.

A. CURRENT COURSES AND EXISTING PROGRAMS -- list current courses and existing university programs which will give strengths to the proposed program. If the courses listed belong to a department that is not a signed party to this implementation request, please obtain the department head's permission to include the courses in the proposed program and information regarding



accessibility to the course(s) for students in the proposed program.

BSPS coursework included above (Section III) takes advantage of complementary UA course offerings in nine departments within five UA colleges. These departments and colleges are presented graphically in Figure 1. In appendix material, we include letters of support from each of the partnering colleges.

B. SPECIAL CONDITIONS FOR ADMISSION TO/DECLARATION OF THIS MAJOR-explain in detail the criteria to join this major, including GPA

requirements, completion of courses prior to declaration, application process, interviews, etc. These conditions must be approved by faculty governance to be enforced.

- (1) Official transcripts, GPA ≥ 2.0 in program required supporting courses
- (2) Application and personal statement explaining how enrollment into the BSPS Program will allow the students to achieve their career goals

C. NEW COURSES NEEDED -- list any new courses which must be added to initiate the program; include a course prefix, number, title, catalog description and number of units for each of these courses.

New Courses Required	
Course Number / Title	Description
PCOL 301 (1 unit) Bioethics in Drug Development and Clinical Trials	This colloquium-styled course will broadly introduce students to the importance of biomedical research in drug approval and in research ethics, with special focus on ethical issues that arise from the use of animals in pharmaceutical research (e.g. animal alternatives, use of primates), and issues that have historically come to light in human drug clinical trials (e.g. physician-pharma relationships, contracted research in economically disadvantaged countries). Faculty from various UA units (Philosophy, Law, Nursing, Medicine, Pharmacy, Office of Research Integrity, Human Subjects Protection Program) will be invited to participate.
PCOL 305 (3 units) Scientific Writing: Publications to Proposals to Drug Information	In this fully online course students will learn to read and interpret basic and clinical science papers and to write scientific manuscripts and research proposals. Emphasis will be placed on conveying the significance of research, outlining aims, and discussing results for scientific papers and grant proposals. Students will learn the traditional sections of a scientific paper, how methods are used and presented, how results are communicated, and the elements of a good discussion section. Best practices for figures and tables (data presentation) will be described and students will be shown how to craft an abstract from a work of literature. Students will learn what a research proposal contains (modeled on NIH grants) and how one is constructed. Students will also learn about science translation to non-science audiences through studying drug information publications that target a general audience.
PCOL 310 (2 units) New Drug Approval: The 3 Billion Dollar Bet	This course will provide students a background to the expansive pharmaceutical regulatory process that aims to prevent unsafe and ineffective drugs from entering the marketplace, and to ensure that approved drugs are effective and safe when used in expanded populations of patients.
PCOL 350 (3 units) ADME: How the Body Changes Drugs	ADME, an acronym for absorption, distribution, metabolism, excretion, is often the determining factor in whether drugs generate the desired effect, or no effect, or a harmful effect. PCOL 350 provides students with a rounded education in the ways that the body changes the chemical form of drugs, as well as the ways that the body directs the movement of drugs over time, from administration through excretion.
PCOL 360 (5 units) Pharmacology: How Drugs Change the Body	In contrast to ADME, pharmacology is the science of the ways in which drugs interact with their targets in the body to change a particular body function. This course will provide students with comprehensive content in the altered biology and physiology that underlie major human diseases. That content will be tightly linked to the ways that perturbed biology and physiology become the targets of the major classes of drugs that are currently in use or in development.
PCOL 390 (3 units) Biomarkers: Analysis of Drug Effect and Toxicity	One of the most active areas in drug development research is the discovery of truly sensitive and specific ways to measure, in an animals or humans, how well an experimental drug is exerting its beneficial effect, and how much an experimental drug is exerting a toxic effect. For example, commonly used measurements of

	<p>kidney toxicity may not show any change until over half of kidney function is lost. This course will introduce students to the field of biomarker discovery and measurement, including companion diagnostics. Course topics will complement PCOL310 by presenting this material in the context of the federal drug regulatory environment, focusing on the development of better biomarkers that can improve the drug approval process.</p>
<p>PCOL 410 (5 units) Integrated Medicinal Chemistry and Lab</p>	<p>PCOL 410 will be a combined lecture/lab course delivering content in the application of the foundation sciences to drug design. At an appropriate level of content targeting, students will draw on prior math, physics, and chemistry courses in the study of how drugs are conceptualized, designed, and developed. Content will build from basic concepts (structural factors associated with drug activity, drug solubility, pharmacophores) to a consideration of relevant biological drug targets, as well as basic content in structural biology analytical approaches. Lab work will include exposure to computational tools as well as "wet bench" work in screening a set of anti-cancer drugs in human cell lines.</p>
<p>PCOL 440 (2 units) Rigor and Reproducibility: Bridging Academia and Pharma</p>	<p>PCOL 440 will introduce students to a timely issue of intense focus, both at the level of funding agencies, as well as at the level of academic-pharma/biotech partnerships in drug commercialization. In both of these environments serious concerns have been raised regarding the level of rigor and reproducibility in academic science. This course will expose students to the spectrum of rigor and reproducibility, and engage students in discussions that aim to link the particular rigor applied to an experiment with the demands that exist for the data; for example, contrasting the demands of a pilot experiment to initially test an idea Vs. the measurement of the response to a new drug that will be used as data to seek investment from a pharmaceutical company. Students will be challenged to develop plans for assays that include clearly described validation schemes.</p>
<p>PCOL 455 (3 units) Drug Delivery Systems</p>	<p>In this course, undergraduates will learn the basic principles of physical chemistry necessary to understand pharmaceutical dosage forms and their design. We will cover various dosage forms and drug delivery systems, and how medicinal and pharmaceutical substances are incorporated into them. We will also link course content to prior coursework in ADME (PCOL 350), focusing on how drug delivery interacts with biological factors affecting drug bioavailability, time course of drugs and metabolites in the body, and individualizing dosage regimens</p>
<p>PHCL 460 (3 units) Designing Drugs: From Chemistry to Cure</p>	<p>This course, conducted in collaboration with the College of Medicine Department of Pharmacology, will integrate content from the entire curriculum in an advanced course focused on identification of diseases of interest, identification of disease targets, and considerations of the design of drugs targeting these molecules. This will happen at a depth of knowledge greater than that of the prior general drug discovery course (PCOL 410), and will introduce students to computational approaches to designing drug molecules based on a protein target of known 3-dimensional structure using lectures and laboratory exercises.</p>
<p>PCOL 470 (4 units) Pharmacogenomics: Predicting a Patient's Future</p>	<p>One of the most exciting areas of the pharmaceutical sciences is "Precision Medicine". Faced with 8-10 different anti-hypertension drugs, intuition and generic recommendations currently guide the choice of which drug to start with. Often this leads to frustrating and dangerous rounds of waiting to see if the drug works safely, and if not, trying the next drug in line. PCOL 470 will introduce the student to the</p>

	field of pharmacogenomics, which involves <i>a priori</i> measuring the subtle differences in the biological blueprint and its expression in different individuals, and from that drawing conclusions about the likelihood of that individual having a beneficial drug effect, no effect, or a toxic effect. The course will discuss this in the context of new drug development, where avoiding such points of individual response variability may be the most efficient strategy.
PCOL 493 (6 units) Internship in Pharmaceutical Science	This internship is intended to provide advanced undergraduates in the BSPS program with practical experience in the broad fields applicable to the Pharmaceutical Sciences. Organizations hosting students for this summer experience could include pharmaceutical companies, biotech companies, analytical laboratories, or regulatory organizations such as CPATH here in Tucson.

D. REQUIREMENTS FOR ACCREDITATION -- describe the requirements for accreditation if the program will seek to become accredited. Assess the eligibility of the proposed program for accreditation.

There are no requirements for accreditation of this degree program.

IV. STUDENT LEARNING OUTCOMES AND ASSESSMENT

A. STUDENT OUTCOMES -- describe what students should know, understand, and/or be able to do at the conclusion of this program of study.

Our overarching goals for the BSPS program are to graduate students who will have the ability to:

- a) demonstrate an understanding of chemical-biological interactions as related to current drugs and the discovery and development of new drugs;
- b) demonstrate an understanding of the governmental regulation of the drug development process, including the demanding requirement for stringently controlled research;
- c) apply the scientific method to address gaps in knowledge, through hypothesis formulation, data collection/analysis, and rational interpretation;
- d) understand the techniques, skills, and modern tools in use by pharmaceutical science industry;
- e) communicate effectively in written and oral presentation.

B. STUDENT ASSESSMENT — provide a plan for assessing intended student outcomes while the students are in the program and after they have completed the degree.

The framework for assessment of these outcomes in the UA BSPS program is outlined in the table below. The plan involves the use of both direct and indirect outcome measures that sample students and employers using surveys, embedded components of program coursework, and rubric-guided evaluation of student presentations and composition. The entire assessment scheme will be measured in a 3-year cycle. We will periodically review this assessment scheme with UA-OIA for critical input/improvement.

UA BSPS Assessment Scheme					
MAJOR OUTCOMES	Outcome 1: understand chemical-biological interactions as related to current drugs and the discovery and development of new drugs.	Outcome 2: understand the governmental regulation of the drug development process, including the demanding requirement for stringently controlled research	Outcome 3: apply the scientific method to address gaps in knowledge, through hypothesis formulation, data collection/analysis, and rational interpretation	Outcome 4: understand the techniques, skills, and modern tools in use by pharmaceutical science industry	Outcome 5: communicate effectively in written and oral presentation
METHOD FOR ASSESSING LEARNING	Surveys focused on students' knowledge and preparedness, administered to research mentors, internship supervisors, employers. Will begin in Year 2 and be conducted annually (indirect measure)				
	Graduating seniors and alumni will be surveyed using prompts related to the students' level of comfort in understanding scientific content in these areas, in designing a strategy to scientifically address questions in these areas, and in the use of contemporary tools and techniques to conduct research in these areas. Will begin in Year 2 and be conducted annually (indirect measure)				
	Response to selected questions embedded in exams/assignments in PCOL 310, PCOL 390, PCOL 360, PCOL 410 will be analyzed. (direct measure)		Term paper (PCOL 460) scoring rubric includes rational use of scientific method (direct measure)	Response to selected questions embedded in PCOL 310, PCOL 390, PCOL 360, PCOL 410 will be analyzed. (direct measure)	Senior semester oral presentation (PCOL 460) and Term Paper (PCOL 470) scored using standardized rubric (direct measure)
					Oral presentations describing internships scored using standardized rubric (direct measure)
					Students will be encouraged to participate in scientific conferences locally and beyond. Posters will be scored by a faculty member using a standardized rubric (direct measure)
TIMELINE: Aim is to review all five outcomes within a 3 year cycle	Year 1	Year 1	Year 2	Year 2	Year 3

Mapping of required major coursework to student outcomes is represented in the table below (green shading indicates course contributes to outcome).

Curriculum Map (Major Courses) to Outcomes

	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5
BIOC 384					
PCOL 305					
PCOL 310					
PCOL 350					
PCOL 360					
PCOL 390					
PCOL 410					
PCOL 440					
PCOL 455					
PHCL 460					
PCOL 470					
Capstone Project					
Internship					

V. STATE'S NEED FOR THE PROGRAM

A. HOW DOES THIS PROGRAM FULFILL THE NEEDS OF THE STATE OF ARIZONA AND THE REGION? -- INCLUDE AN EXPLANATION OF THE PROCESS OR SOURCE FOR ARRIVING AT ALL NUMBERS USED IN THIS SECTION

1. IS THERE SUFFICIENT STUDENT DEMAND FOR THE PROGRAM?

Demand within current UA students: We are confident that there is sufficient student demand to support the projected program enrollment. One indicator of this is the membership of the pre-pharmacy club, which is generally around 150 students per year. These students have a self-evident interest in the pharmaceutical sciences, with a particular focus on the pharmacy professional track, one of the career paths that we envision for the BSPS program. Together with students interested in this major as a path to pharmaceutical/biotech careers we think that student interest will support our projected enrollment numbers. We are currently conducting a survey of student interest in this major within the pre-pharmacy club and will submit those data as a separate document.

Plan to market program to prospective UA undergraduate students:

In conjunction with UA Admissions, the COP Communications Director is in the process of developing a marketing plan for the BSPS program that is focused on the enrollment of qualified students from outside UA. In this marketing effort:

Students will be recruited primarily from the Southwest, focusing on attracting exceptional college freshman and sophomores from community colleges, public and private higher education institutes in Arizona, New Mexico, Nevada, Colorado, Utah, and California. Recruitment in the southwest will also target high-school students and parents.

Marketing Outreach

We anticipate using a mix of marketing outreach activities to engage prospective students, as well as the individuals who may guide them as they explore options in higher education (their parents, academic advisors, and STEM educators).

- Tap into UA Admissions. UA Admissions is the University's gateway to entering an undergraduate program here. Working with their team, educate recruiters about the degree and provide materials/giveaways to empower them to promote the degree while 'on the road' marketing UA.

Once approved as a degree, the Assistant Vice President for Enrollment Planning and Recruitment, along with our Senior Director for Undergraduate Recruitment, will work with us to further refine our marketing plan.

- Ensure the program is advertised as part of UA's marketing and website. The university has many (free) places where prospective students can explore degree options both online and in print. Make sure our program is included and provide compelling information about the degree.
- Build the program presence online, and do it well. Create new content and place quality images that effectively market the program on the college's website. Optimize pages for mobile and search so our program information can be found, ranked and displayed in search engines. This content, along with the program brochure, will be the foundational talking points for the program. A well-built website will help us attract prospective students with similar interests.
- Google advertising. Key word search is an excellent way to target prospective students based on their searches. Paid advertisements via Google display ads and Google search ads (appearing in text searches) could be placed to increase awareness among target audiences.

- Paid print advertising. Place paid advertisements in the Arizona alumni magazine, and explore options for a media campaign in targeted areas. This could include print or radio ads.
- Media relations. Generate excitement around the launch of the new degree program by generating a press release and pitching Arizona media about it. Address how the degree will benefit students, what type of professional it will prepare and how this degree program will benefit the state.
- College recruitment fairs. Many associations host recruitment fairs which allow colleges and units to promote their programs and degrees. Evaluate and explore these groups to tap into their events hosted year-round:
 - o Each fall and spring the National Association for College Admission Counseling (NACAC) holds free college fairs in cities across the country.
 - o Arizona School Counselors Association College Fairs
 - o Rocky Mountain Association for College Admission Counseling hosts fairs in Utah, Arizona, Colorado and New Mexico
 - o The UA also hosts multiple fairs for its students to help expose them to different careers and majors:
 - o Meet your Major
 - o Arizona Insider (for high school seniors)
 - o Arizona Experience (for prospective students)
 - o College Knowledge for Middle- School Parents
- High School presentations. The College of Pharmacy has built a substantial network of outreach to local high-schools (One Example: COP developed the highly-successful KEYS summer internship program. <https://www.keys.pharmacy.arizona.edu/content/about-keys>) Plan a circuit and visit high schools in Arizona to speak about this program and other career options in pharmacy to junior and senior students.
- Coordinate a direct mail campaign targeting high school counselors, college admissions counselors and STEM faculty leadership in post-secondary institutes in Arizona, Utah, Colorado, Nevada and California. Purchase mailing lists for the purpose of introducing the degree program to them and send tailored information about the program.
- Host informational sessions for interested students and their parents. Prospective students may have many questions about why they should select this degree over other science-based bachelor's degree programs. Hosting an information session allows students to gather, ask questions, and meet the student services team. Sessions would be targeted at freshman and sophomores in college and can be promoted at community colleges and schools that may have students interested in transferring to the UA.

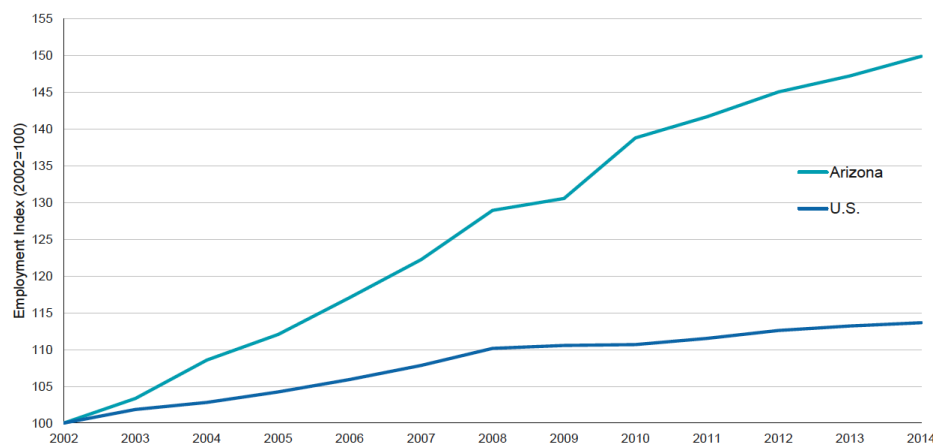
2. What is the anticipated student enrollment for this program? (Please utilize the following tabular format).

5-YEAR PROJECTED ANNUAL ENROLLMENT					
	1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year
Number of Majors	30	85	115	115	115

3. What is the local, regional and national need for this program? Provide market analysis data or other tangible evidence of the need for and interest in this program This might include results from surveys of current students, alumni, and/or employers or reference to student enrollments in similar programs in the state or region. Include an assessment of the employment opportunities for graduates of the program during the next three years.

We see two broad paths for UA BSPS graduates: post-baccalaureate education to pursue professional healthcare degrees (Medicine, Pharmacy, Nursing, Dentistry, Veterinary, etc.) and pursuit of technical/scientific employment in the biosciences (Academia, Pharmaceutical, Testing, Biotech, Medical Devices, Regulatory, etc.), either with a Bachelor's degree or with a subsequent graduate degree.

AZ & U.S. Bioscience Employment: 2002-14



Source: TEconomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

The Flinn Foundation and the Batelle Institute have developed and shepherded the Arizona Biosciences Roadmap. In the most recent large-scale analysis of business climate in the biosciences, data from 2002 - 2014 was analyzed. During that period, which included a major economic recession, growth in Arizona employment within the sector defined as "Bioscience" by the U.S. Bureau of Labor Statistics substantially outstripped the national average (figure above). The Bioscience sector is a useful indicator of potential employment for BSPS graduates because it includes both healthcare as well as the

The Flinn Foundation and the Batelle Institute have developed and shepherded the Arizona Biosciences Roadmap. In the most recent large-scale analysis of business climate in the biosciences, data from 2002 - 2014 was analyzed. During that

pharma/biotechnology sector. Hospitals are the dominant employers in the Bioscience sector, with 78% of the positions. Dividing the 2002-2014 period into pre-recession (2002-2007), recession (2007-2009), and recovery (2009-2014), employment in Arizona hospitals grew by 23%, 7%, and 14% respectively while U.S. hospital employment grew by 9%, 4% and 3%, respectively.

Non-hospital biosciences (includes agricultural feedstock/chemicals, bioscience-related distribution, drugs and pharmaceuticals, medical devices and equipment, and research/testing/medical Laboratories) is an employment category useful in defining the non-healthcare path that we envision for BSPS graduates. In Arizona, non-hospital biosciences employ over 24,000 people, and during those three periods of time between 2002-2014 that sector grew by 19%, 6%, and 17%. In comparison, the U.S employment change for those periods was 6%, -1%, and 3%. By 2014 U.S. employment in non-hospital biosciences was 1.66 million.

The most recent 2014-2025 Biosciences Roadmap highlighted the continued strength of the biosciences in Arizona, and highlighted four goals that are needed to sustain the growth of Arizona biosciences. Noteworthy to our proposed program was this goal:

Build "trees of talent" by encouraging scientific, technical, and managerial talent to be developed and retained in the state.

We believe that innovative university programs that graduate highly qualified individuals with unique bioscience skills directly address a statewide need, as well as a need to fuel the biosciences wherever they are flourishing. To that end, we have included letters of support from two individuals whose careers intersect a diverse array of companies in the biosciences sector. Dr. Martha Brumfield is President and CEO of Critical Path Institute, a nonprofit public-private partnership with the Food and Drug Administration (FDA) created under the auspices of the FDA's Critical Path Initiative program in 2005. This unique organization has carved out a role as an "honest broker" in creating an environment in which ordinarily exclusively competitive pharmaceutical companies can share some data with their competitors that will be mutually beneficial in accelerating the approval of safe, effective drugs. Dr. David Allen is the Vice President of Tech-Launch Arizona, the UA unit responsible for commercialization of UA research. Both of these individuals have a keen sense of the workforce needs in the biosciences sector that UA BSPS graduates can satisfy.

4. Beginning with the first year in which degrees will be awarded, what is the anticipated number of degrees that will be awarded each year for the first five years? (Please utilize the following tabular format).

PROJECTED DEGREES AWARDED ANNUALLY					
	1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year
Number of Degrees	25	55	55	55	55

IV. APPROPRIATENESS FOR THE UNIVERSITY -- Explain how the proposed program is consistent with the University mission and strategic direction statements of the university and why the university is the most appropriate location within the Arizona University System for the program. Please explain how this proposed program is consistent with the College strategic plan.

The UA BSPS program fits squarely into the mission and strategic planning for UA and for the College of Pharmacy. The UA mission is: To improve the prospects and enrich the lives of the people of Arizona and the world through education, research, creative expression, and community and business partnerships. This is accomplished through the strategic pillars of engaging, innovating, partnering, and synergy. The BSPS program is designed to provide a cutting-edge curriculum in which active learning is emphasized, and real world experience permeates the student experience through faculty who work or have worked in the commercial sector, and through internship experiences in the commercial world. The BSPS program draws from 5 colleges and from experts in the commercialization of innovative ideas and the route to navigating complex government regulation of that commercialization. The very nature of the program speaks to the pillars of partnering and synergy.

A complementary set of goals exist within the College of Pharmacy Strategic Plan that are designed to operationalize the university strategic plan. These include the pursuit of educational excellence, and the advancement of community engagement and workforce development. The BSPS program directly addresses these goals. We believe that the program is an excellent plan for undergraduate education that will have a positive impact on Arizona workforce development in the biosciences.

UA-Tucson is the ideal place to initiate this program because it takes advantage of the active research environment surrounding drug discovery and development. Locating the program in Tucson also leverages the local pool of commercial entities “spun off” of the UA, as well as the unique organizations like CPATH that simply cannot be found anywhere else.

V. EXISTING PROGRAMS WITHIN THE ARIZONA UNIVERSITY SYSTEM

- A. Arizona University System -- List all similar programs at the same academic level (Bachelor's, Master's, Doctoral) currently offered in the Arizona University System. (Please utilize the following tabular format).**

	Program Name	Degree Type	Number of Students Enrolled	LOCATION University & Site	PROGRAM ACCREDITATION? YES/NO
1					
2					

Curricular Affairs (and the Graduate College for graduate programs) will determine if you are required to complete a comparison chart to discuss the ways in which the proposed program differs from University of Arizona programs.

No Existing Similar Bachelor's Programs at UA

VI. EXPECTED FACULTY AND RESOURCE REQUIREMENTS

A. FACULTY

- Current Faculty -- List the name, rank, highest degree, primary department and estimate of the level of involvement of all current faculty members who will participate in the program. If proposed program is at the graduate level, also list the number of master's theses and doctoral dissertations each of these faculty members have directed to completion. Attach a brief vita for each faculty member listed.**

NAME	DEPARTMENT	INVOLVEMENT
Walt Klimecki, DVM, Ph.D.	Pharmacology and Toxicology	Program Director, Coordinating/Teaching 1 course (1 unit, 3 units)
Nathan Cherrington, Ph.D.	Pharmacology and Toxicology	Coordinating/Teaching 1 courses (3 units)
John Regan, Ph.D.	Pharmacology and Toxicology	Coordinating/Teaching 1 courses (5 units)
Chris Hulme, Ph.D.	Pharmacology and Toxicology	Coordinating/Teaching 1 courses (5 units)
Elizabeth Hall-Lipsy, J.D., M.P.H.	Pharmacy Practice and Science	Coordinating/Teaching 1 course (3 units)

Amanda Baker, Pharm.D., Ph.D.	Pharmacy Practice and Science	Coordinating/Teaching 2 courses (3 units, 2 units)
Paul Myrdal, Ph.D.	Pharmacy Practice and Science	Coordinating/Teaching 1 course (3 units)
Jennifer Schnellmann, Ph.D.	Pharmacology	Coordinating/Teaching 1 course (3 units)
May Khanna, Ph.D.	Pharmacology	Coordinating/Teaching 1 course (3 units)
Roger Miesfeld	Chemistry/Biochemistry	Coordinating/Teaching 1 course (3 units)

2. Additional Faculty -- Describe the additional faculty needed during the next three years for the initiation of the program and list the anticipated schedule for addition of these faculty members.

We do not anticipate the need to hire additional faculty for the near-term.

3. Current Student and Faculty FTEs -- Give the present numbers of Student FTE (identify number by graduate and undergraduate students) and Faculty FTE in the department or unit in which the program will be offered.

The Pharmacology and Toxicology department currently has no undergraduate students (the BSPS will be the first undergraduate major/degree offered in our college)

There are 21 graduate students in the Pharmacology and Toxicology department.

There are 16 faculty FTE in the Pharmacology and Toxicology department

4. Projected Student and Faculty FTEs -- Give the proposed numbers of Student FTE and Faculty FTE for the next three years in the department or unit in which the program will be offered.

	AY 17/18	AY 18/19	AY 19/20	AY 20/21
Undergraduate*	0	30	85	110
Graduate**	21	25	28	30
Faculty**	20	23	25	25

*Increase based on anticipated expansion of enrollment

** Increase based on current and planned faculty recruitment

B. LIBRARY

1. Acquisitions Needed -- Describe additional library acquisitions needed during the next three years for the successful initiation of the program.

No library acquisitions needed

C. PHYSICAL FACILITIES AND EQUIPMENT

- 1. Existing Physical Facilities -- Assess the adequacy of the existing physical facilities and equipment available to the proposed program. Include special classrooms, laboratories, physical equipment, computer facilities, etc.**

Special classrooms will not be required. Medicinal chemistry laboratory components will be held in existing laboratory space in the Skaggs Pharmaceutical Sciences building and in Drachman Hall A. Computational components of medicinal chemistry laboratories can be accomplished on students' laptop computers.

- 2. Additional Facilities Required or Anticipated -- Describe physical facilities and equipment that will be required or are anticipated during the next three years for the proposed program.**

We do not anticipate that any additional facilities or equipment will be required for the near-term.

D. OTHER SUPPORT

1. Other Support Currently Available -- Include support staff, university and non-university assistance.

As we have highlighted earlier in this proposal, college marketing/communications support is available to publicize the program in student recruitment efforts.

2. Other Support Needed, Next Three Years -- List additional staff needed and other assistance needed for the next three years.

We are not initially planning to employ graduate assistants in this program. Within our enrollment projections the assigned faculty can manage the coursework. Our current departmental graduate programs are typical of many biomedical doctoral programs in offering graduate research assistantships, but not graduate teaching assistantships. Even if we decide to move to employing graduate students as TAs we would first get the program up and running smoothly without that feature, and then carefully plan how we would implement the addition of the graduate student employment option as TAs.

We will hire a program coordinator and an academic advisor dedicated to the BSPS program prior to the launch of the program.

VII. FINANCING

A. SUPPORTING FUNDS FROM OUTSIDE SOURCES --List.

B. BUDGET PROJECTIONS FORM -- Complete the budget projections form describing the current departmental budget and estimating additional costs for the first three years of operation for the proposed program. Please note that these costs for each year are incremental costs, not cumulative costs. Include in this budget the anticipated costs for support for instruction, administration of the program, graduate students, marketing, the support discussed in Section VI-D.2, and any other costs that will be needed.

VIII. OTHER RELEVANT INFORMATION

IX. REQUIRED SIGNATURES:

Managing Unit Administrator: Stacy Lauver, Assistant Dean for Finance and Administration
(name and title)

Managing Administrator's Signature: Stacy D. Lauver Date: 10/12/17

Managing Unit Administrator: _____
(name and title)

Managing Administrator's Signature: _____ Date: _____

Managing Unit Administrator: _____
(name and title)

Managing Administrator's Signature: _____ Date: _____

Dean's Signature:  _____ Date: 10/12/17

Dean's Signature: _____ Date: _____

All programs that will be offered through distance learning must include the following signature. The signature of approval does not indicate a commitment to invest in this program. Any potential investment agreement is a separate process.

Joel Hauff, Associate Vice President of Student Affairs & Enrollment Management/Academic Initiatives and Student Success

Signature: _____ Date: _____

All programs that will be offered fully online must include the following signature: The signature of approval does not indicate a commitment to invest in this program. Any potential investment agreement is a separate process.

Vincent Del Casino Jr., Vice Provost for Digital Learning and Associate Vice President of Student Affairs & Enrollment Management

Signature: _____ Date: _____

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

BRIEF FACULTY CVs

CURRICULUM VITAE: Amanda Baker, Pharm.D., Ph.D.

Assistant Professor of Medicine
College of Medicine, University of Arizona
ABaker@uacc.arizona.edu

EDUCATION

August 1997 Ph.D. Department of Pharmacology and Toxicology, College of Pharmacy, University of Arizona

Mentor: Garth Powis, D. Phil.

May 2000 Pharmacy Doctorate, University of Arizona College of Pharmacy

EMPLOYMENT

Dec 2009-Present Research Scientist, Critical Path Institute, Tucson, AZ

July 2008-Present Associate Professor of Medicine, Research Scholar Track, Section of Hematology/Oncology, Arizona Cancer Center, University of Arizona, Tucson, AZ

Jan. 2002-June 2008 Research Assistant Professor, College of Medicine, Section of Hematology/Oncology, Arizona Cancer Center, University of Arizona, Tucson, AZ

July 2000-Dec. 2001 Research Associate Scientist for Alan List, M.D. and Garth Powis, D.Phil. Arizona Cancer Center, University of Arizona, Tucson, AZ

Dec. 1998-June 1999 Research Specialist for Garth Powis, D. Phil. Arizona Cancer Center, University of Arizona, Tucson, AZ
Dec. 1998 - June 1999

Jan. 1998-Sept. 1998 Pharmacy Intern
Dependable Staffing, Phoenix, AZ

1992-1997 Graduate Student/Research Assistant
Department of Pharmacology/Toxicology, University of Arizona, Tucson, AZ

TEACHING

CBIO 553: Advanced Topics in Cancer Biology
Guest Lecturer

UA Fellows Bootcamp
Guest Lecturer

PHSC 610 Solids, Nanotech, Engineering Design Drug Delivery
Guest Lecturer

SELECTED PEER-REVIEWED PUBLICATIONS

Baker AF, Malm SW, Pandey R,, Laughren C, Cui H, Roe D, Chambers SK. Evaluation of a hypoxia regulated gene panel in ovarian cancer. *Cancer Microenvironment*. 2015 April;8(1):45-56. PMID: 25998313.

Hanke NT, Garland LL, **Baker AF**. Carfilzomib combined with suberanilohydroxamic acid (SAHA) synergistically promotes endoplasmic reticulum stress in non-small cell lung cancer cell lines. J Cancer Res Clin Oncol. 2015 Sept 18 [Epub ahead of print] PMID: 26385374.

Akhenblit PJ, Hanke NT, Gill A, Persky DO, Howison CM, Pagel MD, **Baker AF**. Assessing Metabolic Changes in Response to mTOR Inhibition in a Mantle Cell Lymphoma Xenograft Model Using AcidoCEST MRI. Mol Imaging. 2016 May 2;15. PMID: 27140422.

Zhang X, Wojtkowiak JW, Martinez GV, Cornnell HH, Hart CP, **Baker AF**, Gillies R. MR Imaging Biomarkers to Monitor Early Response to Hypoxia-Activated Prodrug TH-302 in Pancreatic Cancer Xenografts. PLoS One. 2016 May 26;11(5): 2016. PMID: 27227903.

Sinharay S, Howison CM, **Baker AF**, Pagel MD., Detecting in vivo urokinase plasminogen activator activity with a catalyCEST MRI contrast agent, NMR Biomed. 2017 Mar 29. PMID: 28370884.

Regulatory Briefing Documents

- Contributor, Critical Path Institute Predictive Safety Testing Consortium Nephrotoxicity Working Group and FNIH Biomarkers Consortium Kidney Safety Biomarker Clinical Qualification Project Team Translational Qualification of Drug-Induced Nephrotoxicity Biomarkers – Clinical Briefing Book, Submitted to FDA and EMA, April 13, 2011.
- Contributor, Kidney Safety Project Qualification Submission, A Collaboration of the FNIH Biomarkers Consortium Kidney Safety Biomarkers Project Team and Critical Path Institute PSTC Nephrotoxicity Working Group Learning Phase Clinical Briefing Book, Submitted to FDA and EMA, October 18, 2013.
- Contributor, Kidney Safety Project Qualification Submission, Limited Context of Use, Qualification Briefing Book, Submitted to FDA, July 27, 2015.

CURRICULUM VITAE: Nathan Cherrington, Ph.D.
Professor of Pharmacology and Toxicology
College of Pharmacy, University of Arizona
cherring@pharmacy.arizona.edu

EDUCATION

1997 Ph.D., Toxicology Department, North Carolina State University, Raleigh, North Carolina,
Mentor: Ernst Hodgson

2002 Post-doctoral fellow, Toxicology Department, University of Kansas Medical Center, Kansas
City, KS
Advisor, Curtis D. Klaassen

EMPLOYMENT

2015-Present Interim Director, Arizona Board of Regents Center for Toxicology

2015-Present Director, NIEHS P30 Southwest Environmental Health Sciences Center,
University of Arizona, Tucson, AZ.

2015-Present Director, NIEHS T32 Training in Environmental Toxicology of Human Disease,
University of Arizona, Tucson, AZ.

2012-Present Professor and 1885 Society Distinguished Scholar, Dept. of Pharmacology and
Toxicology, University of Arizona, Tucson, AZ.

2011-Present Director of Graduate Studies, College of Pharmacy, and Head, Dept. of
Pharmaceutical Sciences, University of Arizona, Tucson, AZ.

2008-2012 Associate Professor, Dept. of Pharmacology and Toxicology, University of
Arizona, Tucson, AZ.

2010-Present Associate Professor, Community, Environment and Policy Division, Mel & Enid
Zuckerman College of Public Health, University of Arizona, Tucson, AZ.

2002-2008 Assistant Professor, Dept. of Pharmacology and Toxicology, College of
Pharmacy, University of Arizona, Tucson, AZ. Member, Southwest Environmental
Health Sciences Center

TEACHING

General and Systems Toxicology* (PCOL 602A) *2003-Present*
Required course for Ph.D. and M.S. degrees in Pharmacology and Toxicology
6 lectures each fall semester
* Course Coordinator 2007-Present

Drug Metabolism and Disposition* (PCOL 550) *2003-Present*
Required course for Ph.D. and M.S. degrees in Pharmacology and Toxicology
9 lectures each spring semester
* Course Coordinator 2013-Present

Environmental Toxicology* (PCOL 573)
Required course for Training Grant predocs and postdocs

* Course Coordinator 2016-present

Science of Pharmacology (PCOL 871A) 2003-Present

Required course for Pharm.D., Ph.D. and M.S. degrees

6 lectures each fall semester

Cellular Communications and Signal Transduction (PCOL 630B) 2005-Present

Required course for Ph.D. and M.S. degrees in Pharmacology and Toxicology

3-4 lectures each fall semester

Case Studies in Biochemical Pharmacology (PCOL 870/871) 2003-Present

Required course for Pharm.D. students

3 case studies each fall and spring semesters

Authored "Marilyn Daines" Acetaminophen Toxicity case

Individualized Medicine: Applied Pharmacogenetics (PHPR 887) 2010-2013

Required course for Pharm.D. students

2 lectures each spring semester

Advanced Toxicology* (PCOL 596C) 2004-2010

Required course for Ph.D. and M.S. degrees in Pharmacology and Toxicology

6-7 lectures each fall semester

* Course Coordinator 2004-2010

Intro to Pharmacology/Toxicology Research (PCOL586B) 2003-Present

Required course for Ph.D. and M.S. degrees

Laboratory introduction fall and spring semester

SELECTED PEER-REVIEWED PUBLICATIONS

Dzierlenga AL, Clarke JD, Hargraves TL, Ainslie GR, Vanderah TW, Paine MF, **Cherrington N**. Mechanistic Basis of Altered Morphine Disposition in Nonalcoholic Steatohepatitis. *J Pharmacol Exp Ther*. 2015 Mar; 352(3):462-70.

Lake AD, Novak P, Shipkova P, Aranibar N, Robertson D, Reily MD, Lehman-McKeeman LD, Vaillancourt RR, **Cherrington NJ**. Branched Chain Amino Acid Metabolism Profiles in Progressive Human Nonalcoholic Fatty Liver Disease. *Amino Acids* 2014; 47(3):603-15.

Canet MJ, Merrell MD, Hardwick RN, Betaille AM, Campion SN, Ferreira DW, Manautou JE, A-Kader HH, Erickson RP, **Cherrington NJ**. Altered Regulation of Hepatic Efflux Transporters Disrupts Acetaminophen Disposition in Pediatric Nonalcoholic Steatohepatitis. *Drug Metab Dispos*. 2015 Jun;43(6):829-35.

Clarke JD, **Cherrington NJ**. Nonalcoholic steatohepatitis in precision medicine: Unraveling the factors that contribute to individual variability. *Pharmacol Ther*. 2015 Jul;151:99-106.

Clarke JD, Dzierlenga AL, Nelson NR, Li H, Werts S, Goedken MJ, **Cherrington NJ**. Mechanism of Altered Metformin Distribution in Nonalcoholic Steatohepatitis. *Diabetes*. 2015 Sep;64(9):3305-13.

CURRICULUM VITAE: Elizabeth A. Hall-Lipsy, J.D.
Assistant Professor of Pharmacy Practice and Science
College of Pharmacy, University of Arizona
ehall@pharmacy.arizona.edu

EDUCATION

2005 J.D., University of Arizona College of Law

2002 M.P.H., University of Arizona College of Public Health

Professional Licensures & Certifications

Licensed to practice law in state courts of Arizona, Arizona Bar Association 2005 (Inactive status)

Licensed to practice law, federal courts of District of Arizona, United States District Court, Arizona 2005
(Inactive status)

EMPLOYMENT

2011-Present Assistant Professor of Pharmacy Practice and Science, University of Arizona,
Tucson, AZ

2008-Present Coordinator of Rural Health Professions Program, College of Pharmacy,
University of Arizona, Tucson, AZ

2008-2011 University of Arizona College of Pharmacy: Program Manager for Health
Disparities Initiatives and Community Outreach; Tucson, Arizona

TEACHING

PHPR 843: Pharmacy Laws

Coordinator, Lecturer

PHPR 814: Preventative Care

Lecturer

PHPR 828: Pharmacy Health Disparities in U.S.

Lecturer

PHPR 861c: Drug Literature Evaluation and Application

Guest Lecturer

SELECTED PEER-REVIEWED PUBLICATIONS

Chisholm-Burns MA, Graff Zivin JS, Lee JK, Spivey CA, Slack M, Herrier RN, **Hall-Lipsy E**, Abraham I, Palmer J. Economic effects of pharmacists on health outcomes in the United States: A systematic review. Am J Health Syst Pharm. 2010 Oct 1;67(19):1624-34.

Chisholm-Burns MA, Kim Lee J, Spivey CA, Slack M, Herrier RN, **Hall-Lipsy E**, Graff Zivin J, Abraham I, Palmer J, Martin JR, Kramer SS, Wunz T. US pharmacists' effect as team members on patient care: systematic review and meta-analyses. Med Care. 2010 Oct;48(10):923-33.

Hall-Lipsy EA, Chisholm-Burns MA. Pharmacotherapeutic disparities: racial, ethnic, and sex variations in medication treatment. *Am J Health Syst Pharm*. 2010 Mar 15;67(6):462-8.

CURRICULUM VITAE: Christopher Hulme, Ph.D.
Professor of Pharmacology and Toxicology
College of Pharmacy, University of Arizona
hulme@pharmacy.arizona.edu

EDUCATION

1989 M.Sc., Department of Chemistry, Hertford College, Oxford University, Oxford, England

1992 Ph.D, Hertford College, Oxford University, Oxford, England

Advisor, J.E. Baldwin

1994 Post-Doc, University of Texas, Austin, Texas

Advisor, P. D. Magnus

EMPLOYMENT

2011-Present Professor of Pharmacology and Toxicology, University of Arizona, Tucson, AZ

2007-2011 Associate Professor of Pharmacology and Toxicology, University of Arizona, Tucson, AZ

2004-2007 Group Leader of the High Throughput Medicinal Chemistry Group and Platform Library Sciences, Eli Lilly Pharmaceuticals, Indianapolis, Indiana

1999-2004 Head of Medicinal Chemistry Technologies, Amgen, Thousand Oaks, California

1994-1999 Research Scientist, Senior Research Scientist, Research Fellow, Rhone Poulenc Rorer Pharmaceuticals, Collegeville, Pennsylvania

TEACHING

PCOL 873a: Medicinal Chemistry I

Coordinator, Multiple Lectures

PCOL 873b: Medicinal Chemistry II

Coordinator, Multiple Lectures

PCOL 670: Principles of Drug Discovery and Development

Lecturer

PCOL 195a Pharmaceutical Science: From Bench to Bedside

Guest Lecturer

SELECTED PEER-REVIEWED PUBLICATIONS

Branca C, Shaw DM, Belfiore R, Gokhale V, Shaw AY, Foley C, Smith B, **Hulme C**, Dunckley T, Meechoovet B, Caccamo A, Oddo S. Dyrk1 inhibition improves Alzheimer's disease-like pathology. *Aging Cell*. 2017 Oct;16(5):1146-1154.

Martinez-Ariza G, Mehari BT, Pinho LAG, Foley C, Day K, Jewett JC, **Hulme C**. Synthesis of fluorescent heterocycles via a Knoevenagel/[4 + 1]-cycloaddition cascade using acetyl cyanide. *Org Biomol Chem*. 2017 Jul 26;15(29):6076-6079.

Collet JW, Foley C, Shaw AY, Orru RVA, Ruijter E, **Hulme C**. Copper(i) catalyzed oxidative hydrolysis of Ugi 3-component and Ugi-azide reaction products towards 2° α -ketoamides and α -ketotetrazoles. *Org Biomol Chem*. 2017 Jul 26;15(29):6132-6135.

Foley C, Shaw A, **Hulme C**. Oxidative Deaminations and Deisatinylation of Ugi-Azide and Ugi-3CR Products: A Two-Step MCR-Oxidation Protocol toward Functionalized α -Ketoamides and α -Ketotetrazoles. *Org Lett*. 2017 May 5;19(9):2238-2241.

Foley C, Shaw A, **Hulme C**. Two-Step Route to Diverse N-Functionalized Peptidomimetic-like Isatins through an Oxidation/Intramolecular Oxidative-Amidation Cascade of Ugi Azide and Ugi Three-Component Reaction Products. *Org Lett*. 2016 Oct 7;18(19):4904-4907. Epub 2016 Sep 15.

CURRICULUM VITAE: MAY KHANNA, Ph.D.

Assistant Professor of Pharmacology
College of Medicine, University of Arizona
maykhanna@email.arizona.edu

EDUCATION

1995-2001 Doctor of Philosophy, Department of Chemistry, Wayne State University, Detroit, Michigan
Mentor: Dr. Christine Chow

2001-2004 Postdoctoral Fellow, Department of Chemistry and Biochemistry, University of California, Los Angeles, California
Mentor: Dr. Juli Feigon

2004-2008 Postdoctoral Fellow, Donnelly Center for Cellular and Biomolecular Research, University of Toronto, Toronto, Canada
Mentor: Dr. Benjamin Blencowe

EMPLOYMENT

2009-2013 Visiting Research Assistant Professor, Department of Biochemistry and Molecular Biology, Indiana University, Indianapolis, Indiana
Mentors: Dr. Samy O. Meroueh and Dr. Thomas D. Hurley

July 2014-present Assistant Professor, Department of Pharmacology, College of Medicine, University of Arizona, Tucson, Arizona

TEACHING

G749/G807 Structural and Chemical Biology Course

2 lectures: "Principle of Nuclear Magnetic Resonance (NMR)" and "Principles of NMR in Biomolecular Structure Determination"

PCOL530

2 Lectures in Drug Discovery "Disrupting Protein-Protein Interaction using small molecules"

PHCL 596C

Medical Pharmacology Student Seminar Course Director

CRC Clinical Reasoning Facilitator for Medical Students

SELECTED PEER-REVIEWED PUBLICATIONS

Moutal A, Chew LA, Yang X, Wang Y, Yeon SK, Telemi E, Meroueh S, Park DK, Shrinivasan R, Gilbraith KB, Qu C, Xie JY, Patwardhan AP, Vanderah TW, **Khanna M**, Porreca F, Khanna R, "(S)-Lacosamide inhibition of CRMP2 phosphorylation reduces postoperative and neuropathic pain behaviors through distinct classes of sensory neurons identified by constellation pharmacology"; *Pain*. 2016 Jul;157(7):1448-63.

Xie JY, Chew LA, Yang X, Wang Y, Qu C, Wang Y, Federici LM, Fitz SD, Ripsch MS, Due MR, Moutal A, **Khanna M**, White FA, Vanderah TW, Johnson PL, Porreca F, Khanna R "Sustained relief of ongoing experimental neuropathic pain by a CRMP2 peptide aptamer with low abuse potential"; *Pain*. 2016 Sep;157(9):2124-40.

Dustrude ET, Moutal A, Yang X, Wang Y, **Khanna M**, Khanna R "Hierarchical CRMP2 posttranslational modifications control Nav1.7 function", PNAS 2016 Dec 27; 113 (52): E8443-E8452.

Moutal A, Li W, Wang Y, Ju W, Luo S, Cai S, François-Moutal L, Perez-Miller S, Hu J, Dustrude ET, Vanderah TW, Gokhale V, **Khanna M**, Khanna R." Homology-guided mutational analysis reveals the functional requirements for antinociceptive specificity of CRMP2-derived peptides." Br J Pharmacol. 2017 Feb 5. doi: 10.1111/bph.13737 (epub ahead of print).

Dustrude ET, Francois-Moutal, L, Perez-Miller S, Moutal A, **Khanna M***, Khanna R* "A single structurally conserved SUMOylation site in CRMP2 controls Nav1.7 function" Channels, in press. (*co-corresponding).

Moutal A, Yang X, Li W, Gilbraith KB, Luo S, Cai S, François-Moutal L, Chew LA, Yeon SK, Bellampalli SS, Qu C, Xie JY, Ibrahim MM, **Khanna M**, Park KD, Porreca F, Khanna R. "CRISPR/Cas9 editing of Nf1 gene identifies CRMP2 as a therapeutic target in neurofibromatosis type 1-related pain that is reversed by (S)-Lacosamide." Pain. 2017 Jul 3. doi: 10.1097/j.pain (Epub ahead of print).

CURRICULUM VITAE: Walt Klimecki, DVM, Ph.D.
Associate Professor
Department Head (Interim), Pharmacology and Toxicology
College of Pharmacy, University of Arizona
klimecki@pharmacy.arizona.edu

EDUCATION

- 1998** Post-doc, Cancer Biology, Arizona Cancer Center, Tucson, Arizona, Mentor: G. Tim Bowden
- 1994** Ph.D., Pharmacology and Toxicology, College of Pharmacy University of Arizona, Tucson, Arizona
- 1984** Doctor of Veterinary Medicine, The Ohio State University, Columbus, Ohio

EMPLOYMENT

- | | |
|-----------------------|--|
| 2015-Present | Department Head (Interim)
Department of Pharmacology and Toxicology
College of Pharmacy, University of Arizona |
| 2013-2015 | Associate Department Head
Department of Pharmacology and Toxicology
College of Pharmacy, University of Arizona |
| 2012-Present | Associate Professor of Pharmacology and Toxicology
Department of Pharmacology and Toxicology
College of Pharmacy, University of Arizona |
| 2006 - Present | Assistant Professor of Pharmacology and Toxicology
Department of Pharmacology and Toxicology
College of Pharmacy, University of Arizona |
| 2016 - Present | Joint Appointment: Associate Professor
College of Nursing |
| 2009 - Present | Joint Appointment: Associate Professor
Division of Community, Environment and Policy
Mel and Enid Zuckerman College of Public Health
University of Arizona |
| 2004 - Present | Research Assistant Professor
Department of Medicine
College of Medicine
University of Arizona |

TEACHING

Course/Title	Course Description
NURS 472a/572a Pharmacology for Nursing	Required course for Nursing Students
Coordinator and Sole Lecturer: 2016-Current	
PCOL 887 <i>Individualized Medicine</i>	Required course for 1 st year Pharm. D. professional students.
Involvement: 2012-2014: Coordinator, completely revised course and structured it as “flipped classroom” in 2013, and as a fully online course in 2014. 2017: Guest Lecturer	
PCOL 835A <i>Immunology and Hematology</i>	Required course for 1 st year Pharm. D. professional students.
Involvement: 2006 (6 lecture hours), 2007), 2008, 2010	
PCOL 601 Genomics and Proteomics	Required course for graduate students in Pharm/Tox, frequently taken as elective by grad. students in other departments.
Involvement: 2006, 2007 , 2008, 2009, 2010	
PCOL 631/831 Pharmacogenetics and Pharmacogenomics	Elective course for graduate students and for Pharm. D. students.
Involvement: 2007, 2008, 2010	
PCOL 820/821 Case Studies in Pharmacy	Required course for 1 st year Pharm. D. students
Involvement: Every semester, 2006-Present, 2015-2016 Coordinator	
PCOL 596c Advanced Toxicology	Required course for 1 st year Pharm/Tox graduate students, a weekly journal club
Involvement: 2007-2012	
PCOL 550 Drug Disposition and Metabolism	Required course for first year Pharm/Tox grad students.
Involvement: 2008-Present	
PCOL 573 Environmental Toxicology	Required colloquium for students on the Toxicogenomics training grant
Involvement: 2008 -Present	
PCOL 602a General and Systems Toxicology	Required course for 2 nd year Pharm/Tox grad students.
Involvement: 2007 - Present	
CBA 595h Problems in the Biology of Complex Diseases	A colloquium course offered through the ABCD Complex Diseases Initiative, Sponsored by Arizona Research Labs and BIO5.
Involvement: (<i>Human genetics and disease</i>) 2008-2016	

BME 524 Contrast Agents, Molecular Imaging, and Kinetics	Elective course for Biomedical Engineering Students
Involvement: 2011, 2016	
EPI 573c Advanced Epidemiology	Required course for epidemiology graduate students
Involvement: 2006, 2007	
EPI 677 Genetic Association Studies	Elective course for epidemiology graduate students
Involvement: 2007, 2008, 2010	
PCOL 395 The Chemical Environment, Environmental Exposures, and Human Disease	Required course for undergraduate students on Dr. Klimecki's NIH-funded training grant
Involvement: 2015, 2016, 2017. Developed course. Teach entire course	

SELECTED PEER-REVIEWED PUBLICATIONS

Ramirez-Andreotta MD, Lothrop N, Wilkinson ST, Root RA, Artiola JF, Klimecki W, Loh M. Analyzing Patterns of Community Interest at a Legacy Mining Waste Site to Assess and Inform Environmental Health Literacy Efforts. *J Environ Stud Sci*. 2016 Sep;6(3):543-555.

Klimentidis YC, Bea JW, Thompson P, Klimecki WT, Hu C, Wu G, Nicholas JS, Ryckman KK, Chen Z. Genetic Variant in ACVR2B Is Associated with Lean Mass. *Med Sci Sports Exerc*. 2016 Jul;48(7):1270-5.

Beamer PI, Klimecki WT, Loh M, Van Horne YO, Sugeng AJ, Lothrop N, Billheimer D, Guerra S, Lantz RC, Canales RA, Martinez FD. Association of Children's Urinary CC16 Levels with Arsenic Concentrations in Multiple Environmental Media. *Int J Environ Res Public Health*. 2016 May 23;13(5).

Loh MM, Sugeng A, Lothrop N, Klimecki W, Cox M, Wilkinson ST, Lu Z, Beamer PI. Multimedia exposures to arsenic and lead for children near an inactive mine tailings and smelter site. *Environ Res*. 2016 Apr;146:331-9.

Zhao F, Klimecki WT. Culture conditions profoundly impact phenotype in BEAS-2B, a human pulmonary epithelial model. *J Appl Toxicol*. 2015 Aug;35(8):945-51.

Lothrop N, Wilkinson ST, Verhougstraete M, Sugeng A, Loh MM, Klimecki W, Beamer PI. Home Water Treatment Habits and Effectiveness in a Rural Arizona Community. *Water (Basel)*. 2015;7(3):1217-1231.

Zhao F, Malm SW, Hinchman AN, Li H, Beeks CG, Klimecki WT. Arsenite-induced pseudo-hypoxia results in loss of anchorage-dependent growth in BEAS-2B pulmonary epithelial cells. PLoS One. 2014 Dec 16;9(12):e114549.

CURRICULUM VITAE: ROGER MIESFELD, Ph.D.

Professor and Head, Dept. of Chemistry & Biochemistry

College of Science, University of Arizona

rlm@email.arizona.edu

EDUCATION

1983 Doctor of Philosophy, Department of Biochemistry, Stony Brook University (SUNY), Stony Brook, New York

Mentor: Dr. Norman Arnheim

1983-1987 Postdoctoral Fellow, Department of Biochemistry and Biophysics, University of California, San Francisco, California

Mentor: Dr. Keith Yamamoto

EMPLOYMENT

1987-1983 Assistant Professor, Depts. of Biochemistry and Molecular & Cellular Biology, University of Arizona

1993-1998 Associate Professor, Depts. of Biochemistry and Molecular & Cellular Biology, University of Arizona

1998-Present Professor, Depts. of Chemistry and Biochemistry and Molecular & Cellular Biology, University of Arizona

TEACHING

Medical School Biochemistry (BIOC 801)

Medical School Molecular and Cellular Biology (MCB 801)

Biochemistry Graduate Core Course (BIOC 572)

Biochemistry Graduate Core Course (BIOC 572)

Molecular Biology (MCB 511)

Spring 1992 - Graduate student discussion sessions (8 hours)

Spring 1993 - Graduate student discussion sessions (8 hours)

Spring 1994 - Graduate student discussion sessions (8 hours)

Applied Molecular Genetics (Bioc 471/571)

Fall 1999 - Upper division discussion course (30 lecture hours)

Fall 2000 - Upper division discussion course (30 lecture hours)

Fall 2001 - Upper division discussion course (30 lecture hours)

Opportunities in Biochemistry (Bioc 195G)

Fall 2007 - Colloquium to introduced students to biochemistry (2 sections)

Fall 2008 - Colloquium to introduced students to biochemistry (2 sections)

Undergraduate Majors Biochemistry (Bioc 462)

Spring 1995 - Discussion sections and Honors section (60 hours)

Spring 1996 - Discussion sections and Honors section (60 hours)

Spring 1997 - Discussion sections and 16 lecture hours (62 hours)

Spring 1998 - Discussion sections and 16 lecture hours (62 hours)

Fall 2002 - Discussion sections

Spring 2006 - Discussion section and 14 lecture hours (62 hours)

Undergraduate Non-Majors Biochemistry (Bioc 460)

Spring 1999 - Protein and Metabolic Biochemistry (25 lecture hours)
Spring 2000 - Protein and Metabolic Biochemistry (25 lecture hours)
Spring 2001 - Protein and Metabolic Biochemistry (25 lecture hours)
Spring 2002 - Protein and Metabolic Biochemistry (25 lecture hours)
Spring 2004 - Protein and Metabolic Biochemistry (22 lecture hours)
Spring 2005 - Protein and Metabolic Biochemistry (22 lecture hours)
Summer 2006 - Protein and Metabolic Biochemistry (20 lecture hours)
Spring 2008 - Protein and Metabolic Biochemistry (20 lecture hours)
Fall 2008 - Protein and Metabolic Biochemistry (20 lecture hours, two sections)
Fall 2009 - Protein and Metabolic Biochemistry (20 lecture hours, two sections)
Fall 2010 - Protein and Metabolic Biochemistry (20 lecture hours, two sections)
Spring 2011 - Protein and Metabolic Biochemistry (20 lecture hours, two sections)

Introduction to Biochemical Research (Bioc 296B)

Spring 2009 – Seminar course and small group discussions (15 hours)
Spring 2010 – Seminar course and small group discussions (15 hours)
Fall 2010 – Seminar course and small group discussions (15 hours)
Spring 2012 – Seminar course and small group discussions (15 hours)
Fall 2012 – Seminar course and small group discussions (15 hours)
Spring 2013 – Seminar course and small group discussions (15 hours)

Undergraduate Non-Majors Biochemistry (Bioc 385)

Fall 2011 – Metabolic Biochemistry (42 lecture hours)
Spring 2012 – Metabolic Biochemistry (42 lecture hours)
Spring 2013 – Metabolic Biochemistry (42 lecture hours)
Spring 2014 – Metabolic Biochemistry (42 lecture hours)
Spring 2015 – Metabolic Biochemistry (42 lecture hours)
Spring 2016 – Metabolic Biochemistry (42 lecture hours)
Spring 2017 – Metabolic Biochemistry (42 lecture hours)
Summer 2017 – Metabolic Biochemistry (online)

Undergraduate Non-Majors Biochemistry (Bioc 384)

Spring 2015 – Foundations in Biochemistry (20 lecture hours)
Fall 2016 – Foundations in Biochemistry (42 lecture hours)
Summer 2017 – Metabolic Biochemistry (online)
Fall 2017 – Foundations in Biochemistry (42 lecture hours)

SELECTED PEER-REVIEWED PUBLICATIONS

- Isoe, J., Collins, J., Badgandi, H., Day, W.A., and **Miesfeld, R.** (2011) Defects in the COPI vesicle transport system cause blood feeding induced mortality in Yellow Fever mosquitoes, *Proc. Nat. Acad. Sci.*, 108:E211-E217.
- Rascon, A., Isoe, J., Gearin, J. and **Miesfeld, R.** (2011) In vitro activation and enzyme kinetic analysis of recombinant midgut serine proteases in the Dengue vector mosquito, *BMC Bioc.* 12:43.
- Alabaster, A., Isoe, J., Zhou, G., Lee, A., Murphy, A. and **Miesfeld, R.** (2011) Deficiencies in acetyl-CoA carboxylase and fatty acid synthase differentially affect blood meal metabolism and egg production in *Aedes aegypti*. *Insect. Bioc. Mol. Biol.*, 41:946-955.
- Mack, D.J., Isoe, J., **Miesfeld, R.L.** and Njardarson, J.T. (2012) Distinct biological effects of Golgicide A derivatives on larval and adult mosquitoes, *Bioorg. Med. Chem. Lett.*, 22:5177-5188.
- Isoe, J., Stover, W., Miesfeld, R.B. and **Miesfeld, R.L.** (2013) COPI-mediated blood meal digestion in vector mosquitoes is independent of midgut ARF-GEF and ARF-GAP regulatory activities., *Insect. Bioc. Mol. Biol.*, 43:732-739.

CURRICULUM VITAE: Paul Myrdal, Ph.D.
Associate Professor of Pharmacy Practice and Science
College of Pharmacy, University of Arizona
myrdal@pharmacy.arizona.edu

EDUCATION

1994 Ph.D. in Pharmaceutical Chemistry, University of Arizona College of Pharmacy

EMPLOYMENT

2006-Present Associate Professor of Pharmacy Practice and Science, University of Arizona, Tucson, AZ

2000-2006 Assistant Professor of Pharmacy Practice and Science, University of Arizona, Tucson, AZ

1998-2000 Research Specialist, 3M Pharmaceuticals, St. Paul, Minnesota

TEACHING

PHSC 555: Drug Delivery Systems

Coordinator, Multiple Lectures

PHSC 602: Physiochemical Factors Influencing Drug Action

Multiple Lectures

PHSC 606: Industrial Pharmacy

Multiple Lectures

SELECTED PEER-REVIEWED PUBLICATIONS

Sheth P, Grimes MR, Stein SW, **Myrdal PB**. Impact of droplet evaporation rate on resulting in vitro performance parameters of pressurized metered dose inhalers. *Int J Pharm*. 2017 Aug 7;528(1-2):360-371.

Johnson JL, Guthrie D, Hyde J, Hanson T, Karlage K, **Myrdal PB**. The effect of a holding chamber on albuterol metered-dose inhaler product differences. *Ann Allergy Asthma Immunol*. 2016 Sep;117(3):246-50.

Franklin SJ, Younis US, **Myrdal PB**. Estimating the Aqueous Solubility of Pharmaceutical Hydrates. *J Pharm Sci*. 2016 Jun;105(6):1914-1919.

Aodah A, Pavlik A, Karlage K, **Myrdal PB**. Preformulation Studies on Piperlongumine. *PLoS One*. 2016 Mar 16;11(3):e0151707.

Jeter JM, Curiel-Lewandrowski C, Stratton SP, **Myrdal PB**, Warneke JA, Einspahr JG, Bartels HG, Yozwiak M, Bermudez Y, Hu C, Bartels P, Alberts DS. Phase IIB Randomized Study of Topical Difluoromethylornithine and Topical Diclofenac on Sun-Damaged Skin of the Forearm. *Cancer Prev Res (Phila)*. 2016 Feb;9(2):128-34.

CURRICULUM VITAE: John Regan, Ph.D.
Professor of Pharmacology and Toxicology
College of Pharmacy, University of Arizona
regan@pharmacy.arizona.edu

EDUCATION

1975 Ph.D. in Pharmaceutical Chemistry, University of Arizona College of Pharmacy

EMPLOYMENT

1999-Present Professor of Pharmacology and Toxicology, University of Arizona, Tucson, AZ

1994-1999 Associate Professor of Pharmacology and Toxicology, University of Arizona, Tucson, AZ

1989-1994 Assistant Professor of Pharmacology and Toxicology, University of Arizona, Tucson, AZ

1981-1989 Post-doctoral fellow, Howard Hughes Medical Institute, Duke University, Durham, North Carolina. Mentor: R.J. Lefkowitz

TEACHING

Topics Taught in the Pharm.D. Professional Curriculum (PCOL871; The Science of Pharmacology)

- Receptor theory and molecular mechanisms of drug action (5 hrs)
- The fundamentals of neurotransmission & the autonomic nervous system (2 hrs)
- Drugs used for the treatment of affective and psychotic disorders (5 hrs)
- Opiate analgesics used for the treatment of moderate to severe pain (2 hrs)
- Drugs used for the treatment of chronic pain (1 hr)
- Drugs used for the treatment of migraine (1 hr)
- Properties and use of nonsteroidal anti-inflammatory drugs (NSAIDs) (1 hr)
- Drugs of abuse and the treatment of substance abuse disorders (2 hrs)
- Drugs used in the treatment of overweight and obesity (2 hrs)
- The effect of drugs on sexual function (1 hr)
- The pharmacology of diuretic agents (2 hrs)
- Drugs used for the treatment of asthma (1 hr)
- Drugs used for the treatment of glaucoma (1 hr)

Topics Taught in the Graduate Doctoral Curriculum (PCOL630; Cell Signaling)

- Receptor theory (2 hrs)
- Biochemical and molecular pharmacology of G-protein coupled receptors (7 hrs)

SELECTED PEER-REVIEWED PUBLICATIONS

Ji R, CM Sanchez, CL Chou, XB Chen, DF Woodward, JW Regan. EP1 prostanoid receptor mediated upregulation of the orphan nuclear receptor Nurr1 by cAMP independent activation of protein kinase A, CREB and NF- κ B. *Brit J Pharmacol* 166:1033-1046, 2012.

Yoshida K, H Fujino, S Otake, N Seira, JW Regan, T Murayama. Induction of cyclooxygenase-2 expression by prostaglandin E2 stimulation of the prostanoid EP4 receptor via coupling to Gai and transactivation of the epidermal growth factor receptor in HCA-7 human colon cancer cells. *Eur J Pharmacol* 718:408-417, 2013.

Oyama S, H Fujino, R Yamazaki, I Okura, JW Regan, A Awata, T Arai, T Murayama. A novel indole compound, AWT-489, inhibits prostaglandin D2-induced CD55 expression by acting on DP prostanoid receptors as an antagonist in LS174T human colon cancer cells. *Arch Biochem Biophys* 541:21-29, 2014.

Otake S, K Yoshida, N Seira, CM Sanchez, JW Regan, H Fujino, T Murayama. Cellular density-dependent downregulation of EP4 prostanoid receptors via the up-regulation of hypoxia-inducible factor-1 α in HCA-7 human colon cancer cells. *Pharmacol Res Per* 3(1), 2014

Fujino H, N Seira, N Kurata, Y Araki, H Nakamura, JW Regan, T Murayama. Prostaglandin E2-stimulated EP4 receptors induce prolonged de novo prostaglandin E2 synthesis through biphasic phosphorylation of extracellular signal-regulated kinases mediated by activation of protein kinase A in HCA-7 human colon cancer cells. *Eur J Pharmacol* 768:149-159, 2015.

CURRICULUM VITAE: Jennifer G. Schnellmann, Ph.D.
Assistant Professor of Pharmacology
College of Medicine, University of Arizona
schnellj@email.arizona.edu

EDUCATION

1999 Post-Doc, U.S. Food and Drug Agency, Division of Neurotoxicology
1997 Ph.D., University of Arkansas for Medical Sciences, Little Rock, Arkansas

EMPLOYMENT

2011-Present Associate Professor of Pharmacology, University of Arizona, Tucson, AZ
2007-2011 Coordinator of Rural Health Professions Program, College of Pharmacy,
University of Arizona, Tucson, AZ
2001-2007 Assistant Professor, Senior Grant Writer, Office of Research Development,
Medical University of South Carolina, Charleston, South Carolina

TEACHING (In prior position at MUSC)

SCCP 723: Pathophysiology/Pharmacology II

Developed cardiovascular pharmacology section for second year pharmacy students

SCCP 607: Drug Dosage Forms and Delivery Systems

Developed material for new curriculum; course coordinator, lecturer

SCCP 801: Clinical Toxicology

Developed and delivered first toxicology course for SCCP, course coordinator, lecturer

CHEM 583: Pathophysiology/Pharmacology II

Developed and delivered first toxicology course in the state for undergraduate science majors

SELECTED PEER-REVIEWED PUBLICATIONS

Schnellmann, JG, Distance Education: A Promise Not Kept, Times Higher Education, Edition 442, August 18 2016.


Scott, LA, Swartzentruber, DA, Davis, CA, Wahlquist, AH, **Schnellmann, JG**, Maddux, PT, Life Saving Performance of Patient Care Providers Utilizing a Competency-Based, Multi Actor Emergency Preparedness Training Curriculum (PDM-12-0114) Prehospital and Disaster Medicine December;28(4).

Scott LA, Maddux PT, Tolley J, **Schnellmann JG**, Wahlquist AE. High Fidelity Multi-Actor Emergency Preparedness Training for Patient Care Providers. American Journal of Disaster Medicine;7(2).

Scott LA, Haar CP, **Schnellmann JG**. Fostering Federal and Local Disaster Preparedness Partnerships: A novel use of AmeriCorps volunteers to support community- based disaster planning and training in South Carolina. The Journal of the South Carolina Medical Society;108:69-75

Scott LA, Ross AP, **Schnellmann JG**, Wahlquist AE. Surge capability: CHAPTER and SC healthcare worker preparedness. J S C Med Assoc. Jun;107

COLLABORATING COLLEGE SUPPORT LETTERS

Memorandum**Date:** August 31, 2017**To:** Rick G. Schnellmann
Dean, College of Pharmacy**From:** Michael Staten 
Associate Dean for Career and Academic Services
College of Agriculture and Life Sciences**Subj:** Proposed B.Sc. In Pharmaceutical Science

CALS is pleased to offer its support for the College of Pharmacy's new B.Sc. in Pharmaceutical Science (BSPS). We agree with you that this new degree will be a significant benefit to UA students. And, we are especially pleased to play a supporting role in the curriculum through our Microbiology course, MIC 205.

I have consulted with the unit heads for our Animal and Comparative Biomedical Sciences and Plant Sciences departments, which share the teaching load for MIC 205 (lecture and lab). The course is offered in both the Fall and Spring semesters. Both unit heads are confident that we can absorb the additional students that your new degree would generate.

Please keep us posted as to planned launch date and expected student enrollments. Best wishes for a successful launch.



THE UNIVERSITY OF ARIZONA

James E. Rogers
College of Law

1201 E. Speedway
P.O. Box 210176
Tucson, AZ 85721-0176
Tel: 520-626-1373
Fax: 520-621-9140
<http://www.law.arizona.edu>

October 6, 2017

Rick G. Schnellmann, Ph.D.
Dean, College of Pharmacy
University of Arizona
Room B307
Drachman Hall
1295 North Martin Avenue
Tucson, AZ 85721-0202

Dear Dean Schnellmann:

Thank you for your request. Dean Miller and I have reviewed the new proposal for a B.Sc. in Pharmaceutical Science from the College of Pharmacy. We support this innovative program and look forward to future collaborations.

Sincerely,

Catherine O'Grady
Associate Dean for Academic Affairs and
Professor of Law

cc: Marc Miller, Dean



August 21, 2017

Rick G. Schnellmann, Ph.D.
Dean, College of Pharmacy
Howard J. Schaeffer Endowed Chair
Professor of Pharmacology and Toxicology
schnell@pharmacy.arizona.edu

Dear Rick:

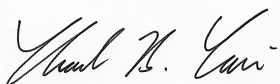
On behalf of the University of Arizona College of Medicine-Tucson, we are pleased to support the College of Pharmacy's new B.Sc. in Pharmaceutical Sciences (BSPS) program.

Your vision on providing students with a solid background in the biological sciences, drug discovery and development, pharmaceuticals, dosage forms, pharmacology, and toxicology is on par to having our students more marketable for entry-level positions in pharma and biotech, and for entry into professional and graduate academic programs.

I am confident the B.Sc. in Pharmaceutical Sciences will benefit the University by building upon the successes of the College's existing programs.

Please contact me at (520) 626-0998 or cairnsc@email.arizona.edu for any questions, comments or for additional information.

Sincerely,



Charles B. Cairns, MD, FACEP, FAHA
Dean
College of Medicine - Tucson
Professor of Emergency Medicine
cairnsc@email.arizona.edu



THE UNIVERSITY OF ARIZONA

Mel & Enid Zuckerman
College of Public Health

OFFICE OF THE DEAN

Roy P. Drachman Hall
1295 N. Martin Ave., Bldg.202A
P.O. Box 245163
Tucson, AZ 85724-5163
Tel: (520) 626-7083
Fax: (520) 626-8685
www.publichealth.arizona.edu

September 18, 2017

Rick G. Schnellmann, PhD
Dean, College of Pharmacy
Howard J. Schaeffer Endowed Chair
Professor of Pharmacology & Toxicology
POB 210202
CAMPUS

Dear Dean Schnellmann:

On behalf of the Mel and Enid Zuckerman College of Public Health we are writing to express our support for your proposed Bachelor's of Science in Pharmaceutical Science (BSPS) program.

Looking over the information you provided, we should be able to accommodate your students in *PHPM 310 – Health Care in the U.S.* This course will be a valuable addition to the curriculum as one of the major elective courses.

Your proposed BSPS program offers wide-ranging benefits to the health sciences, and the UA Zuckerman College of Public Health is committed to providing support as indicated in the proposal. We believe this program will certainly provide an excellent foundation for students.

Sincerely,

Iman Hakim, MD, PhD, MPH
Dean and Professor
Mel & Enid Zuckerman Endowed Chair
in Public Health

Daniel Derksen MD, Professor and Chair
Community, Environment & Policy Department
Walter H. Pearce Endowed Chair & Director
Arizona Center for Rural Health

c: Douglas Taren, Associate Dean for Academic Affairs



October 1, 2017

Rick G. Schnellmann, Ph.D.
Dean, College of Pharmacy
Howard J. Schaeffer Endowed Chair
Professor of Pharmacology and Toxicology
schnell@pharmacy.arizona.edu

Dear Rick:

The University of Arizona's College of Science is pleased to support the College of Pharmacy's new B.Sc. in Pharmaceutical Sciences (BSPS) program.

After reviewing your proposal for the BSPS curriculum, and in consultation with our department heads, we feel confident that the College of Science can provide many of the foundational courses required by the students enrolled in this program. Your vision on providing students with a solid background in the biological sciences, drug discovery and development, pharmaceuticals, dosage forms, pharmacology, and toxicology is on track to having graduates more competitive for entry-level positions in pharmacology and biotech, and for entry into professional and graduate academic programs.

We offer the full and enthusiastic backing of the College of Science. Best wishes for a successful BSPS program launch.

Best Regards,



Elliott Cheu
Associate Dean and Distinguished Professor of Physics
College of Science
The University of Arizona

INDUSTRY SUPPORT LETTERS

TECH LAUNCH ARIZONA

University Services Annex, 4th Floor
220 W. Sixth Street
PO Box 210300
Tucson, AZ, 85721-0300

Ofc: 520-621-5000
Fax: 520-626-4600

techlaunch.arizona.edu

September 29, 2017

Rick G. Schnellmann, Ph.D.
Dean, College of Pharmacy
Howard J. Schaeffer Endowed Chair
Professor of Pharmacology and Toxicology
schnell@pharmacy.arizona.edu

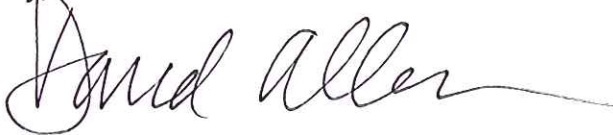
Dear Rick,

On behalf of Tech Launch Arizona (TLA) I am pleased to voice my support for your exciting new Bachelor's of Science in Pharmaceutical Sciences (BSPS) proposed by the College of Pharmacy.

As you know, the field of pharmaceutical sciences, including drug development, feature significantly in University of Arizona commercialization portfolio. Through my related work with the biotech and pharmaceutical industries in Arizona and beyond, I feel strongly that the education and experience that the college will provide to its BSPS graduates will make them attractive candidates for employment in this growing Arizona business sector. I am enthusiastic about the coursework that includes important aspects of the regulatory side of drug development, including the intensified focus on data robustness and reproducibility in early-stage drug research.

Please let me know if I can help in any way with regard to the approval process. I fully endorse the establishment of this new Bachelor's degree offering.

Sincerely,



David N. Allen, PhD
Vice President
Tech Launch Arizona
The University of Arizona
University Services Annex, Room A433 | PO Box 210300
220 W. 6th Street | Tucson, AZ 85721-0300



THE UNIVERSITY OF ARIZONA
**TECH LAUNCH
ARIZONA**



October 11, 2017

Rick G. Schnellmann, Ph.D.
Dean, College of Pharmacy
Howard J. Schaeffer Endowed Chair
Professor of Pharmacology and Toxicology
schnell@pharmacy.arizona.edu

Dear Rick,

I was excited to learn that the UA College of Pharmacy was developing a Bachelor's of Science curriculum in the pharmaceutical sciences and I am providing this letter in support of your program. As you know, Critical Path Institute (C-Path) is an independent, nonprofit organization with public and private philanthropic support from the Arizona community, Science Foundation Arizona, and the US Food and Drug Administration (FDA). C-Path's mission is to catalyze the development of new approaches that advance medical innovation and regulatory science, accelerating the path to a healthier world. An international leader in forming collaborations, C-Path has established 14 global, public-private partnerships that currently include over 1,300 scientists from government and regulatory agencies, academia, patient advocacy organizations, and dozens of major pharmaceutical companies. Sustaining our effort will require well-educated, trained personnel with an understanding of the drug development and regulatory landscape.

Your proposed Bachelor's program looks like a great foundation to prepare students for entry level positions in the industry or to subsequent post-baccalaureate education leading to employment at a higher level.

I am interested in the opportunity that we have discussed for our scientists to deliver presentations to your students as well as the possibility of C-Path providing internship opportunities for advanced undergraduates.

Best wishes as your program launches.

Sincerely,

A handwritten signature in black ink, reading 'Martha A. Brumfield'.

Martha A. Brumfield, Ph.D.
President and CEO

1730 E. River Rd., Suite 200
Tucson, AZ 85718
T 520.547.3440 F 520.547.3456
www.c-path.org

SURVEYING STUDENT INTEREST IN THE BSPS MAJOR

Students with email addresses in the Pre-Pharmacy Club list-serv were surveyed over a period of two days in October 2017. The survey provided a synopsis of the proposed program and curriculum, followed by branching questions designed to stratify participants into students who were actively in the process of evaluating/selecting majors (we assume mostly freshman and sophomore undergraduates), and participants who were not actively in that process (we assume a combination of current undergraduates who are in their selected major, together with recent alumni for whom the email address is still correct). The survey scheme and text is included on the following page.

There were 47 students who indicated that they were actively evaluating majors and were presented with the following question:

If a University of Arizona Bachelor of Science major in Pharmaceutical Sciences (BSPS) becomes available, would you be seriously interested in the BSPS as your major?

RESPONSE: Yes: 44 (93.6%) No: 3 (6.4%)

The 100 students who indicated that they were not actively evaluating majors were presented with the following question:

If a University of Arizona Bachelor of Science major in Pharmaceutical Sciences (BSPS) was available when you were evaluating possible majors, would you have been seriously interested in the BSPS as your major?

RESPONSE: Yes: 92 (92.0%) No: 8 (8.0%)

We appreciate the limitations of surveying students in this way, but student response suggests an interest level in this major that is consistent with a sustainable program in which students have interest.

The U of A College of Pharmacy is in the planning stages of an exciting new major, the Bachelor of Science in Pharmaceutical Sciences (BSPS). BSPS will be a 4-year Bachelor's degree program that begins with the biomedical science foundations courses that you are familiar with, including Gen-Chem, O-chem, Biology, Micro, Anatomy, and Physiology. The major coursework is where we think the program shines. Students will study pharmacology (how drugs change the body), ADME (how the body changes drugs), new drug design/discovery, pharmacogenetics (how inherited genes influence drug response) and the arduous process that a drug undergoes to get government approval as safe and effective.

Overall the curriculum focuses on human biology and how drugs can improve unhealthy biology. But more than that the BSPS program will introduce students to the science of drug development, including the challenges of doing science that meets government standards for new drug approval. We think that BSPS graduates will be sought-after hires in the pharmaceutical, academic lab, biotechnology, medical device, and government regulatory sectors. Internship semesters with industry partners will be available to students to add a practical element to their education.

Beyond job possibilities, we think that the BSPS focus on human health, disease, and drugs will also make graduates competitive applicants for continuing their education in healthcare professional programs (Pharm.D., M.D., D.V.M., etc.) or in graduate school to pursue a Master's or Ph.D. degree.

Are you currently enrolled as a UA undergraduate?

NO

YES

If a University of Arizona Bachelor of Science major in Pharmaceutical Sciences (BSPS) was available when you were evaluating possible majors, would you have been seriously interested in the BSPS as your major?

NO

Are you currently evaluating majors at U.A. along the path to selecting one?

YES

If a University of Arizona Bachelor of Science major in Pharmaceutical Sciences (BSPS) becomes available, would you be seriously interested in the BSPS as your major?

BUDGET PROJECTION FORM

	Projected		
	1st Year * 2018 - 2019	2nd Year ** 2019 - 2020	3rd Year *** 2020- 2021
METRICS			
Net increase in annual college enrollment UG	30	85	110
Net increase in college SCH UG	600	1,525	1,850
Net increase in annual college enrollment Grad			
Net increase in college SCH Grad			
Number of enrollments being charged a Program Fee			
New Sponsored Activity (MTDC)			
Number of Faculty FTE			
FUNDING SOURCES			
Continuing Sources			
UG RCM Revenue (net of cost allocation)	-	170,987	453,326
Grad RCM Revenue (net of cost allocation)			
Program Fee RCM Revenue (net of cost allocation)			
F and A Revenues (net of cost allocations)			
UA Online Revenues			
Distance Learning Revenues			
Reallocation from existing College funds (attach description)	101,250		
Other Items (attach description)			
Total Continuing	\$ 101,250	\$ 170,987	\$ 453,326
One-time Sources			
College fund balances			
Institutional Strategic Investment			
Gift Funding			
Other Items (attach description)			
Total One-time	\$ -	\$ -	\$ -
TOTAL SOURCES	\$ 101,250	\$ 170,987	\$ 453,326
EXPENDITURE ITEMS			
Continuing Expenditures			
Faculty (Director of Undergraduate Academics stipend)	10,000	10,000	10,000
Other Personnel (Program Coord & Advisor)	65,000	65,000	85,000
Employee Related Expense	26,250	26,250	33,250
Graduate Assistantships			
Other Graduate Aid			
Operations (materials, supplies, phones, etc.)			
Additional Space Cost			
Other Items (attach description)			
Total Continuing	\$ 101,250	\$ 101,250	\$ 128,250
One-time Expenditures			
Construction or Renovation			
Start-up Equipment			
Replace Equipment			
Library Resources			
Other Items (attach description)			
Total One-time	\$ -	\$ -	\$ -
TOTAL EXPENDITURES	\$ 101,250	\$ 101,250	\$ 128,250
Net Projected Fiscal Effect	\$ -	\$ 69,737	\$ 325,076
PROJECTED BUDGET ASSUMPTIONS			
*30 students start the program as juniors who have already completed most of their general education courses and want to switch their major to Pharmacy when they hear about this new degree program			
**25 students are retained from FY19 they will graduate in FY20. 60 new juniors declare a Pharmacy major in FY20			
***50 students are retained from FY20, they will graduate in FY21. 60 new juniors declare a Pharmacy major in FY21			
Year 1: 1.0 FTE Program Coordinatr and 0.50 FTE Advisor			
Year 2: 1.0 FTE Program Coordinatr and 0.50 FTE Advisor			
Year 3: 1.0 FTE Program Coordinator and 1.0 FTE Advisor			