



New Program Proposal: Graduate Degree Program

Form 2B

Version 2016-10-13

This form should be used to seek SUNY’s approval and New York State Education Department’s (SED) registration of a proposed new academic program leading to master’s or doctoral degree. Approval and registration are both required before a proposed program can be promoted or advertised, or can enroll students. The campus Chief Executive or Chief Academic Officer should send a signed cover letter and this completed form (unless a different form applies¹), which should include appended items that may be required for Sections 1 through 6, 9 and 10 and MPA-1 of this form, to the SUNY Provost at program.review@suny.edu. The completed form and appended items should be sent as a single, continuously paginated document.² If Sections 7 and 8 of this form apply, External Evaluation Reports and a single Institutional Response should also be sent, but in a separate electronic document. Guidance on academic program planning is available [here](#).

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NOTE: Please update this Table of Contents automatically after the form has been completed. To do this, put the cursor anywhere over the Table of Contents, right click, and, on the pop-up menus, select “Update Field” and then “Update Page Numbers Only.” The last item in the Table of Contents is the List of Appended and/or Accompanying Items, but the actual appended items should continue the pagination.

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Section MPA-1. Need for Master Plan Amendment and/or Degree Authorization ²⁶*Use a different form if the proposed new program will lead to a graduate degree or any credit-bearing certificate; be a combination of existing registered programs (i.e. for a multi-award or multi-institution program); be a breakout of a registered track or option in an existing registered program; or lead to certification as a classroom teacher, school or district leader, or pupil personnel services professional (e.g., school counselor).*

²This email address limits attachments to 25 MB. If a file with the proposal and appended materials exceeds that limit, it should be emailed in part

Section 1. General Information

a) Institutional Information	Date of Proposal:	
	Institution's 6-digit SED Code :	211000
	Institution's Name:	Binghamton University
	Address:	PO Box 6000, Binghamton, NY 13902-6000
	Dept of Labor/ Regent's Region :	
b) Program Locations	List each campus where the entire program will be offered (with each institutional or branch campus 6-digit SED Code): 211000	
	List the name and address of off-campus locations (i.e., extension sites or extension centers) where courses will offered, or check here [X] if not applicable:	
c) Proposed Program Information	Program Title:	Pharmaceutical Sciences
	Award(s) (e.g., M.A., Ph.D.):	M.S. and Ph.D.
	Number of Required Credits:	Minimum [MS 33, PhD 67] If tracks or options, largest minimum []
	Proposed HEGIS Code :	1910
	Proposed 6-digit CIP 2010 Code :	51.2010
	If the program will be accredited, list the accrediting agency and expected date of accreditation:	
	If applicable, list the SED professional licensure title(s) ³ to which the program leads:	
d) Campus Contact	Name and title: Aondover A Tarhule, PhD., Vice Provost and Dean of the Graduate School.	
	Telephone: (607) 777-4821 E-mail: atarhule@binghamton.edu	
e) Chief Executive or Chief Academic Officer Approval	Signature affirms that the proposal has met all applicable campus administrative and shared governance procedures for consultation, and the institution's commitment to support the proposed program. E-signatures are acceptable.	
	Name and title: Donald G. Nieman, Executive Vice President and Provost.	
	Signature and date:	
If the program will be registered jointly⁴ with one or more other institutions, provide the following information for <u>each</u> institution:		
Partner institution's name and 6-digit SED Code : 211000		
Name, title, and signature of partner institution's CEO (or append a signed letter indicating approval of this proposal):		

³ If the proposed program leads to a professional license, a [specialized form for the specific profession](#) may need to accompany this proposal.

⁴ If the partner institution is non-degree-granting, see SED's [CEO Memo 94-04](#).

Attestation and Assurances

On behalf of the institution, I hereby attest to the following:

That all educational activities offered as part of this proposed curriculum are aligned with the institutions' goals and objectives and meet all statutory and regulatory requirements, including but not limited to Parts 50, 52, 53 and 54 of the Rules of the Board of Regents and the following specific requirements:

That credit for study in the proposed program will be granted consistent with the requirements in §50.1(o).

That, consistent with §52.1(b)(3), a reviewing system has been devised to estimate the success of students and faculty in achieving the goals and objectives of the program, including the use of data to inform program improvements.⁵

That, consistent with §52.2(a), the institution possesses the financial resources necessary to accomplish its mission and the purposes of each registered program, provides classrooms and other necessary facilities and equipment as described in §52.2(a)(2) and (3), sufficient for the programs dependent on their use, and provides libraries and library resources and maintains collections sufficient to support the institution and each registered curriculum as provided in §52.2(a)(4), including for the program proposed in this application.

That, consistent with 52.2(b), the information provided in this application demonstrates that the institution is in compliance with the requirements of §52.2(b), relating to faculty.

That all curriculum and courses are offered and all credits are awarded, consistent with the requirements of §52.2(c).

That admissions decisions are made consistent with the requirements of §52.2(d)(1) and (2) of the Regulations of the Commissioner of Education.

That, consistent with §52.2(e) of the Regulations of the Commissioner of Education: overall educational policy and its implementation are the responsibility of the institution's faculty and academic officers, that the institution establishes, publishes and enforces explicit policies as required by §52.2(e)(3), that academic policies applicable to each course as required by §52.2(e)(4), including learning objectives and methods of assessing student achievement, are made explicit by the instructor at the beginning of each term; that the institution provides academic advice to students as required by §52.2(e)(5), that the institution maintains and provides student records as required by §52.2(e)(6).

That, consistent with §52.2(f)(2) of the Regulations of the Commissioner of Education, the institution provides adequate academic support services and that all educational activities offered as part of a registered curriculum meet the requirements established by state, the Rules of the Board of Regents and Part 52 of the Commissioner's regulations.

CHIEF ADMINISTRATIVE or ACADEMIC OFFICER/ PROVOST	
Signature	Date
Type or print the name and title of signatory	Phone Number

⁵ The NY State Education Department reserves the right to request this data at any time and to use such data as part of its evaluation of future program registration applications submitted by the institution.

Section 2. Program Information

2.1. Program Format

Check all SED-defined formats, mode and other program features that apply to the entire program.

- a) Format(s): Day Evening Weekend Evening/Weekend Not Full-Time
- b) Modes: Standard Independent Study External Accelerated Distance Education
NOTE: If the program is designed to enable students to complete 50% or more of the course requirements through distance education, check Distance Education, see Section 10, and append a Distance Education Format Proposal.
- c) Other: Bilingual Language Other Than English Upper Division Cooperative 4.5 year 5 year

2.2. Related Degree Program

NOTE: This section is not applicable to a program leading to a graduate degree.

2.3. Program Description, Purposes and Planning

- a) *What is the description of the program as it will appear in the institution's catalog?*

The Master of Science (MS) and Doctor of Philosophy (PhD) programs in Pharmaceutical Sciences will train students in the use, development, and implementation of emerging technologies to advance research in the fields of pharmaceutical and biomedical sciences. Students in the program will gain the essential strategic, intellectual, and technical skills necessary to enter careers in the biotech/pharmaceutical industry, regulatory agencies, and academia in New York State and beyond. The program will educate the next generation of scientists to be well-versed in emerging areas of drug target discovery, drug testing and drug delivery, and will prepare graduates for careers in a variety of scientific fields and healthcare leadership positions. The MS program is focused on foundational and technical knowledge to prepare students with work force-ready skills. The final semester of the 1.5 year MS program allows for a research project, internship, and/or elective coursework depending on availability of placements and students' interests. The PhD program is interdisciplinary with strong research and resource capabilities, where students can learn from laboratories and faculty members in many different areas. It consists of foundational courses in the first year followed by more specialized teaching in the second year. Remaining years of the program are dedicated to mentored research, culminating in a doctoral dissertation. Specific training in experimental design and scientific communication take place throughout the PhD program duration, which typically takes 5 year for completion.

- b) *What are the program's educational and, if appropriate, career objectives, and the program's primary student learning outcomes (SLOs)? NOTE: SLOs are defined by the Middle States Commission on Higher Education in the Characteristics of Excellence in Higher Education (2006) as "clearly articulated written statements, expressed in observable terms, of key learning outcomes: the knowledge, skills and competencies that students are expected to exhibit upon completion of the program."*

Program's educational and career objectives: The program is intended to prepare skilled and competent scientists who will become lead investigators in the field of pharmaceutical and biomedical sciences. They will develop the competencies and sound professional judgment needed to become successful research assistants, laboratory managers or independent research investigators working in specialized areas in academia, industry or federal agencies. They will be self-directed lifelong learners who can adapt to changing needs and conditions in the field of pharmaceutical and biomedical sciences.

We have chosen to articulate on the following standards.

Standard I Mission and Goals: "Clearly define the program's mission that is guided by goals and objectives that

are appropriate and realistic”. The program is designed to prepare highly competent scientists to conduct innovative and impactful research in the fields of pharmaceutical and biomedical sciences in industry, academic, private or federal agencies. The program is highly integrative and interdisciplinary, intended to deliver high quality innovative teaching and training experiences supported by competent and well-qualified faculty, laboratory managers and administrative staff.

Standard III Design and Delivery of the Student Learning Experience: “Deliver students with learning experiences that are rigorous and coherent”. The graduate program is designed for students to gain breadth and depth of expertise in pharmaceutical sciences with independent thinking, application and creation of knowledge. The rigor of the learning experience and quality of training is secured by highly-qualified faculty scholars with extensive academic research, teaching, industry and entrepreneurial experience and periodic student, course and programmatic review. Student learning experiences are coherent by clear, published program requirements, course catalog, institutional and graduate school student resources, and individual course syllabi. In addition, students in the PhD program conduct novel, mentored scholarly activities and scientifically rigorous research designed to help answer specific questions in biomedical and pharmaceutical sciences and to address knowledge gaps in the field.

Standard V Educational Effectiveness Assessment: To meet this standard, the program is organized to implement an assessment plan that evaluates the overall success of the program in achieving its mission and goals above. We will focus on assessing students on three major learning outcomes (e.g. knowledge, technical skills and competency) and the result will be used to improve the program and shape its overall mission. Students at graduation have achieved appropriate higher education goals (see below).

By the end of the program, successful graduates will:

- Be skilled in emerging areas of drug target discovery and drug development, especially in studies related to pre-clinical pharmacology, clinical trials, biomarker development, pharmacogenomics, medicinal chemistry and pharmaceuticals.
- Acquire foundational skills and competencies to conduct independent studies in the fields of pharmaceutical and biomedical sciences.
- Master and incorporate cutting edge analytical methods and tools in their research projects (e.g. genomics, proteomics, liquid chromatography, mass spectrometry, bioinformatics, biostatistics and machine learning modeling).
- Be able to design and implement experimental methods to answer specific biological and clinical questions related to health and pharmaceutical sciences.
- Conduct scholarly activities and scientifically rigorous research designed to solve biological and clinical questions. (Required for PhD, optional for MS)
- Develop competency in scientific rigor and scientific communication, manuscript and grant writing. (Manuscript and grant writing required for PhD only)
- Become an independent research oriented investigator in the field of pharmaceutical sciences. (PhD)

It is important to point out that a number of our faculty in the Department of Pharmaceutical Sciences have established strong collaborations with our clinical practice faculty within the school as well as clinicians in New York State (Upstate Medical School, University of Rochester Medical Center) and beyond (Children’s National Health System, Washington DC, University of Pittsburgh School of Medicine, UC Davis Medical Center, Ann & Robert H. Lurie Children’s Hospital of Chicago). Our future graduate students will have opportunities to work on different clinical and translation research projects and gain expertise in the field.

- c) *How does the program relate to the institution’s and SUNY’s mission and strategic goals and priorities? What is the program’s importance to the institution, and its relationship to existing and/or projected programs and its expected impact on them? As applicable, how does the program reflect diversity and/or international perspectives? For doctoral programs, what is this program’s potential to achieve national and/or international prominence and distinction?*

More broadly, Binghamton University's mission combines academic excellence and public service. The university's strategic plan, "the Road Map," notes that "Binghamton University is a premier public university dedicated to enriching the lives of people in the state, region, nation, and world through discovery and education and to be enriched by partnerships in those communities." In order to accomplish this goal, the university has laid out the plan of becoming "a nationally recognized university for outstanding graduate education" by increasing the "transformational impact of the university's research, scholarship, creative activities and graduate education on society." The "transformational impact" of academic scholarship can be clearly seen in the healthcare field, as both education and research provide a widely recognized and tangible societal benefit. Thus, Binghamton University's recent addition of School of Pharmacy and Pharmaceutical Sciences (SOPPS) and, specifically, the NYS Department of Education registration of the Doctor of Pharmacy (PharmD) program, is a significant step towards accomplishing these goals. The proposed Doctor of Philosophy (PhD) in Pharmaceutical Sciences program, is a natural next step in these endeavors and illustrates our commitment to becoming a nationally recognized center for healthcare scholarship and research.

The proposed MS and PhD programs in Pharmaceutical Sciences will add a level of research excellence to the university and the region, and advance our mission in both academic excellence and public service. As one of the SUNY- system university centers, Binghamton has been a leader in graduate education since 1965, with a distinguished record in health professional fields, engineering, and management as well as in the arts and sciences. The addition of MS and PhD programs in Pharmaceutical Sciences will expand our research and practice in the field of biomedical and pharmaceutical sciences and will contribute to better and healthier lives in the community. Collaborating with our existing graduate programs in nursing, biomedical anthropology, biomedical engineering, chemistry, psychology, and biology will enable a wide range of inter-professional health care learning experiences for our students. More importantly, the program will also help to meet rapidly expanding local, state, national, and global needs for professionals in the field of pharmaceutical and biopharmaceutical sciences.

Through our strategic planning process, Binghamton has developed an academic focus on Transdisciplinary Areas of Excellence, called "TAEs," that have generated intensive collaboration across disciplinary lines. One of the five "TAEs" is Health Sciences; its steering committee brings together researchers from 9 different departments and 5 different schools. This collaborative campus climate makes Binghamton an ideal location for MS and PhD programs in Pharmaceutical Sciences, which will further strengthen our Health Sciences TAE and our School of Pharmacy and Pharmaceutical Sciences.

SUNY is among the largest university systems worldwide, with ~400,000 students enrolled in 64 colleges and universities each year. However, there is only one full-fledged graduate research (MS, PhD) pharmacy program within the SUNY system, located at the University of Buffalo. There are three additional private pharmacy schools in NYS. In conjunction with its PharmD curriculum, the Buffalo MS/PhD program provides a strong and traditional training experience, with strengths in many fundamental areas of drug metabolism and development. Stony Brook University has an established PhD program in the related field of Biomedical Sciences, Molecular and Cellular Pharmacology Track, but the program is not associated with a Pharmacy school. Three other private NYS Pharmacy schools offer MS and/or PhD programs in Pharmaceutical Sciences – Long Island University (PhD in Pharmaceutics), St. John's University (PhD in Pharmaceutical Sciences [Industrial Pharmacy, Pharmacology, Toxicology, Medicinal Chemistry]), while Albany College of Pharmacy offers a MS, but not a PhD, program in Pharmaceutical Sciences.

The key focus of Binghamton's MS and PhD programs in Pharmaceutical Sciences is innovation in drug development, including molecular targeting and novel formulations. Therefore, we anticipate little or no overlap with other programs in NYS. On the contrary, the proposed MS and PhD programs will help fill an existing gap in research-trained pharmaceutical scientists. Our graduates will be well-equipped to pursue regulatory, industry, and academic careers where there are documented shortfalls in such trained individuals. Our graduate program will have a substantial impact through preparing our Pharmaceutical Sciences graduate students to make advances in therapeutics, to contribute to the evolving regulatory landscape, and to educate future generations of scientists. Furthermore, the proposed Binghamton University PhD program will be differentiated from the above programs by focusing on emerging areas of drug target discovery and drug development especially in pre-clinical and clinical trials, cutting edge analytical methods, biomarker development, medicinal chemistry, and regulatory sciences. Thus, there is clear differentiation between the programs. We are also working on integrating programs,

with SOPPS faculty from Binghamton speaking at Buffalo, and vice versa. For example, Dr. Hoffman is serving on a search committee for a bioinformatics-focused faculty hire at the University at Buffalo.

Our proposed program will strengthen interdepartmental collaboration at Binghamton University through opportunities such as shared classes, cross-disciplinary dissertation projects, and collaborative grant proposals. This can already be seen as a number of Biomedical Engineering (BME) graduate students are performing research under the direction of SOPPS faculty and undergraduates from science programs in Harpur College of Arts & Sciences are seeking research experiences with our faculty, indicating a potential pool of local qualified applicants. The program will build upon and complement our existing PharmD program and will further our connections with the Decker School of Nursing, the Harpur College of Arts and Sciences (including chemistry, biology, biochemistry, anthropology, and psychology), and the Watson School of Engineering and Applied Science (particularly the biomedical engineering program).

The program will reflect diversity both at the student level and faculty level as noted below under diversity section 2.4.c. We will also insure that program is internationally recognized through website, publication records, networking, workshop and conferences. We will foster collaboration and exchange programs with internationally recognized universities. The vision of the Graduate School at Binghamton University is to increase enrollment international students across different departments. We will work closely with the Graduate School to retain those international students and encourage them to enroll in our MS and PhD programs. There are existing annual workshops on campus (e.g. Freshman Research Immersion, FRI) where each department is invited to present their research projects and recruit potential students to work in their laboratory. Even without our MS/PhD program in place, we have already started attracting students from diverse background and geographic locations to work and receive training in our department. Currently, our faculty collectively supervise and train a total of 10 undergraduate students from Chemistry, Biochemistry, Neuroscience, and Biology and several of them have expressed interest in the graduate programs we are developing.

d) How were faculty involved in the program's design? Describe input by external partners, if any (e.g., employers and institutions offering further education)?

The program was designed by faculty from the School of Pharmacy and Pharmaceutical Sciences. The standing graduate program committee comprised of 6 faculty members Dr. Katie Edwards, Dr. Tracy Brooks, Dr. Aaron Beedle, Dr. Nathan Tumey, Dr. Ryan Pelis (former faculty member), and Dr. Yetrib Hathout (Departmental Graduate Director) from the Pharmaceutical Sciences Department that met biweekly to plan and discuss the program design. The faculty have all recently joined Binghamton University as part of the newly formed School of Pharmacy. Each of the members brings with her or him unique external perspectives that guided the design of the graduate program. For instance, Dr. Brooks and Dr. Beedle both came from pharmaceutical sciences departments that offered graduate programs (University of Georgia and University of Mississippi), where they each developed graduate programs including curricular and programmatic design. Likewise, Dr. Edwards and Dr. Hathout both came from biological engineering and biomedical sciences graduate programs (Cornell University and the George Washington University Medical School) and worked in labs associated with multiple graduate programs. Dr. Tumey came from the pharmaceutical industry, having spent the past 15 years performing drug discovery research in biotech and large-pharma companies. Together, the faculty have brought a valuable external perspective to the design of the program to ensure that the program provides an education that is both academically rigorous and also industrially relevant.

Other faculty members of the department (di Pasqua, Nagaraju, Hoffman) and from the Departments of Health Outcomes and Pharmacy Practice also participated in the development of the program by providing input on the curriculum and didactic courses. Due to the closely related subject matter, a few of the didactic courses will be offered as electives for PharmD students. Likewise, students from the Pharmaceutical Sciences graduate program will be able to enroll in selected PharmD classes with faculty approval. The final document was reviewed by the Pharmacy Leadership Team committee members including the Dean of the School of Pharmacy (Dr. Gloria Meredith), Associate Dean of Research (Dr. Eric P Hoffman), Associate Dean for Academic Affairs and Assessment (Dr. Gail Rattinger), Department Chairs (Drs. Leon Cosler, Sarah Spinler, Kanneboyina Nagaraju) and Assistant Deans of Student Affairs and Experiential Education (Drs. Coulter Ward and Angela Riley).

- e) *How did input, if any, from external partners (e.g., educational institutions and employers) or standards influence the program's design? If the program is designed to meet specialized accreditation or other external standards, such as the educational requirements in Commissioner's Regulations for the profession, append a side-by-side chart to show how the program's components meet those external standards. If SED's Office of the Professions requires a specialized form for the profession to which the proposed program leads, append a completed form at the end of this document.*

We also received feedback and advice from the Provost (Dr. Donald G Nieman), The Dean and the previous Associate Dean of the Graduate School (Dr. Aondover A Tarhule, Dr. Sarah S Lam) and the Assistant Provost for Institutional Research and Effectiveness (Dr. Nasrin Fatima).

- f) Enter anticipated enrollments for Years 1 through 5 in the table below. How were they determined, and what assumptions were used? What contingencies exist if anticipated enrollments are not achieved?

We anticipate admitting cohorts of approximately 10 students each year for the MS program who will take a full-time course load and graduate from the MS program in three semesters. For the PhD program, we anticipate to enroll 7 students the first year of the program and 2 to 3 each year subsequently. The first cohort will take a full time course load and will graduate in 4 to 5 years, with most students expected to finish in 5 years. The numbers below reflect the expectation that we will begin with somewhat smaller classes and achieve the expected size over a few years.

Our expectations below are based on the level of interest expressed by Binghamton University undergraduates in biology, biochemistry and chemistry departments and Broome Community College students. Close to 30 undergraduates receive internship opportunities with our faculty annually and some of these students are eager to enroll in our graduate program once it is available. We believe that the affordable SUNY tuition for the graduate programs is likely to attract additional applicants from outside as well.

Anticipated enrollment for the MS program (Note: second year students are enrolled for Fall semester only)

Year	Anticipated Headcount Enrollment			Estimated FTE
	Full-time	Part-time	Total	
1	10		10	10
2	20		20	20
3	20		20	20
4	20		20	20
5	20		20	20

Anticipated enrollment for the PhD program

Year	Anticipated Headcount Enrollment			Estimated FTE
	Full-time	Part-time	Total	
1	7		7	7
2	10		10	10
3	12		12	12
4	17		17	17
5	22		22	22

- g) *Outline all curricular requirements for the proposed program, including prerequisite, core, specialization (track, concentration), internship, capstone, and any other relevant component requirements, but do not list each General Education course.*

Program pre-requisite:

- MS and PhD:
 - 12 or more credits in higher level chemistry, biochemistry, biology, physiology, pharmacology, pharmaceuticals, genetics and/or related area.
- PhD:
 - Core classes (credits; year to be taken): Cellular and Molecular Basis of Human Disease (4; 1); Biostatistics (3;1); Pharmaceutical Sciences I and II (4 each; 1); Lab rotations (3 each; 1); Student seminar (1 per semester; all years); Critical Thinking and Communication (4; 2); Research/Dissertation research (varied; 2-completion).
 - The remainder of the credits required (~9) will be tailored to the needs and research areas of each doctoral student through three electives (3 credits each) to be taken in the second year. Options for this class include, but are not limited to, doctoral level chemistry, biomedical engineering, pharmaceutical sciences, or pharmacy classes.
- MS:
 - Core classes (credits; year to be taken): Cellular and Molecular Basis of Human Disease (4; 1); Biostatistics (3;1); Pharmaceutical sciences I and II (4 each; 1); Analytical Methods and Instrumentation I and II (3 each; 1); Student seminar (1 per semester; all years). Note, a student may petition the departmental graduate committee to accept PHRM 698 Lab rotations (up to 6 credits), in place of the Analytical Methods and Instrumentation I and II coursework requirement.
 - The remainder of the credits required (~9) will be tailored to the needs and goals of each master's student through either a research project/industry rotation and one elective, or from 9 credit hours of electives. Electives must be taken from 500+ level options from biology, chemistry, biomedical engineering, pharmaceutical sciences, or pharmacy classes. Note, PHRM 699 Mentored Research (up to 6 credits) may be accepted in place of the MS research project/industry rotation to meet MS degree requirements.

The 4-credit hour core classes will be given as 2 hour classes twice per week and the 3-credit hour core classes will be given as 1.5 hour classes twice per week.

h) Program Impact on SUNY and New York State

h) (1) Need: *What is the need for the proposed program in terms of the clientele it will serve and the educational and/or economic needs of the area and New York State? How was need determined? Why are similar programs, if any, not meeting the need?*

The market need and demand for MS and PhDs in Pharmaceutical Sciences is strong on the national level. There is a critical under-supply of both MS and PhDs in Pharmaceutical Sciences, due in part to the rapid growth of the pharmaceutical and biotechnology industries as well as the paucity of robust training programs leading to such degrees in Pharmaceutical Sciences. In contrast, only 3 similar graduate programs in pharmaceutical sciences exist in the state of New York (see section h)(3)).

The value of a research-oriented MS degree is widely recognized in the pharmaceutical and affiliated industry. Based on personal experience of our faculty (several of whom have worked in the pharmaceutical industry), finding appropriately trained MS candidates can be quite challenging. No doubt the reasons for this are two-fold: 1) The demand for highly trained scientists to fill bench-research positions and 2) The scarcity of MS-degree programs that provide relevant training. There are currently only 41 schools in the United States that offer an MS degree in Pharmaceutical Sciences or related discipline (such as pharmaceuticals). The proposed program at Binghamton University focuses heavily on "hands-on" training using state-of-the-art technologies and equipment that is widely employed in the industrial sector. The first-hand experience with this instrumentation and technology will enable our

graduates to quickly jump into productive careers in the life-sciences industry.

Currently, the only full graduate program in Pharmaceutical Sciences (MS and PhD) within the SUNY system is located at the University at Buffalo. According to Peterson's Guide, only 9% of the 339 applicants to the University at Buffalo - SUNY Pharmaceutical Sciences program are admitted. This strongly indicates that there is a high unmet demand for training in this field at the MS and PhD levels. The program at the University at Buffalo has strengths in pharmacokinetics, biologic drugs, pharmacometrics, and cancer therapeutics. Related graduate programs at Stony Brook University and Upstate Medical University are focused on pharmacology and are associated with their schools of medicine. Our School of Pharmacy and Pharmaceutical Sciences associated program will focus on medicinal chemistry, pre-clinical and clinical efficacy, and biomarker development, hence we do not see significant overlap with these existing programs. In addition, our faculty have experience in scientific entrepreneurship, including venture philanthropy models and clinical network development within our areas of focus, further expanding the unique opportunities with this program. Thus, our program will provide additional opportunity for students to pursue a MS or PhD in Pharmaceutical Sciences with a focus different from the University at Buffalo, Upstate Medical University, and Stony Brook University programs. Further, logistically, the only Pharmaceutical Sciences program within the SUNY system is located in western NYS, therefore, our program will likely attract applicants from other geographical regions (in particular from the New York City region), hence we do not see a significant impact on their enrollment.

Recognition of the potential significance of the proposed graduate program in Pharmaceutical Sciences has been provided by the SUNY Research Foundation in Albany. Three of the leaders of the PhD program (Hathout, Hoffman, Nagaraju) received a \$1M SUNY Empire Innovation Program grant in 2017 to foster the continued growth of research in pharmaceutical science in SOPPS. With this and with the Binghamton University's reputation for academic excellence and commitment to research, we have and will continue to attract exceptional faculty, motivated students, and will be able to develop an outstanding graduate program.

The strong research focus of the new School of Pharmacy and Pharmaceutical Sciences has already attracted professionals from outside of the local area. Our faculty have been recruited from top-tier research universities, research hospitals, and major pharmaceutical companies. Coupled with the investment made by NYS, research in the SOPPS has already seen exciting growth. Within our first year of operation, 7 graduate students from the Biomedical Engineering Departments at Binghamton University have been placed in Pharmaceutical Science Laboratories for their MS and PhD work. Further, we have employed 12 technical staff (including 5 postdoctoral fellows) and one departmental lab manager to support our students and faculty - positions that would not have existed without investment in SOPPS. Grant awards to date have totaled in excess of \$4.2 million, indicating that we have more than merely potential; we have demonstrated the ability to attract funding to support a high quality MS and PhD program.

- h)(2) Employment:** For programs designed to prepare graduates for immediate employment, use the table below to list potential employers of graduates that have requested establishment of the program and state their specific number of positions needed. If letters from employers support the program, they may be **appended** at the end of this form.

We anticipate that employment of graduates from both the PhD and MS programs will be strong. While there is some overlap in the employment opportunities between these two degree programs, we anticipate the PhD graduates will be particularly well suited for academic, government, and industrial research positions while the MS graduates will be particularly well suited for the life-sciences sector and technology-service organizations.

Of the 142 Colleges of Pharmacy in the U.S., all need to employ PhD faculty in Pharmaceutical Sciences for teaching much of the first three years of curriculum. However, of these 142, only 65 offer a PhD program in Pharmaceutical Sciences or related research-oriented degrees. Thus, there is a great need for PhD-trained instructors at a large number of schools, with few well-trained PhDs to fill these roles. This need or gap is further highlighted in a recent report conducted by AACP Graduate Education Special Interest Group on the future of the pharmaceutical sciences and graduate education (Wu-Pong S et al. American Association of Colleges of Pharmacy Graduate Education Special Interest Group. The future of the pharmaceutical sciences and graduate education: recommendations from the AACP Graduate Education Special Interest Group. *Am J Pharm Educ.* 2013; 77(4):S2. doi: 10.5688/ajpe774S2.

Review. PubMed PMID: 23716757; PubMed Central PMCID: PMC3663643).

Drug development companies and contract research organizations (CROs) are also expanding, with hundreds of start-ups pursuing personalized and targeted drug development. Most of the 65 universities and colleges offering graduate degrees in Pharmaceutical Sciences focus on traditional drug development, and thus will not overlap appreciably with the proposed Binghamton University graduate program, which will have a focus in pre-clinical and clinical research. The drug development paradigm at major pharmaceutical companies has significantly shifted in the past decade such that it is now common practice to feed their development pipeline by acquisition of innovative drug candidates from smaller biotechnology companies and to outsource aspects of their business to contract research organizations (CROs). This has yielded a streamlining of the business model for many major pharmaceutical companies. Yet the demand for medications has not diminished. Projections from the U.S. Census Bureau indicate that the population aged 65 and older is estimated to reach 83.7 million in 2050, nearly double that of 2012. With these demographic changes, it is no surprise that healthcare spending (pharmaceutical spending in particular) has outpaced GDP growth for many years. While this is frequently viewed as a negative, the increased lifespan and mobility of our population is no-doubt linked to innovative advances in disease treatment. Additionally, the increase in pharmaceutical options for the treatment of various diseases has resulted in a concomitant decline in costs associated with hospitalization. Thus, the growth in pharmaceutical research is expected to continue unabated for the foreseeable future. Continued progress requires highly trained scientists that are intimately familiar with drug design, genomics, pharmacology, clinical trial design, and regulatory affairs. Moreover, the recent explosion of biologics-based drugs has created a need for scientists that are fluent in biopharmaceutical development, analysis, and regulation. With many of the current biologic drugs poised to come off patent protection, the next wave of opportunity for our graduates will be in biosimilars, providing generic solutions and an economic advantage to consumers. Thus, there exist numerous opportunities for our graduates to be involved in the development of new small-molecule and biologic drugs or, potentially, to start their own CROs or generic firms to bolster the local or regional economy. Further, with several hiring initiatives in place nationally, there is a need for pharmaceutical scientists to fill positions at the FDA to provide regulatory guidance. Overall, there exists great opportunity for our graduates at various stages of the pharmaceutical development pipeline – from research and development through manufacturing and regulatory guidance.

According to the American Association of Pharmaceutical Sciences (AAPS), in 2007, the median base salary for MS level pharmaceutical scientists in the private sector was \$120,400 for those with 0-5 years of experience. Not only are salaries good, but demand is strong. According to the Bureau of Labor Statistics, the projected growth rate in jobs for biomedical scientists is 13% over the next 10 years, well above the average rate of growth. Employment opportunities for graduates exist in academia, biotechnology, and pharmaceutical companies, as well as agencies such as the FDA, USDA, USPTO, USP, and NIH. We believe that the industry will benefit from having a high quality, research-intensive program added to Binghamton University.

National employers of graduates in pharmaceutical sciences include colleges, biopharma companies, startup companies, the National Institute of Health, and the U.S. Food and Drug Administration. The growing number of pharmacist training programs (currently 142 accredited schools and programs) require PhD holders in pharmaceutical sciences to provide instruction, particularly in the first two years of the four-year PharmD training programs.

A recent search of job sites for graduates in Pharmaceutical Sciences shows more than 4,000 open positions on indeed.com. There has been a rapid growth in biomedical and pharmaceutical start-up companies, in part due to cut-backs in R&D by major pharma. Thus, training in entrepreneurship is an important part of the proposed training program. Graduates would also be expected to be in demand for consulting, often providing services to these same start-ups on a part-time basis. In addition, the rapid growth of small biotechnology companies has created a market for technical advisors within law firms, venture capital firms, and the financial services industry. The government sector is also expected to be a major employer of graduates, including the United States Pharmacopoeia, the US patent and trademark office (USPTO), the US center for disease control (CDC) and the U.S. Food and Drug Administration (FDA).

On the more local level, within a one-hour drive from Binghamton, current potential employers of MS and PhD graduates in Pharmaceutical Sciences include one major pharmaceutical company, several contract pharmaceutical development companies, small start-up companies associated with university incubators, sales/technical support

positions by scientific vendors to support these companies, and regional FDA positions for regulatory assurance. Both of our degree programs are devoted to train highly skilled and professionally ready graduates with cutting edge technical expertise currently needed in the field of biopharmaceutical sciences. This will boost the economy regionally and nationally.

Specific projections of need for employees in pharmaceutical sciences are not readily available; we cite the table below based on the essay by Fuhrmann et al. 2011 (*CBE—Life Sciences Education Vol. 10, 239–249*) and the U.S. Bureau of Labor Statistics employment projection 2016 to 2026. Based on the 10 years projected employment growth, academia and biotech companies will be the largest employer of MS and PhD graduate in Pharmaceutical Sciences followed by moderate growth in federal jobs, CROs and startup companies.

Potential Employers	Need: Projected Positions	
	Ten-year employment percent growth	Ten-year projected number of new jobs
Biotech and Pharmaceutical companies	8.2%	9,790
Academia (state and private universities)	7.8%	5,950
Federal (NIH, FDA, NIST, CDC)	3.2%	1,172
CRO labs and Startup companies	3.8%	1,570

- h)(3) *Similar Programs:*** Use the table below to list similar programs at other institutions, public and independent, in the service area, region and state, as appropriate. Expand the table as needed. **NOTE:** *Detailed program-level information for SUNY institutions is available in the [Academic Program Enterprise System \(APES\)](#) or [Academic Program Dashboards](#). Institutional research and information security officers at your campus should be able to help provide access to these password-protected sites. For non-SUNY programs, program titles and degree information – but no enrollment data – is available from [SED’s Inventory of Registered Programs](#).*

Institution	Program Title	Degrees	Enrollment
University at Buffalo	Pharmaceutical Sciences	M.S., PhD	70
Long Island University	Pharmaceutics	M.S., PhD	45
St. John’s University	Pharmaceutical Sciences	M.S., PhD	29
Albany College of Pharmacy	Pharmaceutical Sciences	M.S.	8

- h)(4) *Collaboration:*** *Did this program’s design benefit from consultation with other SUNY campuses? If so, what was that consultation and its result?*

N/A

- h)(5) *Concerns or Objections:*** *If concerns and/or objections were raised by other SUNY campuses, how were they resolved?*

N/A

2.4. Admissions

- a) *What are all admission requirements for students in this program? Please note those that differ from the institution’s minimum admissions requirements and explain why they differ.*

Admissions requirements and pre-requisites:

- All students applying to graduate programs are to submit their application materials through the graduate school, including an application form, transcripts, GRE scores, TOEFL scores (as applicable), two letters of recommendation, and a personal statement.

- Students must hold a bachelor’s degree before they may enter the MS or PhD graduate program
- Bachelor’s degree must have been earned from a nationally or regionally accredited college or university
- 12 or more credits in higher level chemistry, biochemistry, biology, physiology, pharmacology, or related areas. All students need to have basic introductory coursework in chemistry.
- Students are expected to have a cumulative GPA of 3.0 or above, with a science GPA being 3.0 or above.
- Cumulative verbal and quantitative GRE scores are desired and expected to be above 300, and international students must submit TOEFL scores above 100 to be considered for admissions.
- Exceptions will be considered on a case-by-case basis; students will be advised to contact the graduate director for advice.
- The Pharmaceutical Sciences admission committee composed of 5 faculty including a chair will conduct on-site interviews for pre-selected national and regional MS and PhD applicants, and remote interviews for international applicants.

b) *What is the process for evaluating exceptions to those requirements?*

The admission committee will evaluate the overall suitability of the applicant to join the program on case by case basis taking into account alternative course work and/or relevant experiences.

Three pipelines are proposed for admission of students to our program depending on their earned degree and completed course work:

- Students with a Bachelor’s degree who are admitted to our MS or PhD program will have to complete all proposed course work.
- The graduate program director with the admission committee might grant course waivers to external students with a Master’s degree in pharmaceutical sciences who are admitted to our PhD program if the courses taken by the students at their previous institution are equivalent to our proposed courses (a core course waiver form will need to be completed and evaluated by the program director and the admission committee).
- Students who have completed our Master’s program and wish to apply to our PhD program will be granted automatic course waivers for the completed credits.

c) *How will the institution encourage enrollment in this program by persons from groups historically underrepresented in the institution, discipline or occupation?*

In the biological sciences such as Pharmaceutical Sciences, women show high presentation, as do people of Asian and Caucasian ethnicity. Thus, we do not expect any difficulty achieving diversity of women and Asian groups. Under-represented minorities are African-American, Latino, and Native Americans.

As Binghamton University is a SUNY school, the majority of students are drawn from New York State. Thus, demographics of students enrolled in educational programs can be benchmarked against the distribution of ethnicities in New York, shown below:

Ethnic distributions of New York State population

White	61.5%
Asian	7.4%
Hispanic/Latino	10.5%
Black or African American	15.1%
Native	0.2%
Native Hawaiian or Other Pacific Islander	0.3%

Two or more races	2.1%
Others	2.9%

The Binghamton University undergraduate student population shows overall fit with ethnic diversity of New York, with an over-representation of Asian, and under-representation of Black and Latino, as shown below:

Students enrolled in Binghamton University undergraduate programs

White	57.3%
Asian	13.9%
Hispanic/Latino	11.2%
Black or African American	5.2%
Non-Resident Alien	8.3%
American Indian or Alaska Native	0.1%
Native Hawaiian or Other Pacific Islander	0.1%
Others	3.9%

Perhaps the most accurate expectation of student diversity for the proposed MS and PhD programs in Pharmaceutical Sciences program is the students enrolled in the Binghamton University PharmD degree program. Indeed, we expect many PhD students to be drawn from either Binghamton University undergraduates, or similar institutions that top recruitment into our PharmD program. The ethnic distribution of the initial 225 students enrolled (3 classes) shows even stronger recruitment of African-Americans (15%), exceeding the Binghamton university undergraduate numbers (5.2%).

Students enrolled in Binghamton University PharmD program

White	42%
Asian	31%
Hispanic/Latino	5%
Black or African American	15%
Multiple Races	3%
Others	4%

We will strive for graduate student classes that reflect New York State ethnic diversity. If we find that particular groups, such as African-Americans, are under-represented, then we will work towards more targeted recruitment. For example, Dr. Angela Riley initiated a collaborative conversation with Lincoln University in PA, a Historically Black College and University (HBCU), to create a pipeline to recruit high quality underrepresented students to

our graduate program, including PharmD, MS and PhD programs. Lincoln University has strong undergraduate programs in chemistry, biochemistry and biology, but no graduate programs in these same disciplines. Thus undergraduate programs from Lincoln University, and other such connections made going forward, will provide an excellent source for recruitment of underrepresented students into our graduate programs. Our admissions committee is actively sending faculty to give seminars and introduce our programs to neighboring universities and colleges. Another member of the proposed training faculty, Dr. Hoffman, has extensive collaborative relationships with Howard University (an HBCU) in Washington DC, and has served as the PhD advisor for Howard students. We will also work with Howard University to specifically recruit potential students from there.

In term of diversity, our faculty members of the Department of Pharmaceutical Sciences are diverse, representing four continents (North America, Europe, Africa and Asia). Two of our new faculty members are underrepresented minorities (African American and Hispanic). The Department of Pharmaceutical Sciences was recently awarded a Presidential Diversity Fellowship at Binghamton University to recruit a native Nigerian, who currently contributes to Departmental teaching and research. About half of our faculty members are women. Recruiting more qualified women and minority faculty is essential for continued growth and creativity in our academic setting. For the future faculty hires both within the School and the Department, we will continue to encourage applications from women and underrepresented minorities. We have created a hiring pipeline to ensure equal opportunity employment, compensation, and other terms and conditions of employment without discrimination on the basis of age, race, color, religion, disability, national origin, gender identity or expression, sexual orientation, or marital status.

To improve tenure, promotion and retention our School has mandated that each faculty member will have a mentoring team. This team is assembled immediately after recruitment and provides guidance to the faculty members on teaching, research and service areas annually. Each faculty member submits a report to their respective mentoring team and receives written, constructive feedback annually. Faculty mentoring teams and their reports are coordinated by the Associate Dean for Research in our School.

- d) *What is the expected student body in terms of geographic origins (i.e., same county, same Regents Region, New York State, and out-of-state); academic origins; proportions of women and minority group members; and students for whom English is a second language?*

The student body is expected to adhere to the New York State distributions, as noted above.

2.5. Academic and Other Support Services

- a) *Summarize the academic advising and support services available to help students succeed in the program.*

Academic advising will be done by the faculty, as in most other graduate programs on campus. The faculty committee of four that serves (with the program director) as an admission committee will also serve as advisors to students, providing information, resolving problems, and helping students with academic questions. Students will do a self-assessment of their competencies at the start of the program and at the end of each semester. Students' progress will also be monitored each semester by the program director, with the goal of connecting any student who encounters difficulty in classes to tutoring help where appropriate. Students will be required to maintain a 3.0 average in order to be placed in labs; the program faculty will develop additional procedures for identifying and supporting students who encounter difficulties in the coursework.

Specific to the PhD program, each student will be assigned a faculty advisor upon entry into the program. This individual will guide the student through coursework and research opportunities prior to selection of a dissertation advisor. During the student's 2nd semester, they are expected to work with the department to select a dissertation advisor that fits both the student's research interests and also the research and budgetary availability of the department faculty members. This faculty will serve as the primary advisor going forward through the program. Additionally, the student will be in frequent contact with the members of their dissertation committee (established during the 2nd academic year). Each dissertation committee will be composed of a minimum of 4 members, including the chair. At least one committee member must be a tenure track faculty member external to the department. The established committee will provide support and guidance

as the student is working towards completion of his or her terminal degree. Additional academic guidance and support will be provided through the SOPPS Office of Student Affairs.

For other forms of advising, including external placements and career opportunities, the faculty program director will be assisted by an assistant director, who will oversee placements and assessment, and by faculty aligned with their career interests.

In addition to the departmental support structure, Binghamton University offers a variety of support services that are available (free of charge) to graduate students. These include:

- Fleishman Center for Career and Professional Development: This office provides career guidance and support including job searching, mock-interviews, resume design, and job fairs.
- Binghamton University Counseling Center: This office provides student confidential counseling services and mental-health support. Support for conflict resolution is also provided.
- The office of International Student and Scholar Services (ISSS) assists all international students in gaining initial visas for U.S. entry, permission for Optional Practical Training, and information required in emergencies.
- Other student support services, ranging from expert library faculty and staff to health services to counseling, are also available to all students in the program.

b) Describe types, amounts and sources of student financial support anticipated. Indicate the proportion of the student body receiving each type of support, including those receiving no support.

We anticipate that all students enrolled in the PhD program will receive full tuition and stipend support through a combination of TA (teaching assistant, up to 16 positions) and GA (graduate research assistant) awards. We do not anticipate enrolling a significant number of self-funded students. Support for GA positions will come from faculty and departmental research grants – many of which have already been initiated. As of spring 2018, SOPPS faculty have applied for federal and private grants and have been awarded >\$3 million in funding. Additionally, the Binghamton University graduate school has a number of fellowship opportunities that are available for all graduate students. These include:

- Clifford D. Clark Diversity Fellowships
- Louis Stokes Alliance for Minority Participation (LSAMP) Bridge to Doctorate (BD) program
- Binghamton University Foundation Fellowships

In addition, a number of our faculty were previously successful in securing NIH training grants (e.g. T32, F31). We also anticipate the establishment of specific fellowships for SOPPS as the department expands and philanthropic donors are identified. For example, in summer 2018, SOPPS secured a \$25,000 award from Dr. Mildred Shellig Fund for Student-Faculty Research Collaboration and instituted a summer fellowship that supported five students in order to spend their summer performing research with a SOPPS faculty member.

c) Describe types, amounts and sources of student financial support anticipated. Indicate the proportion of the student body receiving each type of support, including those receiving no support.

Students in the PhD program will receive full-time stipend and tuition support through TA or GA appointments. Students in the MS program are responsible for payment of tuition; no stipends are provided. These students have full access to Binghamton University Graduate School Financial Support resources in collaboration with the university Office of Financial Aid and Student Records. The graduate school provides resources for graduate students for financial aid, assistantships, fellowships and scholarships, employment opportunities, opportunities for underrepresented students, opportunities for tuition payment support, research and travel funding, and external funding.

2.6. Prior Learning Assessment

If this program will grant credit based on Prior Learning Assessment, describe the methods of evaluating the learning and the maximum number of credits allowed, **or check here [X] if not applicable.**

2.7. Program Assessment and Improvement

*Describe how this program's achievement of its objectives will be assessed, in accordance with [SUNY policy](#), including the date of the program's initial assessment and the length (in years) of the assessment cycle. Explain plans for assessing achievement of students learning outcomes during the program and success after completion of the program. **Append at the end of this form, a plan or curriculum map** showing the courses in which the program's educational and, if appropriate, career objectives – from Item 2.3(b) of this form – will be taught and assessed. **NOTE:** The University Faculty Senate's [Guide for the Evaluation of Undergraduate Programs](#) is a helpful reference.*

The MS degree is awarded for advanced knowledge in pharmaceutical sciences through didactic, analytical, and applied learning opportunities. As for the PhD program, the coursework and seminars are designed to provide students with theoretical and applied knowledge. The MS program, in particular, requires class and lab work in analytical methods and instrumentation in order to prepare students for the workforce. Students have the option of completing a research project in the department or through internships to expand their experience, or to enhance their learning through didactic lectures. The entire program is designed to be completed in 1.5 years.

The PhD is awarded for an original investigation leading to significant advanced of knowledge in the field of pharmaceutical and/or biomedical sciences. Didactic courses and seminars will provide students with the required theoretical knowledge, basic principles and methods in the field. Under guidance of the departmental graduate committee, students will complete those courses which best serve their particular needs. In the course of their training, they are expected to demonstrate by appropriate examination a breadth of knowledge particularly in pharmaceutical and biomedical sciences and how chemistry, biochemistry, biology and physiology can help them build this knowledge. Students are also expected to develop competency to evaluate and communicate scientific research via oral presentation and in writing.

As part of the regular assessment cycle for all programs at Binghamton University, student learning outcomes will be assessed at regular intervals by the faculty to determine how effectively graduates have attained the desired knowledge, skills, and competencies. Feedback from the assessment process will be used to modify and improve courses, practicum, and curriculum design.

The entire program requires 4 to 5 years and will be assessed on the following components:

Courses: Each student is expected to take five basic courses and at least two electives depending on their research track. All courses are taken in the first and second year of the program. Each course will be assessed by the faculty (e.g. self-reflection) and data from course based assessment including first time pass rate. The departmental graduate committee and the department chair will review and evaluate each course after the first delivery and then every three years thereafter. Student rating of the course will be also taken into consideration in case there is a conflicting report.

Comprehensive exam: Following the satisfactory completion of the course work, students are required to complete a written comprehensive exam in the form of a grant proposal (K01 or F32 type) followed by an oral presentation of the proposal. Failure to maintain a minimum overall GPA of 3.0 or failure of the comprehensive exam with a maximum of two attempts will result in dismissal from the PhD program. We expect the first time remediation rate to be less than 20%. This will be monitored by the departmental graduate committee.

Research and dissertation: Since the PhD in pharmaceutical sciences is earned on the basis of original investigative research work, students will begin working on their research project early in their training after they have completed the three laboratory rotations and have been placed in a given laboratory. Each student, with the help of his/her advisor will establish a dissertation committee composed of a minimum of 4 members, a chair and three other faculty (two from the department and one external). The committee will review each student's progress every year. The evaluation report

from the committee will be forwarded to the departmental graduate committee. The overall success of a student will be evaluated based the overall grades, the number of conference presentations, publications, awards, fellowship. We expect the attrition rate to be < 25 % which is below the national PhD average attrition rate of 50%. Students are required to submit at least two, publication-quality, scientific manuscripts for peer review prior to dissertation.

After completion of the program, success will be assessed by the graduation rate in each cycle, by adequate student placement in doctoral or postdoctoral programs, academia, industry and federal agencies, and by increased admission rate including the rejected applicant rate. Other indicators of programmatic success will be assessed, such as increased lab productivity (e.g. publication in high impact peer-reviewed scientific journal) and increased grant awards from both federal and private agencies.

Finally, both programs will assess their achievement of career objectives for students by tracking graduates' success after completion. Placement data will be compiled and evaluated every year and will form part of the program review accomplished at regular intervals. Importantly, as we move forward with our programmatic assessment, evaluation will focus on meeting the needs of the market.

Section 3. Program Schedule and Curriculum

Complete the **SUNY Graduate Program Schedule** to show how a typical student may progress through the program.

This is the registered curriculum, so please be precise. Enter required courses where applicable, and enter generic course types for electives or options. Either complete the blank Schedule that appears in this section, or complete an Excel equivalent that computes all sums for you, found [here](#). Rows for terms that are not required can be deleted.

NOTES: The **Graduate Schedule** must include all curriculum requirements and demonstrate that expectations from in Regulation 52.2 <http://www.highered.nysed.gov/ocue/lrp/rules.htm> are met.

Special Cases for the Program Schedules:

- For a program with multiple tracks, or with multiple schedule options (such as full-time and part-time options), use one Program Schedule for each track or schedule option. Note that licensure qualifying and non-licensure qualifying options cannot be tracks; they must be separate programs.
 - When this form is used for a multi-award and/or multi-institution program that is not based entirely on existing programs, use the schedule to show how a sample student can complete the proposed program. **NOTE:** Form 3A, [Changes to an Existing Program](#), should be used for new multi-award and/or multi-institution programs that are based entirely on existing programs. [SUNY policy](#) governs the awarding of two degrees at the same level.
- a) If the program will be offered through a nontraditional schedule (i.e., not on a semester calendar), what is the schedule and how does it impact financial aid eligibility? **NOTE:** Consult with your campus financial aid administrator for information about nontraditional schedules and financial aid eligibility.
N/A
 - b) For each existing course that is part of the proposed graduate program, **append** a catalog description at the end of this document.
 - c) For each new course in the graduate program, **append** a syllabus at the end of this document. **NOTE:** Syllabi for all courses should be available upon request. Each syllabus should show that all work for credit is graduate level and of the appropriate rigor. Syllabi generally include a course description, prerequisites and corequisites, the number of lecture and/or other contact hours per week, credits allocated (consistent with [SUNY policy on credit/contact hours](#)), general course requirements, and expected student learning outcomes.
See Appendix A
 - d) If the program requires external instruction, such as clinical or field experience, agency placement, an internship, fieldwork, or cooperative education, **append** a completed [External Instruction](#) form at the end of this document NA

MS program schedule:

SUNY Graduate Program Schedule (OPTION: You can insert an Excel version of this schedule AFTER this line, and delete the rest of this page.)

Program/Track Title and Award: Pharmaceutical Sciences MS (Project option)

- a) Indicate **academic calendar** type: [] Semester [] Quarter [] Trimester [] Other (describe):
- b) **Label each term in sequence**, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
- c) Use the table to show **how a typical student may progress through the program**; copy/expand the table as needed.
- d) Complete the last row to show program totals and comprehensive, culminating elements. **Complete all columns that apply to a course.**

Term 1: Fall 1				Term 2: Spring 1			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 601: Pharmaceutical Sciences I	4	X		PHRM 602: Pharmaceutical Sciences II	4	X	PHRM 601
PHRM 610: Cellular and Molecular Basis of Human Diseases	4			PHRM 611: Biostatistics	3	X	
PHRM 600: Department and Student Seminar Series	1	X		PHRM 600: Department and Student Seminar Series	1	X	
PHRM 518: Analytical methods and instrumentation I	3	X		PHRM 519: Analytical methods and instrumentation II	3	X	
Term credit total:	12			PHRM 597MS: Independent study	1		
				Term credit total:	12		
Term 3: Fall 2							
Course Number & Title	Credits	New	Co/Prerequisites				
PHRM 598MS: Research Project	6	X					
3-credit elective 500 level or above	3	X					
		X					
Term credit total:	9						
Program Total:	Total Credits: 33	Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable: 4 foundation courses (PHRM601, PHRM602, PHRM610, PHRM611), 6 credit hours of research project plus 3 credit hours for 1 elective (500 level or higher).					

MS program schedule:

SUNY Graduate Program Schedule (OPTION: You can insert an Excel version of this schedule AFTER this line, and delete the rest of this page.)

Program/Track Title and Award: Pharmaceutical Sciences MS (Industry internship option).

- e) Indicate **academic calendar** type: [] Semester [] Quarter [] Trimester [] Other (describe):
- f) **Label each term in sequence**, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
- g) Use the table to show **how a typical student may progress through the program**; copy/expand the table as needed.
- h) Complete the last row to show program totals and comprehensive, culminating elements. **Complete all columns that apply to a course.**

Term 1: Fall 1				Term 2: Spring 1			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 601: Pharmaceutical Sciences I	4	X		PHRM 602: Pharmaceutical Sciences II	4	X	PHRM 601
PHRM 610: Cellular and Molecular Basis of Human Diseases	4			PHRM 611: Biostatistics	3	X	
PHRM 600: Department and Student Seminar Series	1	X		PHRM 600: Department and Student Seminar Series.	1	X	
PHRM 518: Analytical methods and instrumentation I	3	X		PHRM 519: Analytical methods and instrumentation II	3	X	
Term credit total:	12			PHRM 597MS: Independent study	1		
				Term credit total:	12		
Fall 2							
Course Number & Title	Credits	New	Co/Prerequisites				
PHRM 591MS: Industry Internship	6	X					
3-credit elective 500 level or above	3	X					
		X					
Term credit total:	9						
Program Total:	Total Credits: 33		Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable: 4 foundation courses (PHRM601, PHRM602, PHRM610, PHRM611), 6 credit hours of industry internship plus 3 credit hours for 1 elective (500 level or higher).				

MS program schedule:

SUNY Graduate Program Schedule (OPTION: You can insert an Excel version of this schedule AFTER this line, and delete the rest of this page.)

Program/Track Title and Award: Pharmaceutical Sciences MS (Electives option).

- i) Indicate **academic calendar** type: [] Semester [] Quarter [] Trimester [] Other (describe):
- j) **Label each term in sequence**, consistent with the institution’s academic calendar (e.g., Fall 1, Spring 1, Fall 2)
- k) Use the table to show **how a typical student may progress through the program**; copy/expand the table as needed.
- l) Complete the last row to show program totals and comprehensive, culminating elements. **Complete all columns that apply to a course.**

Term 1: Fall 1				Term 2: Spring 1			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 601: Pharmaceutical Sciences I	4	X		PHRM 602: Pharmaceutical Sciences II	4	X	PHRM 601
PHRM 610: Cellular and Molecular Basis of Human Diseases	4			PHRM 611: Biostatistics	3	X	
PHRM 600: Department and Student Seminar Series	1	X		PHRM 600: Department and Student Seminar Series.	1	X	
PHRM 518: Analytical methods and instrumentation I	3	X		PHRM 519: Analytical methods and instrumentation II	3	X	
Term credit total:	12			PHRM 597MS: Independent study	1		
				Term credit total:	12		
Fall 2							
Course Number & Title	Credits	New	Co/Prerequisites				
9 credit hours of electives 500 level or above	9	X					
		X					
		X					
Term credit total:	9						
Program Total:	Total Credits: 33		Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable: 4 foundation courses (PHRM601, PHRM602, PHRM610, PHRM611), 9 credit hours of 3 electives (500 level or higher).				

PhD program schedule

SUNY Graduate Program Schedule (*OPTION: You can insert an [Excel version](#) of this schedule AFTER this line, and delete the rest of this page.*)

Program/Track Title and Award: **Pharmaceutical Sciences PhD (Option 1- entering program with BA or BS)**

- m) Indicate academic calendar type: [X] Semester [] Quarter [] Trimester [] Other (describe):
n) Label each term in sequence, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
o) Use the table to show how a typical student may progress through the program; copy/expand the table as needed.
p) Complete the last row to show program totals and comprehensive, culminating elements. Complete all columns that apply to a course.

Term 1: Fall 1				Term 2: Spring 1			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 601: Pharmaceutical Sciences I	4	X		PHRM 602: Pharmaceutical Sciences II	4	X	
PHRM 610: Cellular and Molecular Basis of Human Diseases	4			PHRM 611: Biostatistics	3	X	
PHRM 600: Department and Student Seminar Series	1	X		PHRM 600: Department and Student Seminar Series.	1	X	
PHRM698: 1st and 2nd Lab Rotations	3	X		PHRM698: 3rd Lab Rotation and placement	4	X	
Term credit total:	12			Term credit total:	12		
Term 3: Fall 2				Term 4: Spring 2			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 680a (or other): Elective 1	3	X		PHRM 680c (or other): Elective 3	3	X	
PHRM 680b (or other): Elective 2	3	X		PHRM 613: Critical Thinking and Communication in Research and Drug Development.	4		
PHRM 600: Department and Student seminar series	1	X		PHRM 600: Department and Student seminar series	1	X	
PHRM 699: Dissertation Research	2	X		PHRM 699: Dissertation Research	1	X	
Term credit total:	9			Term credit total:	9		
Program Total:	Total Credits: see next page		Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable. See next page.				

New: X if new course Prerequisite(s): list prerequisite(s) for the listed courses

Term 5: Fall 3*				Term 6: Spring 3*			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 699: Dissertation Research	8	X		PHRM 699: Dissertation Research	8	X	
PHRM 600: Department and Student seminar series	1	X		PHRM 600: Department and Student seminar series	1	X	
Term credit total:	9			Term credit total:	9		
Term 7: Fall 4*				Term 8: Spring 4*			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 699: Dissertation Research	1	X	PhD Candidate Status	PHRM 699: Dissertation Research	1	X	PhD Candidate Status
		X				X	
Term credit total:				Term credit total:	1		
Term 9: Fall 5*				Term 10: Spring 5*			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 699: Dissertation Research	1	X	PhD Candidate Status	PHRM 699: Dissertation Research	1	X	PhD Candidate Status
Term credit total:	1			Term credit total:	1		
*With "Full-time working toward degree status"				*With "Full-time working toward degree status"			
Program Total:		Total Credits: 64		Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable: Submission and defense of a PhD dissertation.			

New: X if new course Prerequisite(s): list prerequisite(s) for the listed courses

PhD program schedule

SUNY Graduate Program Schedule (*OPTION: You can insert an [Excel version](#) of this schedule AFTER this line, and delete the rest of this page.*)

Program/Track Title and Award: Pharmaceutical Sciences PhD (Option 2 - MS degree in Pharmaceutical Sciences from a different institution)

- q) Indicate academic calendar type: [X] Semester [] Quarter [] Trimester [] Other (describe):
 r) Label each term in sequence, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
 s) Use the table to show how a typical student may progress through the program; copy/expand the table as needed.
 t) Complete the last row to show program totals and comprehensive, culminating elements. Complete all columns that apply to a course.

Term 1: Fall 1				Term 2: Spring 1			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 601: Pharmaceutical Sciences I	4	X	Can be waived at the discretion of the program director.	PHRM 602: Pharmaceutical Sciences II	4	X	Can be waived at the discretion of the program director.
PHRM 610: Cellular and Molecular Basis of Human Diseases	4		Can be waived at the discretion of the program director.	PHRM 611: Biostatistics	3	X	Can be waived at the discretion of the program director.
PHRM 600: Department and Student Seminar Series	1	X		PHRM 600: Department and Student Seminar Series.	1	X	
PHRM 698: 1st and 2nd Lab Rotations	3	X		PHRM 698: 3rd Lab Rotation and placement	4	X	
Term credit total:	12			Term credit total:	12		
Term 3: Fall 2				Term 4: Spring 2			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 680a (or other): Elective 1	3	X		PHRM 680c (or other): Elective 3	3	X	
PHRM 680b (or other): Elective 2	3	X		PHRM 613: Critical Thinking and Communication in Research and Drug Development.	4		
PHRM 600: Department and Student seminar series	1	X		PHRM 600: Department and Student seminar series	1	X	
PHRM 699: Dissertation Research	2	X	Graduate standing at PharmSci Dept.	PHRM 699: Dissertation Research	1	X	Graduate standing at PharmSci Dept.
Term credit total:	9			Term credit total:	9		
Program Total:	Total Credits: see next page		Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable. See next page.				

New: X if new course Prerequisite(s): list prerequisite(s) for the listed courses

Term 5: Fall 3*				Term 6: Spring 3*			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 699: Dissertation research	8	X	Graduate standing at PharmSci Dept.	PHRM 699: Dissertation research	8	X	Graduate standing at PharmSci Dept.
PHRM 600: Department and Student seminar series	1	X		PHRM 600: Department and Student seminar series	1	X	
Term credit total:	9			Term credit total:	9		
Term 7: Fall 4*				Term 8: Spring 4*			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 699: Dissertation Research	1	X	PhD Candidate Status	PHRM 699: Dissertation Research	1	X	PhD Candidate Status
Term credit total:				Term credit total:	1		
Term 9: Fall 5*				Term 10: Spring 5*			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 699: Dissertation Research	1	X	PhD Candidate Status	PHRM 699: Dissertation Research	1	X	PhD Candidate Status
Term credit total:	1			Term credit total:	1		
*With "Full-time working toward degree status"				*With "Full-time working toward degree status"			
Program Total:	Total Credits: 64		Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable: Submission and defense of a PhD dissertation.				

New: X if new course Prerequisite(s): list prerequisite(s) for the listed courses

PhD program schedule

SUNY Graduate Program Schedule (*OPTION: You can insert an [Excel version](#) of this schedule AFTER this line, and delete the rest of this page.*)

Program/Track Title and Award: Pharmaceutical Sciences PhD (Option 3 - MS degree in Pharmaceutical Sciences from Binghamton University)

- u) Indicate **academic calendar** type: [] Semester [] Quarter [] Trimester [] Other (describe):
v) **Label each term in sequence**, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
w) Use the table to show **how a typical student may progress through the program**; copy/expand the table as needed.
x) Complete the last row to show program totals and comprehensive, culminating elements. **Complete all columns that apply to a course.**

Term 1: Fall 1				Term 2: Spring 1			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 601: Pharmaceutical Sciences I	4	X	Waived	PHRM 602: Pharmaceutical Sciences II	4	X	Waived
PHRM 610: Cellular and Molecular Basis of Human Diseases	4		Waived	PHRM 611: Biostatistics	3	X	Waived
PHRM 600: Department and Student Seminar Series	1	X		PHRM 600: Department and Student Seminar Series.	1	X	
PHRM 698: 1st and 2nd Lab Rotations	3	X		PHRM 698: 3rd Lab Rotation and placement	4	X	
Term credit total:	12			Term credit total:	12		
Term 3: Fall 2				Term 4: Spring 2			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 680a (or other): Elective 1	3	X		PHRM 680c (or other): Elective 3	3	X	
PHRM 680b (or other): Elective 2	3	X		PHRM 613: Critical Thinking and Communication in Research and Drug Development	4		
PHRM 600: Department and Student seminar series	1	X		PHRM 600: Department and Student seminar series	1	X	
PHRM 699: Dissertation Research	2	X		PHRM 699: Dissertation Research	1	X	
Term credit total:	9			Term credit total:	9		
Program Total:	Total Credits: see next page		Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable. See next page.				

New: X if new course **Prerequisite(s):** list prerequisite(s) for the listed courses

Term 5: Fall 3*				Term 6: Spring 3*			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 699: Dissertation Research	8	X	PhD candidate status	PHRM 699: Dissertation Research	8	X	
PHRM 600: Department and Student seminar series	1	X		PHRM 600: Department and Student seminar series	1	X	
Term credit total:	9			Term credit total:	9		
Term 7: Fall 4*				Term 8: Spring 4*			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 699: Dissertation Research	1	X	PhD Candidate Status	PHRM 699: Dissertation Research	1	X	PhD Candidate Status
Term credit total:	1			Term credit total:	1		
Term 9: Fall 5*				Term 10: Spring 5*			
Course Number & Title	Credits	New	Co/Prerequisites	Course Number & Title	Credits	New	Co/Prerequisites
PHRM 699: Dissertation Research	1	X	PhD candidate status	PHRM 699: Dissertation Research	1	X	PhD candidate status
Term credit total:	1			Term credit total:	1		
*With "Full-time working toward degree status"				*With "Full-time working toward degree status"			
Program Total:	Total Credits: 64		Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable: Submission and defense of a PhD dissertation.				

New: X if new course Prerequisite(s): list prerequisite(s) for the listed courses

Section 4. Faculty

- a) Complete the **SUNY Faculty Table** on the next page to describe current faculty and to-be-hired (TBH) faculty.
- b) **Append** at the end of this document position descriptions or announcements for each to-be-hired faculty member.

***NOTE:** CVs for all faculty should be available upon request. Faculty CVs should include rank and employment status, educational and employment background, professional affiliations and activities, important awards and recognition, publications (noting refereed journal articles), and brief descriptions of research and other externally funded projects. New York State's requirements for faculty qualifications are in in Regulation 52.2*

<http://www.highered.nysed.gov/ocue/lrp/rules.htm>

- c) What is the institution's definition of "full-time" faculty?

Full-time faculty serve in academic year (10-month) appointments. Each Dean and Department Chair determine teaching, research, and service loads for a full-time obligation of faculty employed by the unit.

SUNY Faculty Table

Provide information on current and prospective faculty members (identifying those at off-campus locations) who will be expected to teach any course in the graduate program. Expand the table as needed. Use a separate Faculty Table for each institution if the program is a multi-institution program.

(a)	(b)	(c)	(d)	(e)	(f)
Faculty Member Name and Title/Rank (Include and identify Program Director with an asterisk)	% of Time Dedicated to This Program	Program Courses Which May Be Taught (Number and Title)	Highest and Other Applicable Earned Degrees (include College or University)	Discipline(s) of Highest and Other Applicable Earned Degrees	Additional Qualifications: List related certifications, licenses and professional experience in field
PART 1. Full-Time Faculty					
Yatrib Hathout, Grad Program Direct. Professor	75%	601, 680a, 698, 699, 519, 597MS, 591MS	Ph.D. U. Burgundy	Biochemistry	M.S. (France), Director Mass spectrometry facility.
Gail Rattinger, Assoc. Dean, Prof.	25%	613, 698, 699	Ph.D. U. Illinois Ch-U	Chemistry	Prev. Dept Chair (NJ), PharmD (CA)
Leon Cosler, Dept. Chair, Assoc. Prof.	25%	602, 698, 699	Ph.D. Union College	Pharmacoeconomic	R.Ph (NY), M.S. (WV), co-Dir. Res.
Aaron Beedle, Vice-Chair, Assoc. Prof	75%	602, 613, 698, 699, 518, 597MS	Ph.D. U. Calgary	Neuroscience	PhD and MS curriculum development (GA)
Tracy Brooks, Assistant Professor	75%	601, 600, 680b, 698, 699	Ph.D. U. Buffalo	Pharmacology	PhD program/curriculum devel. (MS)
Nathan Tumey, Assistant Professor	75%	602, 698, 680b, 699, 519, 597MS	Ph.D. Duke U.	Chemistry	15 yrs Pharma drug development
Mohammed Ali, Assistant Professor	50%	601, 602, 698, 699, 597MS	Ph.D. U. Alberta	Pharmacology	M.S. (Egypt), Clinical Pharmacist (Licensed Clinical Pharmacist with Additional Prescribing Authorization, Alberta Canada)
Katie Edwards, Assistant Professor	75%	680b, 680c, 698, 699, 518, 597MS	Ph.D. Cornell U.	Env. Toxicology	5 yrs Pharma organic chemist
Eric Hoffman, Assoc Dean, Prof.	50%	613, 680a, 698, 699,	Ph.D. Johns Hopkins U.	Biology (Genetics)	Founder, Pres., CEO; Prev. Director, Chair
K. Nagaraju, Chair, Professor	50%	613, 698, 699, 518, 597MS	Ph.D. SGPGI Med Sci	Immunology	Founder, Pres., CEO; Prev. Int. Chair

Tony Davis, PhD, Assistant Professor (start Fall 2020)	50%	601, 680c, 698, 699, 597MS	Ph.D. Cornell U.	Molecular Pharmacology & Chemistry	Expertise: Medicinal Chemistry, Pharmacology
Utkarsh Dang, Assistant Professor	25%	611, 698, 699, 597MS	Ph.D. U. Guelph	Statistics	M.S. (Canada)
Rubi Mahato, PhD, MBA, Lecturer	50%	601, 680b	Ph.D. U. Missouri-Kansas City; MBA Farleigh Dickinson Univ.	Pharmaceutical Sci., Chemistry	Expertise: Pharmaceutics
Melissa Morales, PhD Assistant Professor (start Fall 2020)	75%	601, 519, 680b, 698, 699, 597MS	Ph.D. Binghamton University	Neuroscience	Expertise: Neuroscience, Immunology, Genetics
Part 2. Part-Time Faculty					
Anthony di Pasqua, Assistant Prof.	50%	602, 680b, 698,	Ph.D. Syracuse U.	Chemistry	Founder, Pres., CEO; Patent holder
Part 3. Faculty To-Be-Hired (List as TBH1, TBH2, etc., and provide title/rank and expected hiring date)					
TBH1, Assistant Professor, Fall 2020 (funded from the SOPPS approved business plan for the PharmD program)	50%	610, 698, 699, 518, 570MS	Tbd*		Expertise: Pharmaceutics
TBH2, Assistant Professor, Fall 2021 (funded from the SOPPS approved business plan for the PharmD program)	50%	601, 602, 698, 699, 597MS	Tbd*		Exp: Pharmacology

***These two positions will be funded by the NY State for the PharmD program and no part of the salaries are budgeted from the proposed MS and PhD programs.**

Section 5. Financial Resources and Instructional Facilities

- a) *What is the resource plan for ensuring the success of the proposed program over time? Summarize the instructional facilities and equipment committed to ensure the success of the program. Please explain new and/or reallocated resources over the first five years for operations, including faculty and other personnel, the library, equipment, laboratories, and supplies. Also include resources for capital projects and other expenses.*

Committed extramural research funding to SOPPS is \$2.3M in its 3rd year of operation, including two projects in a NIH U54 pediatric pharmacology center. The proposed graduate program draws on a transdisciplinary group of faculty working at the Department of Pharmaceutical Sciences and the Department of Health Outcomes and Administrative Sciences. We currently have 12 qualified faculty in the Department of Pharmaceutical Sciences alone to participate in teaching and/or training of graduate students in specialized methods and instrumentation required in contemporary pharmaceutical sciences research programs. We anticipate hiring five additional faculty (four assistant professors and one lecturer [currently in progress]) by the end of 2021 with expertise in genetics/biomedical pharmaceuticals, pharmacology and medicinal chemistry.

Thus, we expect approximately 20 faculty members to support the program, participating in teaching, program development, and acting as advisors for graduate students. While these faculty members will support various teaching and educational responsibilities in the PharmD program, there is sufficient overlap in discipline and expertise, such that we do not anticipate an overwhelming teaching load for our faculty.

The School of Pharmacy and Pharmaceutical Sciences is housed in a \$65M newly constructed, dedicated 4-floor building that opened in fall 2018 (Figure below).



The 105,521 sq. ft. SOPPS building includes two floors of educational space and two floors of research space. Research wet laboratories on the 3rd and 4th floors are flexible and open design (12,400 sq. ft. per floor). Wet labs use a modular/flexible system with ceiling mounts of electricity, computing/IT, and gases. The vivarium will be attached to the School of Pharmacy and Pharmaceutical Sciences building and is planned for occupancy in 2020. This clearly shows that we have the capacity and resources in place to support the proposed MS and PhD programs. In addition to these resources, we have also begun to receive philanthropic donations to support research faculty and the training of our students. From 2018 and 2019 we received \$50,000 in donations from the Mildred Shellig Fund to support student training.

Space is available on each floor of the building for face-to-face meetings of the program director, faculty and support staff and for sub-committees including admissions committee and thesis committees.

See appendix D for detailed instructional facilities and equipment. The state of the art instrumentations at SOPPS is supported by service contracts to ensure uninterrupted research projects and plans. As SOPPS is a very new school, we are working towards achieving this distributed shared balance of support. Funds to cover the cost of the service contracts can be partially budgeted on grants when available, but we have also

established a charge back mechanism that will help with partially covering service contract and consumable. For example, just last year we have generated \$25 K from charge backs that we will use to cover the annual service contract for Thermo Scientific™ Q Exactive™ HF hybrid quadrupole-Orbitrap mass spectrometer.

Financial support to the students and research:

In the first two years of the PhD program, students will be financially supported through teaching assistantships within the PharmD program offering them valuable experience educating those in a closely-related profession. We currently have 16-18 approved teaching assistantships to support students' tuition and stipends during the first two years; after that time, students are expected to be fully supported by grants from their faculty advisors. Several of our faculty members are well-supported by federal grants, foundation grants, and/or private investments, and are currently conducting research in various aspects of the biomedical and pharmaceutical sciences. Our success rate in landing federal and foundation grants is superior to other neighboring schools. We are also planning to apply for federal training grants (NIH and NSF) on a regular basis to further support our PhD program. Additional financial support will be provided through the indirect cost recovery program at BU, specific to each advisor depending on external grant funding. This budget could be used to support students attending conferences and obtaining specialized training benefiting them during their PhD studies.

Students in the MS program are responsible for payment of tuition; no stipends are provided. These students have full access to Binghamton University Graduate School Financial Support resources in collaboration with the university Office of Financial Aid and Student Records. The graduate school provides resources for graduate students for financial aid, assistantships, fellowships and scholarships, employment opportunities, opportunities for underrepresented students, opportunities for tuition payment support, research and travel funding, and external funding. In addition to the financial support mechanisms listed above, we have also begun to receive philanthropic donations to support and train our students in their respective research projects.

- b) *Complete the five-year SUNY Program Expenses Table, below, consistent with the resource plan summary. Enter the anticipated academic years in the top row of this table. List all resources that will be engaged specifically as a result of the proposed program (e.g., a new faculty position or additional library resources). If they represent a continuing cost, new resources for a given year should be included in the subsequent year(s), with adjustments for inflation or negotiated compensation. Include explanatory notes as needed.*

SUNY Program Expenses Table

OPTION: You can paste an [Excel version](#) of this schedule **AFTER** this sentence, and delete the table below.

The proposed MS and PhD programs in Pharmaceutical Sciences are expected to produce a net gain for Binghamton University. The overall program will be supported through the already existing and ongoing SOPPS institutional infrastructure, financial and human resources including full-time paid faculty, 1.7 laboratory technical staff and one Administrative Assistant as detailed in the paragraph below.

As shown in the SUNY faculty table above, the Department of Pharmaceutical Sciences will direct and administer the MS and PhD programs. The Department has already hired 10 full-time faculty (4 tenured and 6 tenure-track), one part-time tenured faculty, one part-time tenure-track faculty, and one full-time lecturer. Two additional tenure track faculty will be hired by the School to join the Department of Pharmaceutical Sciences by 2021. It is important to emphasize that the budget to hire these faculty has been already allotted to School for the PharmD program as whole faculty lines, approved by the President and the Provost. For this reason, no faculty salaries are listed as expenses in the financial plan below. No additional cost or expenditure is required to hire the remaining Departmental faculty (TBH1, TBH2). Three existing faculty from the Department of Health Outcomes and Administrative Sciences will also assist in administering the proposed programs and will provide expertise in the field of bioinformatics and biostatistics. As existing faculty members are experts with areas of specialization appropriate to deliver all areas of research and educational skills needed for the MS and PhD programs, we are well-positioned to start the program immediately upon receiving SUNY approval. In addition to its existing faculty members, the Department of Pharmaceutical Sciences has one full time and one half-time dedicated laboratory technician staff who will assist with practical courses. One full time IT staff member is already well-integrated in and supported by the School. He assists lab personnel and faculty with computer, internet; institutional software, database and data storage capabilities; and will provide these services at no additional cost to MS and PhD program

operations. Furthermore, one librarian is dedicated to the School on a part-time basis for the PharmD program. She will also support the MS and PhD programs within her current effort at the School.^b One Graduate administrative assistant and one TA will be hired to assist with the program. The only personnel resources as expenditures to the new program are one graduate administrative assistant and one teaching assistant that will be hired to assist with the programs. Additional support for the PhD program will come from external funding and future training grants.

New net revenue and expenses presented in Table below is specifically for the MS Program. These include a budget to support a Teaching Assistant, a Graduate Administrative Assistant, a budget to support laboratory courses (large equipment use and maintenance, small equipment purchases [year 1], reagents and consumables), and program advertising and recruitment. Please see a more detailed description above in “Costs”.

Enrollment and revenue for the MS program					
	Year 1	Year 2	Year 3	Year 4	Year 5
Full-time	10	20 (2 nd year students Fall semester only)	20 (2 nd year students Fall semester only)	20 (2 nd year students Fall semester only)	20 (2 nd year students Fall semester only)
Revenue	\$131,940	\$197,910	\$197,910	\$197,910	\$197,910
Program expenses					
^a Faculty salaries	0	0	0	0	0
^b Library	0	0	0	0	0
Laboratories	0	0	0	0	0
Capital Expenses	0	0	0	0	0
Equipment (small)	\$18,000	\$1,500	\$1,500	\$1,500	\$1,500
Supplies: Laboratory consumables, reagents, and software	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
Others (specify) -Maintenance of core equipment	\$5,000	\$8,500	\$8,500	\$8,500	\$8,500
Program recruitment (advertising, travel)	\$8,000	\$8,000	\$8,000	\$8,000	\$8,000
One TA line	\$20,000 (0.5 TA line for year 1)	\$40,000	\$40,000	\$40,000	\$40,000
SL1- Administrative assistant	\$37,000	\$38,110	\$39,253	\$40,430	\$41,643
Total expenses	\$103,000	\$111,110	\$112,253	\$113,430	\$114,643
Net gain/loss	\$28,940	\$86,800	\$85,657	\$84,480	\$83,267

Section 6. Library Resources

- a) *Summarize the analysis of library collection resources and needs for this program by the collection librarian and program faculty. Include an assessment of existing library resources and accessibility to those resources for students enrolled in the program in all formats, including the institution's implementation of SUNY Connect, the SUNY-wide electronic library program.*

The library resources for the pharmacy program are mostly online and by subscription. As is common in schools of pharmacy, there is a quiet reading room in the pharmacy building, where selected print library materials will be available, on reserve, for faculty and students in the program. In this rapidly evolving profession, ready access to digital information provides more significant support for a strong education than a brick-and-mortar library collection. The BU libraries have 2.4 million volumes and over 93,000 journals, including many of the world's leading biomedical journals. Over 95% of these titles are available electronically both on- and off-campus.

The Binghamton University Libraries provides a variety of services and resources designed to enrich the learning experience for students and provide support for the School of Pharmacy and Pharmaceutical Sciences faculty and programs. The Binghamton University Library system has four physical locations. The Glenn G. Bartle Library (main library) houses collections in the computer sciences, mathematics, humanities, social sciences, and Special Collections. The Science Library holds materials in the engineering disciplines and the sciences. The University Downtown Center Library houses materials in community and public affairs. When completed, the new School of Pharmacy and Pharmaceutical Sciences facility will house a reserve collection of critical print resources, as well as direct, high speed network connections to all library resources. The off-campus Library Annex houses more than 500,000 volumes in a high-density, climate controlled environment.

The table below summarizes the current library resources.

Current Library Collection Statistics (7/1/2014)	
Volumes (print, government, & electronic books)	3,518,720
Electronic Databases	264
Journal Holdings	93,414
Microforms	1,877,568
Multimedia (CD's, DVD's, Videos & Sound Recordings) 12	126,483
Archives & Manuscripts	2000 (linear feet)

All library locations offer group study rooms and quiet study spaces. Group study rooms can be reserved online. Bartle Library is open 24/5 during the regular semester and 24/7 for the last two weeks of the semester. Science and UDC libraries are open weekdays and offer Monday through Thursday evening hours and on Sundays. The new School of Pharmacy and Pharmaceutical Sciences facility will offer several group study rooms as well as a dedicated quiet study space, with evening and weekend access to all students and faculty.

With 303 computer workstations, our Information Commons (IC) are busy, vital, collaborative learning spaces within the Bartle, Science, and UDC libraries. Pharmacy students can access a powerful selection of print and online library resources, a vast array of application software and tools (including engineering-specific tools), and expert assistance to help with their use. The ICs offer scanning, color printing, advanced resource discovery tools, presentation practice space, and multi-media production capability. The ICs are a collaborative project with the University's Information Technology Services.

Pharmaceutical Collection and Resources

The Binghamton University Libraries holdings include more than 93,000 journal subscriptions, 234 subscription databases, and 2.4 million print and electronic books. Our professional journal holdings include more than 680 titles in the field of pharmaceutical sciences. Our current database subscriptions, with an annual cost of more than \$730,000,

which support PhD pharmaceutical sciences program include:

- BIOSIS
- BioMed Central
- CINAHL
- Medline
- PubMed
- Scopus
- ScienceDirect
- SciFinder
- SpringerLink
- UpToDate
- USP-NF
- Web of Science

Pharmaceutical sciences students and faculty access our Libraries’ catalog, online databases and journals, and resources via the Libraries’ website (<http://www.binghamton.edu/libraries>). The Libraries provide access to Find It!, a next-generation, single-search tool providing a dynamic “one-stop” discovery and delivery service for our patrons. Find It! searches scholarly resources from the Libraries' catalog, its digitized collections, and a “mega- aggregated” index of millions of scholarly resources, which allows the search to expand beyond the Libraries’ collection.

Additional new resources, acquired or currently under review for acquisition specifically for the School of Pharmacy and Pharmaceutical Sciences, include the following:

- Access Medicine
- Access Pharmacy
- Allies and Complementary Medicine
- Clinical Key
- Cochrane Database
- ERIC
- International Pharmaceutical Abstracts
- Lexi-Comp
- McGraw-Hill Pharmacy Library
- Medicines Complete
- Micromedex
- Ovid Book and Journal Packages
- Primal Anatomy
- Rosetta Stone Library Solution (EBSCO Solution)
- Scientific American Medicine

To ensure students of the School of Pharmacy and Pharmaceutical Sciences have comprehensive library resources, the following investment is planned. It is important to note that this resource has been already allotted to the school as whole and will be leveraged herein to support the new MS and PhD program as well. No additional cost or expenditure will be required to run the proposed graduate program. For this reason, the library cost below is not listed under the SUNY Program Expenses table above. It is listed here just to show the overall expenses on the library resource by the School.

Library and Educational Resources Budget	FY	FY	FY	FY
	2017 - 18	2018 - 19	2019 - 20	2020 - 21
Books & Periodicals (new acquisitions)	\$ 20,000	\$ 21,000	\$ 22,050	\$ 23,153
Information Databases (new acquisitions)	\$ 90,000	\$ 96,300	\$103,041	\$110,254

Research Databases	\$ 35,000	\$ 36,750	\$ 38,588	\$ 40,517
Total Investment:	\$145,000	\$ 154,050	\$163,679	\$173,923

Interlibrary Loan Service

Interlibrary loan services are available for university faculty, staff, and students and in support of teaching and research activities. The service expands the range of research materials available for instruction and scholarship by obtaining materials not owned by the Libraries from other local, state, national and international libraries. The Libraries are members of numerous library cooperative programs and resource sharing partnerships such as the Center for Research Libraries (CRL) and Online Computer Library Center (OCLC) that extends our patrons' access to research collections and resources regionally, nationally, and internationally.

Library Instruction & Research Assistance

The Libraries provide curriculum-integrated instruction, individual consultation, and general research assistance. Online research guides (created by subject librarians) provide a list of discipline-specific resources (including journals, e-books, databases, etc.) and library services. In addition, the Libraries provide in-person research assistance for faculty and students at the Bartle Library Research Help Desk. Instruction on accessing major medical information databases like PubMed, STAT!Ref (electronic medical texts and an evidence-based medical database) and EBSCO Research Database is offered by Reference and e-Resources librarians. Professional library staff is available for assistance and consultation. The Libraries also provide virtual reference service via chat, email, text, Skype and phone.

Reciprocal Borrowing Privileges

The Libraries provide generous borrowing privileges for patrons. Through SUNY Open Access, faculty and students can also take advantage of reciprocal borrowing services at other SUNY institutions, including Downstate Medical, Upstate Medical Center, and Stony Brook Health Science Center Library. Through our OCLC SHARES program membership, faculty and students have onsite access to partnering institutions, including Columbia University, Cornell University, New York University and Syracuse University.

Scholarly Communication Services

Access to the major medical information databases, such as the Cochrane Library, PubMed, and EBSCO Research Databases, are provided. Most research journals for the pharmaceutical, health outcomes and clinical scientists are already present in the BU libraries. Usage statistics guide subscriptions, both in the number of users and the frequency of contact. The Libraries' Scholarly Communications Services facilitates discussion of emerging publication and scholarship models to support faculty, staff and student publishing and archiving of scholarly works. Services include assistance with NIH access policy support, copyright compliance, author rights and data management plans.

Subject Librarians

Subject librarians are available to provide specialized research consultation for faculty and students. They also serve as liaison between the Libraries and academic departments and programs; select materials for the collections; and provide subject-specific instruction in the use of information resources. The new School of Pharmacy and Pharmaceutical Sciences will work closely with existing library staff^b and will carefully assess the need for any additional dedicated staff during the initial years. Library services include reference assistance to identify and locate scientific and health-related literature, online database searching, interlibrary loan requests, and instruction on the use of library resources. The libraries on the BU campus also have 24-hour study space.

- b) Describe the institution's response to identified collection needs and its plan for library development. NA

Section 7. External Evaluation

SUNY and SED require external evaluation of all proposed graduate degree programs. List below all SUNY-approved evaluators who conducted evaluations (adding rows as needed), and **append at the end of this document** each original, signed [External Evaluation Report](#). **NOTE:** *To select external evaluators, a campus sends 3-5 proposed evaluators' names, titles and CVs to the assigned SUNY Program Reviewer, expresses its preferences and requests approval.*

Names and contact info of potential external evaluators will be forwarded to the Dean Aondover Tarhule and he will personally contact them after approval from SUNY.

<u>Evaluator #1</u>	<u>Evaluator #2</u>
Name: Dr. Robert D. Arnold, PhD Title: Interim Department Head & Professor, Dept. of Drug Discovery & Development Institution: Auburn University.	Name: Dr. May Xiong, PhD Title: Associate Professor of Pharmaceutical & Biomedical Sciences. Institution: University of Georgia.

Section 8. Institutional Response to External Evaluator Reports

Append at the end of this document a single *Institutional Response* to all *External Evaluation Reports*.
See appendix E

Section 9. SUNY Undergraduate Transfer

NOTE: *SUNY Undergraduate Transfer policy does not apply to graduate programs.*

Section 10. Application for Distance Education

- Does the program's design enable students to complete 50% or more of the course requirements through distance education? No Yes. If yes, append a completed SUNY Distance Education Format Proposal at the end of this proposal to apply for the program to be registered for the distance education format.
- Does the program's design enable students to complete 100% of the course requirements through distance education? No Yes

Section MPA-1. Need for Master Plan Amendment and/or Degree Authorization

- Based on guidance on Master Plan Amendments, please indicate if this proposal requires a Master Plan Amendment.
 No Yes, a completed Master Plan Amendment Form is appended at the end of this proposal.
- Based on SUNY Guidance on Degree Authorizations (below), please indicate if this proposal requires degree authorization.
 No Yes, once the program is approved by the SUNY Provost, the campus will work with its Campus Reviewer to draft a resolution that the SUNY Chancellor will recommend to the SUNY Board of Trustees.

SUNY Guidance on Degree Authorization. *Degree authorization is required when a proposed program will lead to a [new degree](#) (e.g., B.F.A., M.P.H.) at an existing level of study (i.e., associate, baccalaureate, first-professional, master's, and doctoral) in an existing disciplinary area at an institution. Disciplinary areas are defined by the [New York State Taxonomy of Academic Programs](#). Degree authorization requires approval by the SUNY Provost, the SUNY Board of Trustees and the Board of Regents.*

List of Appended Items

Appended Items: Materials required in selected items in Sections 1 through 10 and MPA-1 of this form should be appended after this page, with continued pagination. In the first column of the chart below, please number the appended items, and append them in number order.

Number	Appended Items	Reference Items
NA	<i>For multi-institution programs</i> , a letter of approval from partner institution(s)	Section 1, Item (e)
NA	<i>For programs leading to professional licensure</i> , a side-by-side chart showing how the program's components meet the requirements of specialized accreditation, Commissioner's Regulations for the Profession , or other applicable external	Section 2.3, Item (e)
NA	<i>For programs leading to licensure in selected professions for which the SED Office of Professions (OP) requires a specialized form</i> , a completed version of that form	Section 2.3, Item (e)
NA	<i>OPTIONAL: For programs leading directly to employment</i> , letters of support from employers, if available	Section 2, Item 2.3 (h)(2)
Appendix A	<i>For all programs</i> , a plan or curriculum map showing the courses in which the program's educational and (if appropriate) career objectives will be taught and assessed	Section 2, Item 7
Appendix B	<i>For all programs</i> , a catalog description for each existing course that is part of the proposed graduate major program	Section 3, Item (b)
Appendix C	<i>For all programs with new courses</i> , syllabi for all new courses in a proposed graduate program	Section 3, Item (c)
NA	<i>For programs requiring external instruction</i> , a completed External Instruction Form and documentation required on that	Section 3, Item (d)
NA	<i>For programs that will depend on new faculty</i> , position descriptions or announcements for faculty to-be-hired	Section 4, Item (b)
Appendix D	<i>For all programs</i> , original, signed External Evaluation Reports from SUNY-approved evaluators	Section 7
Appendix E	<i>For all programs</i> , a single Institutional Response to External Evaluators' Reports	Section 8
	<i>For programs designed to enable students to complete at least 50% of the course requirements at a distance</i> , a Distance Education Format Proposal	Section 10
	<i>For programs requiring an MPA</i> , a Master Plan Amendment form	Section MPA-1

Appendix A

Curriculum map: Program learning objectives and competencies	PHRM 601	PHRM 602	PHRM 610	PHRM 611	PHRM 600	PHRM 613	PHRM 698a lab rotation	PHRM 698b 3rd lab rot	PHRM 680a Elect 1	PHRM 680b Elect 2	PHRM 680c Elect 3	PHRM 699 a-h Research/dissertation	PHRM 518	PHRM 519	PHRM 597MS	PHRM 598MS
1. Become skilled in emerging areas of drug target discovery and drug development especially in studies related to pre-clinical pharmacology, clinical trials, biomarker development, pharmacogenomics, medicinal chemistry and pharmaceuticals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓
2. Acquire foundation skills and competencies to conduct independent studies in the fields of pharmaceutical and biomedical sciences.	✓	✓	✓	✓	✓	✓	✓	✓				✓				✓
3. Master and incorporate cutting edge analytical methods and tools in their research projects (e.g. genomics, proteomics, liquid chromatography, mass spectrometry, bioinformatics, biostatistics and machine learning modeling).							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4. Be able to design and implement experimental methods to answer specific biological and clinical questions related to health and pharmaceutical sciences.		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
5. Conduct scholarly activities and scientifically rigorous research designed to solve biological and clinical questions.					✓	✓						✓	✓	✓	✓	✓
6. Develop competency in scientific rigor and scientific communication, manuscript and grant writing.				✓	✓	✓						✓	✓	✓	✓	✓
7. Become an independent research oriented investigator in the field of pharmaceutical sciences.					✓	✓	✓	✓	✓	✓	✓	✓			✓	✓

Appendix B (catalog description for each existing course)

Course name	Credit/ Contact hours	Course description	Course requirement and learning outcomes
Analytical methods and instrumentation I PHRM 518 Core	3	This course is designed to introduce students to common methodologies in pharmaceutical and biomedical research. Students will gain a theoretical understanding of experimental techniques, protocols, and associated equipment; apply their knowledge to various observation and/or practical laboratory experiments; and analyze and interpret associated experimental data. Methodologies in this course include cell and tissue analysis through sterile culture, FACS, microscopy, protein and nucleic acid quantification (eg. Western blot, ELISA, spectroscopy, electrophoresis).	<ol style="list-style-type: none"> 1. Describe the principles and uses of cell culture including the culture of microorganisms and mammalian cells. Develop, analyze, or demonstrate experimental protocols. 2. Describe the principles and uses of FACS. Develop, analyze, or demonstrate experimental protocols. 3. Describe the principles and uses of microscopy for cells and tissues. Develop, analyze, or demonstrate experimental protocols. 4. Describe the principles and uses of protein extraction, quantification and analysis. Develop, analyze, or demonstrate experimental protocols. 5. Describe the principles and uses of nucleic acid extraction, quantification and analysis. Develop, analyze, or demonstrate experimental protocols. 6. Identify common technical issues associated with methodologies covered in the course. 7. Create figures and written text to present and analyze data obtained using methodologies covered in the course (as would be appropriate for a manuscript).

<p>Analytical methods and instrumentation II PHRM 519</p> <p>Core</p>	<p>3</p>	<p>This course is designed to introduce students to common methodologies in pharmaceutical and biomedical research. Students will gain a theoretical understanding of experimental techniques, protocols, and associated equipment; apply their knowledge to various observation and/or practical laboratory experiments; and analyze and interpret associated experimental data. Methodologies in this course include centrifugation isolation, chromatography (small and large molecule), LCMS, proteomics, and methods for detection of protein binding/folding</p>	<ol style="list-style-type: none"> 1. Describe the principles and uses of centrifugation methods. Develop, analyze, or demonstrate experimental protocols. 2. Describe the principles and uses of chromatography for small and large molecules. Develop, analyze, or demonstrate experimental protocols. 3. Describe the principles and uses of LCMS. Develop, analyze, or demonstrate experimental protocols. 4. Describe the principles and uses of mass spectroscopy (including proteomics and metabolomics). Develop, analyze, or demonstrate experimental protocols. 5. Describe the principles and uses of methods for analysis of protein binding and folding. Develop, analyze, or demonstrate experimental protocols. 6. Identify common technical issues associated with methodologies covered in the course. 7. Develop a strategy for use/apply analytical methodologies covered in the course.
<p>Independent Study PHRM 597MS</p> <p>Required</p>	<p>1</p>	<p>Students will develop an independent study under the guidance of a faculty mentor in a field/topic relevant to the faculty member's expertise. Prior to registration, students must consult with and obtain a faculty mentor. The study will include reading and evaluation of scientific publications, technical materials/specifications, regulatory materials, clinical/administrative materials, online or sample datasets, and/or research protocols. The written study may be done in various formats (e.g. research plan/design, review/critique of</p>	<ol style="list-style-type: none"> 1. Obtain any requisite regulatory training necessary for completion of the study. 2. Identify and explain general approaches to address a research question in the field of study. 3. Perform activities of reading, evaluation, assessment of materials or tasks for the study. 4. Compile a detailed bibliography or list of publications and resources used in the study. 5. Prepare written drafts of the study and respond to critiques and comments.

		emerging drugs or clinical trials, analysis of technical innovations in equipment/methodologies, mining of bioinformatics resources to address a research question, etc.). Students will submit a general topic area for approval in week 2 and a detailed study plan in week 4.	6. Submit the written study and discuss the final outcomes of the study activities.
Pharmaceutical Sciences I PHRM 601 Core	4	This is the first in a series of two courses designed to survey aspects of pharmaceutical sciences, including biochemistry, medicinal chemistry, pharmacodynamics and pharmacokinetics. By the end of the semester, students will be able to understand how medications work, major systems on which they work, how the chemical moiety impacts drug action/toxicity, and kinetic considerations. Examples and active case-based learning are used to assist students' building skills to solve problems associated with the application and science surrounding the pharmaceutical sciences	<ol style="list-style-type: none"> 1. Describe the structure, function and metabolic pathways for carbohydrates, proteins, amino acids, lipids and nucleic acids 2. Describe the biochemistry of membranes including the structure of biological membranes and drug transporters. 3. Describe DNA recombination and discuss the impact on production of proteins as drugs 4. Recognize major chemical groups and their basic properties, such as charge, solubility, and bond potential 5. Explain the importance of chemical structure and the effects of a drug's functional groups; recognize pharmacophores and drug interactions within an active site. 6. Explain drug-receptor interactions, mechanisms of action and signal transduction and second messengers. 7. Explain the basic principles of pharmacokinetics and the effect of chemical structure on pharmacokinetics 8. Identify the relationship between bioavailability, drug metabolism, and blood drug levels. 9. Explain the relationship between safety, effectiveness and toxicity of a drug.
Pharmaceutical Sciences I	4	This course is designed to give students an in-depth understanding of the drug	1. Summarize the process of drug discovery – from conception to drug approval.

<p>PHRM 601</p> <p>Core</p>		<p>development process and to provide students with a foundational knowledge of major classes of therapeutic agents on the market today. By the end of the semester, students will have an in-depth understanding of: 1) Lead identification and lead optimization; 2) Drug metabolism and drug-drug interactions; 3) The regulatory and financial considerations of drug-development; 4) The major classes of therapeutics on the market today; and 5) Up-and-coming pharmaceutical technology that may impact the healthcare field over the next 5-15 years.</p>	<ol style="list-style-type: none"> 2. Explain various biological and chemical assays that are used in the optimization of therapeutic molecules. 3. Recognize key structural features of molecules that may be rapidly metabolized or result in poor physiochemical properties. 4. Summarize the regulatory and legal process by which drugs are approved for marketing. 5. Recognize key pharmacophores for commonly used drugs and be able to explain the mechanism of action for widely used therapeutic agents. 6. Appreciate the challenges that are associated with drug discovery and be able to articulate how a drug discovery team may overcome those challenges.
<p>Cellular and Molecular Basis of Diseases PHRM 610</p> <p>Core</p>	4	<p>This course will provide and reinforce foundational knowledge in the pathophysiology and molecular basis of human disease using representative disease examples to illustrate key principles. Students will learn to link fundamental genetic, molecular and cellular components of disease to primary and secondary aspects of disease pathogenesis in select organ systems. Students will learn to read, evaluate and discuss selected primary research and review articles addressing the cellular and molecular basis of disease.</p>	<ol style="list-style-type: none"> 1. Describe the principles of basic cellular and molecular processes. 2. Identify and analyze genetic principles and components of disease. 3. Explain general disease processes and representative examples of each. 4. Recognize primary versus secondary aspects of disease pathogenesis. 5. Summarize, evaluate, and synthesize new ideas from published literature. 6. Understand and apply (beginner level) techniques for the study of disease pathogenesis. 7. Develop and defend a project plan (beginner level) for the study of disease pathogenesis.
<p>Biostatistics PHRM 611</p> <p>Core</p>	3	<p>This course introduces students to the concepts and methods of biostatistics. The skills learned in this course build the quantitative foundation that students will</p>	<ol style="list-style-type: none"> 1. Describe and apply statistical distributions to biological data. 2. Calculate and interpret descriptive statistics, including various measures of central

		<p>apply to evaluate the biomedical literature and assess its applicability to their patients. Descriptive statistics, inferential statistics, and hypothesis testing will be presented. Non-parametric methods, simple and multivariable regression methods, and survival analyses used in evaluating outcomes associated with pharmacologic therapies and other medical interventions in populations will be introduced. Emphasis will be placed on developing skills for the correct interpretation and evaluation of results.</p>	<p>tendency and variance.</p> <ol style="list-style-type: none"> 3. Describe confidence intervals and perform common statistical tests (e.g. ANOVA, t-test, chi-square, etc.) and correctly interpret the results. 4. Interpret the graphical representation of numeric data from selected pharmacy / biological manuscripts. 5. Describe and interpret the statistical portions of selected pharmacy / biological manuscripts and be able to correctly interpret statistical findings.
<p>Critical Thinking and Communication in Research and Drug Development. PHRM 613</p> <p>Core</p>	4	<p>This course will focus on the development of written and oral skills for communicating and evaluating scientific research and drug development ideas and findings to different audiences. Students will learn to link fundamental concepts in critical thinking to evaluate their own ideas/findings and those of others. Students will advance their skills in reading; evaluating and discussing selected articles and sources. Students in the 4-credit course will also learn about the grant proposal process and develop a full proposal.</p>	<ol style="list-style-type: none"> 1. Describe and employ key principles of written and oral scientific communication, including targeting of communication to different audiences. 2. Understand and identify steps in the scientific process of research. 3. Analyze publications/proposals/communications for scientific study design, rigor, and impact applying critical thinking skills. 4. Describe the drug development process and how it intersects with scientists vs. the public applying critical thinking skills. 5. Synthesize research ideas. 6. Explain the grant proposal process. 7. Develop and defend a project plan (beginner level) for the study of disease pathogenesis.
<p>Advances in Genomic and Proteomic Methods and Applications PHRM 680a</p>	3	<p>This course will provide students with fundamentals in Genomics and Proteomics and the application of these two technologies in biomedical and pharmaceutical science research. Students</p>	<ol style="list-style-type: none"> 1. Learn principles of genomics, proteomics, mass spectrometry and bioinformatics. 2. Learn different methods in genomics and proteomics. 3. Learn how to interpret genomics and

Elective		will learn about the most recent and cutting edge methods including next generation gene sequencing, gene expression profiling, mass spectrometry based proteomics, quantitative proteomics using stable isotope labeling and label free profiling approaches, characterization of post translational modifications of proteins and their implication in biological systems. Data analysis and statistical methods specific to analyses of very large highly parallel data sets will be taught.	<p>proteomics data using bioinformatic tools.</p> <ol style="list-style-type: none"> 4. Summarize, evaluate, and synthesize new ideas from published literature. 5. Be able to design an experimental plan to solve a specific biological or biomedical question using genomics and proteomics methods.
Targeted Drug Delivery and Gene Therapy. PHRM 680b Elective	3	This course will provide students an overview of nanotechnology that is on the market or in development for targeted drug delivery and gene therapy applications. Students will gain an appreciation for the complexity of these therapeutic agents and the challenges associated with their design and approval. Particular focus will be placed on technologies that have entered clinical development and are poised to have a significant impact on patients.	<ol style="list-style-type: none"> 1. Understand the breadth of technologies available for the targeted delivery of therapeutic agents. 2. Explain the strengths and weaknesses of various drug-delivery technologies. 3. Articulate the unique challenges that come with gene therapy and cellular therapy. 4. Recognize the strengths and weaknesses of various gene therapy and cell-therapy technologies. 5. Appreciate the ethical implications of gene therapy 6. Gain an appreciation of and proficiency in reading the primary scientific literature.
Biosensors and Bioanalytical Systems. PHRM 680c Elective	3	This course will address a range of topics from biosensors used in point-of-care settings to complex laboratory-based bioanalytical systems, with specific examples including home glucometers, fluorescence resonance energy transfer, and surface plasmon resonance. A variety of biological molecules, ranging from antibodies and enzymes to lectins and aptamers, that permit specific recognition	<ol style="list-style-type: none"> 1. Explain assay formats commonly used in biosensors and bioanalytical platforms. 2. Describe the structure and function of proteins, enzymes, nucleic acids, aptamers, and enzymes in biorecognition. 3. Explain the basis of commonly used bioanalytical techniques. 4. Understand the applicability of each technique is towards different analytes.

		<p>of the analyte of interest will be covered as well as various methods that transduce the analyte recognition event to a quantifiable signal. The application of selected biosensors and bioanalytical techniques in pharmaceutical product characterization and medical diagnostics will be explored using specific examples. Students will learn the fundamentals behind biosensors and bioanalytical techniques as well as address ethical and practical implementation considerations associated with analytical method development.</p>	<ol style="list-style-type: none">5. Identify common sample preparation techniques for biological and pharmaceutical samples.6. Recognize common analytical challenges and interferences that may occur in clinical samples.
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Appendix C (syllabi)

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 601	
Course Name: Pharmaceutical Sciences I	
Professional Year: Graduate School Program Year 1	Credit Hours: 4
Semester: Fall	Academic Year: TBD
Date approved by curriculum committee: Pending	

Course Description:

This is the first in a series of two courses designed to survey aspects of pharmaceutical sciences, including biochemistry, medicinal chemistry, pharmacodynamics and pharmacokinetics. By the end of the semester, students will be able to understand how medications work, major systems on which they work, how the chemical moiety impacts drug action/toxicity, and kinetic considerations. Examples and active case-based learning are used to assist students' building skills to solve problems associated with the application and science surrounding the pharmaceutical sciences.

Prerequisite(s)/Co-requisite(s):

Admission to the Pharmaceutical Sciences Graduate program

Coordinators	Additional Faculty	Teaching Assistant
Tracy Brooks, PhD PB-331 tbrooks@binghamton.edu (607)777-5842 Office Hours: Open door policy or by appointment	Yetrib Hathout PB-303c yhathout@binghamton.edu (607)777-5825 Office Hours: by appointment	TBD

The information contained in this syllabus is subject to change with prior notification via myCourses. It is the responsibility of the student pharmacist to refer to myCourses for updates.

Course Meeting Times and Location:

TBD

Course Policies:

1. Attendance and Participation Policy

Class attendance and active participation is an important professional responsibility. As such, attendance may be assessed via the use of i>Clicker® questions and other active learning strategies. *Unexcused* absences will result in a zero for the missed day's assignment(s) and no makeup will be offered for missed exams, quizzes, or other assignments due to *unexcused* absences. *Excused* absences may be granted by the Course Coordinator(s) on an individual basis and only if an appropriate excuse/documentation is provided PRIOR to the scheduled class meeting or as soon as possible following an emergency situation. *Excused* absence accommodations are at the discretion of the Course Coordinator(s). Regardless of the nature of a student's absence, they will be held responsible for class materials covered in his/her absence.

2. Late Policy

- Students are expected to arrive to class on time and prepared for active learning/participation. Tardiness is disruptive to fellow classmates and the instructors.
- Due dates/times for assignments are listed on the PHRM 501 myCourses page. All assignments must be turned in on time. Assignments turned in after the posted due date/time will result in a 10% deduction per day late after the stated deadline for the particular assignment.

3. Use of Mobile Devices

Use of technology unrelated to course content should NOT occur during class (i.e. assignments/studying for other courses, games, internet browsing, social media, texting, etc.). Cell phones should NOT be answered during class, except in case of emergency. It is the student's responsibility to notify the instructor before/at the start of class if a device needs to be monitored for an emergency.

4. Exam Policy

Students are required to move all personal items, course notes and materials to the front, side, or back of the room during all closed-book, in-class assessments. No student pharmacist should have a cell phone (or similar device, including a smart watch) on his/her person during a quiz or exam. If there is an emergency or urgent need to monitor a phone during an assessment, it is the student's responsibility to make arrangements with the instructor(s) before the exam. It is the student's responsibility to have a working computer ready for use for all assessments using ExamSoft. Exam attendance is mandatory, please see Attendance Policy (above).

Please refer to the student handbook for the following policies:

- Honor Code Policies
 - Student Conduct and Misconduct During Examinations
- Dropping a Course
- University Tutoring Services
- ITS Helpdesk
- MyCourses Support
- Library Services
- Counseling Services
- Disability and Equal Access
 - "Disability-related and Equal Access Accommodations – Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (<http://www.binghamton.edu/ssd>) for more detailed information. The office is located in University Union, room 119."

Course Objectives:

After completion of this course, the student should be able to:

1. Describe the structure, function and metabolic pathways for carbohydrates, proteins, amino acids, lipids and nucleic acids
2. Describe the biochemistry of membranes including the structure of biological membranes and drug transporters.
3. Describe DNA recombination and discuss the impact on production of proteins as drugs
4. Recognize major chemical groups and their basic properties, such as charge, solubility, and bond potential
5. Explain the importance of chemical structure and the effects of a drug's functional groups; recognize pharmacophores and drug interactions within an active site.
6. Explain drug-receptor interactions, mechanisms of action and signal transduction and second messengers.
7. Explain the basic principles of pharmacokinetics and the effect of chemical structure on pharmacokinetics
8. Identify the relationship between bioavailability, drug metabolism, and blood drug levels.
9. Explain the relationship between safety, effectiveness and toxicity of a drug.

Required Texts and Other Materials:

1. From Bookstore:
 - a. i>Clicker®
 - b. Lemke TL, Williams DA, Roche VF, Zito SW, eds. *Foye's Principles of Medicinal Chemistry*, 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2012.
2. From AccessPharmacy e-learning suite:
 - a. Katzung BG, ed. *Basic & Clinical Pharmacology*, 14th ed. New York: McGraw Hill; 2018.
 - b. Shargel L, Wu-Pong S, Yu ABC, eds. *Applied Biopharmaceutics & Pharmacokinetics*, 6th ed. New York: McGraw Hill; 2012.
 - c. Rodwell VW, Bender DA, Botham KM, Kennelly PJ, Weil PA, eds., *Harper's Illustrated Biochemistry*, Thirtieth ed. New York: McGraw-Hill Education; 2015
3. Selected articles and other course materials will be posted on myCourses.

Course Assessment Methods:

Assessment	Percentage of Course Grade
Exam I	20%
Exam II	20%
Exam III	20%
Final Exam	25%
Semester paper	10%
Homework and Small Group Work	5%

Requirements to pass the course:

A course percentage of 69.5% is required to pass this course.

Description of Assessment Formats:

▪ **Examinations:**

There are three non-cumulative exams (each worth 20% of the total course grade, for a total of 60%) each covering the material of the particular section of the course, and one cumulative final exam (worth 25% of the total course grade). These will be a combination of multiple choice, fill-in-the-blank, matching, and/or short answer questions. Exams are closed book and taken during class time. Aside from the computer used for ExamSoft, no other electronic devices, course materials, electronic materials, or other personal items may be at a student's desk or accessed while taking the assessment.

▪ **Semester paper:**

Students will be assigned a pathophysiological state. They will have to use the knowledge they have developed in to course of biochemistry, medicinal chemistry, pharmacodynamics and pharmacokinetics to describe the current state of medicine options and any drugs under development; the assignment is worth 10% of the total course grade.

▪ **Homework and Small Group Work:**

Several class sessions will include time for small group activities, which may include individual or group homework assignments to be submitted for grading. In addition, short homework tasks to be completed on paper or online may be assigned by individual instructors. These graded assignments contribute to 5% of the course grade.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
A	4.0	92.5 – 100%
A-	3.7	89.5 – 92.4%
B+	3.3	86.5 – 89.4%
B	3.0	82.5 – 86.4%
B-	2.7	79.5 – 82.4%
C+	2.3	74.5 – 79.4%
C	2.0	69.5 – 74.4%
C-	1.7	66.5 – 69.4%
D	1.0	59.5 - 66.4%
F	0.0	< 59.5%

Disclaimer

The syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class time to active discussion, examples, and group exercises as deemed appropriate. It is the student pharmacist's responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings.

week	Topic	Instructor
1 (4hr)	Biochemistry I: Water, pH, and biological membranes	Hathout
2 (4hr)	Biochemistry II: Lipids and Carbohydrates	Hathout
3 (4hr)	Biochemistry III: Nucleic Acids and central dogma	Brooks
4 (4hr)	Biochemistry IV: Proteins and Amino acids	Hathout
5 (4hr)	Exam 1; Genetics and disease	Brooks
6 (4hr)	Pharmacology I: PD and PK Intro; drug: target interactions	Brooks
7 (4hr)	Pharmacology II: Potency, Efficacy, Affinity, and spare receptors	Brooks
8 (4hr)	Pharmacology III: Rational dosing and drug time course	Brooks
9 (4hr)	Exam II; Physiology primer and Biotransformation	Brooks
10 (4hr)	Hepatic and Renal clearance, Linear and non-linear kinetics	Pelis
11 (4hr)	Medicinal chemistry introduction and enzymes	Tumey
12 (4hr)	Pharmacophores	Tumey
13 (4hr)	Exam III; Routes of administration	Brooks
14 (4hr)	Disease Example I: TBD (DM or CHF)	Brooks
15 (4 hr)	Disease Example II: TBD (ID, Anti-viral, or chemo)	Brooks
Final	Exam 4	

Important Dates to Remember: For important university-wide dates to remember please refer to <https://www.binghamton.edu/about/university-calendar.html> for the Academic Calendar.

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 602	
Course Name:	Pharmaceutical Science II
Program:	Graduate Program in Pharmaceutical Sciences
	Credit Hours: 4
Semester:	Spring
	Academic Year (first offered): TBD
Date approved by curriculum committee: Pending	

Course Description:

This course is designed to give students an in-depth understanding of the drug development process and to provide students with a foundational knowledge of major classes of therapeutic agents on the market today. By the end of the semester, students will have an in-depth understanding of: 1) Lead identification and lead optimization; 2) Drug metabolism and drug-drug interactions; 3) The regulatory and financial considerations of drug-development; 4) The major classes of therapeutics on the market today; and 5) Up-and-coming pharmaceutical technology that may impact the healthcare field over the next 5-15 years.

PHRM 602 Prerequisites/Corequisite: PHRM 601

Coordinator	Additional Faculty	Additional Faculty
<i>L. Nathan Tumey, PhD</i>	<i>XXXX, Ph.D.</i>	<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>By appointment in PB421</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in</i> <i>Location yy</i> <i>Xxx by appointment in</i> <i>Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in</i> <i>Location yy</i> <i>Xxx by appointment in</i> <i>Location yy</i>
Email: <i>ntumey@binghamton.edu</i>	Email: <i>xxxx@binghamton.edu</i>	Email: <i>xxxx@binghamton.edu</i>
Telephone: 607-777-5844	Telephone: 607-777-xxxx	Telephone: 607-777-xxxx

Additional Faculty
<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>Xxx by appointment in</i> <i>Location yy</i>
Email: <i>xxxx@binghamton.edu</i>
Telephone: 607-777-xxxx

The information contained in this syllabus is subject to change with prior notification via MyCourses. It is the responsibility of the student to refer to MyCourses for updates.

Course Meeting Times and Location: To be determined.

Course Policies:

1. Attendance and Participation Policy: Students are expected to attend and participate in all classes. A student may forfeit his/her grade for any points assigned to a specific class session if the student fails to attend. Attendance to all assessments (group work/projects, exams, final exam) is required. If illness, personal emergency, or other exceptional problem of a serious nature causes a student to be absent from a required assessment, the student must notify the course coordinator immediately. Each request will be evaluated on its individual merit and the student must provide documentation/verification of the event. Make-up assignments may be given for excused absences at the discretion of the course coordinator and the involved instructors, and may be administered in a different format than the original activity. Scheduled or planned excused absences (eg. Professional meetings) must be approved in advance by the course coordinator.

2. Late Policy: Students are expected to arrive to class on-time as late arrivals are disruptive to the class. A student may forfeit any points assigned to the specific class session if the student arrives late. Late assignments will receive a 10% deduction for every day the assignment is late. Assignments more than 3 days late will not be accepted.

3. Use of technology/mobile devices in classroom: All electronic devices are to be in silent mode or turned off during class unless use of the device is part of a course activity. Cell phones, pagers, etc. should NOT be answered during class, except in case of emergency. It is the student's responsibility to notify the instructor before/at the start of class if a device needs to be monitored for an emergency. The use of any electronic device (eg. Computer, tablet, phone) is to be for classwork only. If a device is used in other, disruptive, manners, the instructor may require the student to remove or relinquish the device for the class period. Repeated disruptions may result in a loss of points and/or referring the student to the Pharmaceutical Sciences Graduate committee.

4. Exam policy: Students are required to move all personal items, course notes and materials to the front, side or back of the room during all closed-book, in-class assessments. No student should have a cell phone (or similar device) on his/her person during a quiz or exam. If there is an emergency or urgent need to monitor a phone during an assessment, it is the student's responsibility to make arrangements with the instructor before the exam. If ExamSoft is used for exam delivery, it is the student's responsibility to have a working computer ready for the assessment. Students must complete individual assessments (exams, homework, etc) with integrity. No unauthorized assistance of any kind is permitted. Please see the handbook "*Student Conduct/Misconduct During Examinations*" for further details.

5. Instructor Materials: Students are not allowed to sell materials posted on MyCourses or distribute the materials outside of the School of Pharmacy and Pharmaceutical Sciences.

Please refer to the student handbook for the following policies:

- Honor Code Policies
 - It is the responsibility of all students to understand and abide by the Binghamton University Academic Honesty Code. Information about and links to the policy are available at <https://www.binghamton.edu/academics/provost/honesty.html>. A student in violation of the Academic Honesty Code will be reported to SOPPS Committee for Awards and Progression.
 - Student Conduct and Misconduct During Examinations
- Disability and equal access

"Disability-related Equal Access Accommodations - Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119."

- Dropping a course
- University tutoring services
- ITS Helpdesk
- MyCourses support
- Library services
- Counseling services

Course Objectives:

1. Summarize the process of drug discovery – from conception to drug approval.
2. Explain various biological and chemical assays that are used in the optimization of therapeutic molecules.
3. Recognize key structural features of molecules that may be rapidly metabolized or result in poor physiochemical properties.
4. Summarize the regulatory and legal process by which drugs are approved for marketing.
5. Recognize key pharmacophores for commonly used drugs and be able to explain the mechanism of action for widely used therapeutic agents.
6. Appreciate the challenges that are associated with drug discovery and be able to articulate how a drug discovery team may overcome those challenges.

Required Texts and Other Materials:

1. Selected articles and other course materials will be posted on MyCourses.
2. From Bookstore:
 - a. Blass, BE; Basic Principles of Drug Discovery and Development, Academic Press (Elsevier), 2015.

- b. Harrold, MW and Zavod, RM; Basic Concepts in Medicinal Chemistry, ASHP publishers, 2018.
3. Limited readings from AccessPharmacy e-learning suite

Course Assessment Methods:

Assessment	Percentage of Course Grade
Exam 1	25%
Exam 2	25%
In class assignments / homework / quizzes	25%
New therapeutic agents project/presentation (15% written / 10% oral)	25%

Requirements to pass the course:

A course percentage of 69.5% is required to pass this course.

Description of Assessment Formats:

Quizzes: Regular quizzes will be given throughout the semester to assess learning. (on average one per week). These quizzes may be multiple choice, short and/or long answer and may be open book or closed book. Generally, quizzes will not be announced.

Exams: There are two in-class exams. Exam 1 is a mid-term that will cover the material presented in class up to that date. Exam 2 will focus on material covered in the second half of the semester. While exam 2 is not cumulative, concepts in the class build on one another – so familiarity with the Exam 1 material will be essential. Question format may be multiple choice, short answer, and/or long answer. Both exams are closed book and taken during class time.

Homework: Homework exercises will be assigned at various times during the course. Homework will count towards the “quiz” portion of the overall grade. (25% total) Homework assignments may be posted in MyCourses for students to download (and upload their completed assignment) or handed out in class and collected at a date/time/location specified.

New therapeutic agents project/presentation: Mid-way through the semester, students will be required to select a drug that has recently been approved or is poised for FDA approval. (phase 3) Students will be required to write a 10 page paper that summarizes how the drug was identified, key challenges that the discovery team overcame, and important business/legal/ethical considerations that the drug faces. The paper will be due approximately 3 weeks prior to the end of the semester. The student will be expected to give a 15-20 minute oral presentation of their findings at the end of the semester. Together, the written and oral components of this project constitute 25% of the student’s grade. Note that the specific focus of the research presentation can be tailored to fit the student’s interest and background. Specific guidance on this project will be given

throughout the semester.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
A	4.0	92.50 - 100
A-	3.7	89.50 – 92.49
B+	3.3	86.50 – 89.49
B	3.0	82.50 – 86.49
B-	2.7	79.50 – 82.49
C+	2.3	74.50 – 79.49
C	2.0	69.50 – 74.49
C-	1.7	66.50 – 69.49
D	1.0	59.50 – 66.49
F	0.0	< 59.5

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class time to active discussion, examples, and group exercises as deemed appropriate. It is the student’s responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings.

week	Topic	Readings	Instructor
1 (2hr)	Assays and Lead identification		Tumey
1 (2hr)	Drug metabolism		Tumey
2 (2hr)	Drug-drug interactions		Tumey
2 (2hr)	Drug Formulation (pt 1)		DiPasqua
3 (2hr)	Drug Formulation (pt 2)		DiPasqua
3 (2hr)	Biological drugs		Nagaraju
4 (2hr)	Gene and cellular therapy		Beedle
4 (2hr)	Animal Models of Disease (pt 1)		Beedle
5 (2hr)	Animal Models of Disease (pt 2)		Beedle
5 (2hr)	Intellectual property and Clinical development		Tumey
6 (2hr)	Drug manufacturing		Tumey
6 (2hr)	Economics and ethics of drug discovery		Tumey and Cosler
7 (2hr)	Review and discussion of research project		Faculty
7 (2hr)	Exam 1		NA

8 (2hr)	Case study in drug development		Tumey or faculty
8 (2hr)	Oncology: Pharmacology & medchem		Brooks and Tumey
9 (2hr)	Oncology: Pharmacology & medchem		Brooks and Tumey
9 (2hr)	Infectious Disease Drugs: Pharmacology & medchem		Tumey and Nagaraju
10 (2hr)	Immunological drugs: Pharmacology & medchem		Nagaraju and Tumey
10 (2hr)	Immunological drugs: Pharmacology & medchem		Nagaraju and Tumey
11 (2hr)	Cardiovascular drugs: Pharmacology & medchem		Beedle and Tumey
11 (2hr)	Endocrine and renal drugs: Pharmacology & medchem		Pelis and Tumey
12 (2hr)	CNS drugs: Pharmacology & medchem		Brooks and Tumey
12 (2hr)	Movement disorders: Pharmacology & medchem		Beedle and Tumey
13 (2hr)	Special topics or guest lecture (case study in drug development)		TBD
13 (2hr)	Class presentations		Students
14 (2hr)	Class presentations		Students
14 (2hr)	Review		Faculty
Final	Exam 2		NA

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 610

Course Name: Cellular and Molecular Basis of Disease

Professional Year: Graduate Program in Pharmaceutical Sciences

Credit Hours: 4

Semester: Fall

Academic Year (first offered): 2020/2021

Date approved by the curriculum committee: Pending

Course Description:

This course will provide and reinforce foundational knowledge in the pathophysiology and molecular basis of human disease using representative disease examples to illustrate key principles. Students will learn to link fundamental genetic, molecular and cellular components of disease to primary and secondary aspects of disease pathogenesis in select organ systems. Students will learn to read, evaluate and discuss selected primary research and review articles addressing the cellular and molecular basis of disease.

PHRM 610 PhD Corequisite: PHRM 601 Pharmaceutical Sciences I

Coordinator	Additional Faculty	Additional Faculty
<i>Aaron Beedle, PhD</i>	<i>XXXX, Ph.D.</i>	<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>
Email: <i>abeedle@binghamton.edu</i>	Email: <i>xxxx@binghamton.edu</i>	Email: <i>xxxx@binghamton.edu</i>
Telephone: <i>607-777-5840</i>	Telephone: <i>607-777-xxxx</i>	Telephone: <i>607-777-xxxx</i>

Additional Faculty	Additional Faculty	Additional Faculty
<i>XXXX, Ph.D.</i>	<i>XXXX, Ph.D.</i>	<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>
Email: <i>xxxx@binghamton.edu</i>	Email: <i>xxxx@binghamton.edu</i>	Email: <i>xxxx@binghamton.edu</i>
Telephone: <i>607-777-xxxx</i>	Telephone: <i>607-777-xxxx</i>	Telephone: <i>607-777-xxxx</i>

The information contained in this syllabus is subject to change with prior notification via MyCourses. It is the responsibility of the student to refer to MyCourses for updates.

Course Meeting Times and Location:

Course Policies:

1. Attendance and Participation Policy: Students are expected to attend and participate in all classes. A student may forfeit his/her grade for any points assigned to a specific class session if the student fails to attend. Attendance to all assessments (group work/projects, exams, final exam) is required. If illness, personal emergency, or other exceptional problem of a serious nature causes a student to be absent from a required assessment, the student must notify the course coordinator immediately. Each request will be evaluated on its individual merit and the student must provide documentation/verification of the event. Non-excused absences will result in a grade of 0 for the assessment with no possibility for makeup. Make-up assignments may be given for excused absences at the discretion of the course coordinator and the involved instructors, and may be administered in a different format (eg. oral, essay) than the original activity. Scheduled or planned excused absences (eg. Professional meetings) must be approved in advance by the course coordinator. For PharmD students, forms are available at the Office of Student Affairs for this purpose.

2. Late Policy: Students are expected to arrive to class on-time as late arrivals are disruptive to the class. A student may forfeit any points assigned to the specific class session if the student arrives late. Late assignments will receive a 10% deduction for every day the assignment is late. Assignments more than 3 days late will not be accepted.

3. Use of technology/mobile devices in classroom: All electronic devices are to be in silent mode or turned off during class unless use of the device is part of a course activity. Cell phones, pagers, etc. should NOT be answered during class, except in case of emergency. It is the student's responsibility to notify the instructor before/at the start of class if a device needs to be monitored for an emergency. The use of any electronic device (eg. Computer, tablet, phone) is to be for classwork only. If a device is used in other, disruptive, manners, the instructor may require the student to remove or relinquish the device for the class period. Repeated disruptions may result in a loss of points and/or referring the student to the Academic and Professionalism committee.

4. Exam policy: Students are required to move all personal items, course notes and materials to the front, side or back of the room during all closed-book, in-class assessments. No student should have a cell phone (or similar device) on his/her person during a quiz or exam. If there is an emergency or urgent need to monitor a phone during an assessment, it is the student's responsibility to make arrangements with the instructor before the exam. It is the student's responsibility to have a working computer ready for use for all assessments using ExamSoft. Exam attendance is mandatory, please see Attendance Policy (above). Individual assessments are an essential component for developing and demonstrating the knowledge and skills of the Pharmacy and Scientific professions. Students must complete individual assessments (exams, homework, etc) with integrity. No unauthorized assistance of any kind is permitted. Please see the handbook "*Student Conduct/Misconduct During Examinations*" for further details.

5. Instructor Materials: Students are not allowed to sell materials posted on MyCourses or distribute the materials outside of the School of Pharmacy and Pharmaceutical Sciences.

Please refer to the student handbook for the following policies:

- Honor Code Policies
 - It is the responsibility of all students to understand and abide by the Binghamton University Academic Honesty Code. Information about and links to the policy are available at <https://www.binghamton.edu/academics/provost/honesty.html>. A student in violation of the Academic Honesty Code will be reported to SOPPS Committee for Awards and Progression.
 - Student Conduct and Misconduct During Examinations

- Disability and equal access

"Disability-related Equal Access Accommodations - Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119."

- Dropping a course
- University tutoring services
- ITS Helpdesk
- MyCourses support
- Library services
- Counseling services

Course Objectives:

1. Describe the principles of basic cellular and molecular processes.
2. Identify and analyze genetic principles and components of disease.
3. Explain general disease processes and representative examples of each.
4. Recognize primary versus secondary aspects of disease pathogenesis.
5. Summarize, evaluate, and synthesize new ideas from published literature.
6. Understand and apply (beginner level) techniques for the study of disease pathogenesis.
7. Develop and defend a project plan (beginner level) for the study of disease pathogenesis.

Required Texts and Other Materials:

1. Selected articles and other course materials will be posted on MyCourses.
2. From Bookstore:
 - a. i>clicker
3. Limited readings from AccessPharmacy e-learning suite
 - a. Hammer GD, McPhee SJ, eds. Pathophysiology of Disease: An Introduction to Clinical Medicine. 7th ed. New York: McGraw-Hill; 2014.
 - b. Barrett KE, Barman SM, Boitano S, Brooks HL. Ganong’s Review of Medical Physiology, 25th ed. McGraw-Hill; 2016.
 - c. Jameson JL, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscaizo J. Harrison’s Principles of Internal Medicine, 20th ed. McGraw-Hill; 2018.

Course Assessment Methods:

Assessment	Percentage of Course Grade (PhD)
Exam 1	19%
Exam 2 (in-class final)	19%
Participation/Paper Discussions & Reflections (5)	12%
Genetics of Disease Project/Presentation	11%

Homework (2)	9%
Online quiz	5%
Student Project/Presentation	25%

Requirements to pass the course:

A course percentage of 69.5% is required to pass this course.

Description of Assessment Formats:

Quiz: There is one online timed quiz testing on material from the classes preceding the quiz. Questions may be multiple choice, short and/or long answer. The quiz is an independent exercise.

Exams: There are two in-class exams. Exam 1 is a mid-term that will cover the material presented in class up to that date, including content covered on previous course assessments (eg. homework, quiz). Exam 2 is a cumulative final exam. It covers new material (with extra emphasis) as well as a review of the material throughout the course. Question format may be multiple choice, short answer, and/or long answer. Both exams are closed book and taken during class time.

Homework: Homework exercises will be assigned two times during the course. Homework assignments may be posted in MyCourses for students to download (and upload their completed assignment) or handed out in class and collected at a date/time/location specified.

Genetics of Disease Project/Presentation: Students will be required to submit an individual or group project and present the project to the class.

Participation/Paper Discussions & Reflections: Class participation/discussion and written reflections will be used to evaluate and analyze select papers, and to extend/create new ideas.

Student project/presentation: For the 4th credit of the course, graduate students will prepare a project (mini-proposal) to address a research question in the Mechanistic Basis of Disease, including developing a hypothesis, formulating a research strategy, applying appropriate techniques, and presenting/defending their proposal in class. The assessment will be broken up into 4 parts: submission of preproposal idea; proposal outline/ group discussion; written project; and oral presentation.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
A	4.0	92.5 - 100
A-	3.7	89.5 – 92.4
B+	3.3	86.5 – 89.4
B	3.0	82.5 – 86.4
B-	2.7	79.5 – 82.4
C+	2.3	74.5 – 79.4
C	2.0	69.5 – 74.4
C-	1.7	66.5 – 69.4
D	1.0	59.5 – 66.4
F	0.0	< 59.5

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class time to active discussion, examples, and group exercises as deemed appropriate. It is the student's responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings.

Week	Topic	Readings	Instructor
1	Cell & Molec Physiology I: DNA/RNA/protein, gene/transcription/translation		Hathout
1	Cell & Molec Physiology II: The eukaryotic cell, organelles & cellular microenvironment		Hathout
2	Cell & Molec Physiology III: Cell signaling, cell cycle, mitosis, meiosis		Hathout
2	Cell differentiation, cell death. <i>Paper discussion 1</i>		Nagaraju
3	The big picture: Genetic and environmental contributions to disease/ <i>Paper discussion 2</i> . -interaction between genetics, ethnicity, culture, socioeconomic status in disease presentation, therapy	<i>+Online Quiz</i>	Beedle
3	Genetics of disease I: i) Genes, chromosomes, alleles; ii) Mutations (SNV, indels, splice site, repeats, structural variants); iii) Principles - de novo vs inherited/germline vs somatic, monogenic vs polygenic, allelic frequency, selection, founder effect, mode of inheritance, pedigree, consanguinity/relatedness, penetrance, anticipation, epigenetics, X inactivation iv) illustrative case studies		Beedle
4	Genetics of disease II: Case studies cont; non-coding RNAs in disease <i>-Short paper/homework assignment due</i> <i>Introduce miniproject for presentations</i>		Beedle
4	Genetics of disease III: Tools and resources (OMIM, NCBI, methods mutation analyses), <i>Paper discussion 3</i>		Beedle or Tbd
5	Genetics of disease IV: Therapeutic strategies for monogenetic disorders (gene replacement, protein replacement, cell replacement, gene correction, splice alteration, complementary/homologous targets)		Beedle
5	<i>Student presentations (grp or ind)</i>		Beedle
6	<i>Exam 1</i>		Faculty to date
6	Cell stress I		Beedle

7	Cell stress II: <i>Paper discussion 4</i>		Beedle
7	Degeneration I: Overview/Principles, Muscle		Beedle
8	Degeneration II: Parkinson's		Meredith
8	Degeneration III: Age related macular degeneration <i>-Homework/short assignment due</i>		Hathout
9	Signaling/Tissue responses I: fibrosis		Beedle
9	Signaling/Tissue responses II: inflammation		Beedle
10	Signaling/Tissue responses III: <i>Paper discussion 5</i>		Beedle
10	Review		Faculty
11	<i>Exam 2 (Final) – all students (PharmD's last class)</i>		Faculty
11	<i>Introduce & assign grad student projects</i>		Beedle
12	Resources/application: NextGen whole genome, exome, RNAseq, CHIPseq		Hoffman
12	Resources/application: Histology/morphology (organelles, cells, tissues) <i>Submit pre-proposal</i>		Beedle
13	<i>Project preparation/discussion</i>		Beedle
13	Resources/application: Biochem		Beedle
14	<i>Grad student project presentations I</i>		Beedle
14	<i>Grad student project presentations II</i>		Beedle

Note: The schedule is subject to revision.

Important Dates to Remember:

For important university wide dates to remember please refer to

<https://www.binghamton.edu/about/university-calendar.html> for the Academic Calendar.

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 611

Course Name: Biostatistics

Professional Year: Graduate Program in Pharmaceutical Sciences

Credit Hours: 3

Semester: Spring

Academic Year: TBD

Date approved by the curriculum committee: Pending

Course Description: This course introduces students to the concepts and methods of biostatistics. The skills learned in this course build the quantitative foundation that students will apply to evaluate the biomedical literature and assess its applicability to their patients. Descriptive statistics, inferential statistics, and hypothesis testing will be presented. Non-parametric methods, simple and multivariable regression methods, and survival analyses used in evaluating outcomes associated with pharmacologic therapies and other medical interventions in populations will be introduced. Emphasis will be placed on developing skills for the correct interpretation and evaluation of results.

Prerequisite(s)/Co-requisite(s):

Pre-pharmacy curriculum and admission to the pharmacy program.

Coordinator(s)	Teaching Assistant(s)
Utkarsh J. Dang, Ph.D.	TBD
Office Hours at PB-315 By appointment	Office Hours at TBD TBD
Email: udang@binghamton.edu	Email:
Telephone: 607-777-5822	Telephone:

The information contained in this syllabus is subject to change with prior notification via blackboard. It is the responsibility of the student to refer to blackboard for updates.

Course Meeting Times and Location:

Mon/Wed: TBD

Course Policies:

- Attendance and Participation Policy:** Attendance is expected. Arrangements for make-up of an excused absence should be made in advance with the course faculty member with the exception of a documentable emergency. Each separate or discrete absence requires a separate signed note (in other words, only one absence period can be covered with each signed note).

2. **Late Policy:** Students are expected to arrive on time. Extra time will not be given to a student who arrives late for a quiz or activity.
3. **Use of mobile devices (if applicable):** Students should refrain from using mobile devices in ways that are distracting to others. Course faculty will reserve the right to ask students to refrain from using their mobile devices during class as needed.
4. **Recording or videotaping materials:** In support of each individual's reasonable expectation of privacy, copyright and intellectual property laws, the use of these cellular phone features by students must be used in conjunction with express consent. Students are expressly forbidden to video, use camera or voice recordings without the ***express consent of the subject(s) being photographed or recorded***. Any student whose use of their electronic device violates another's reasonable expectation of privacy or produces any media as a result of recordings without express consent may be found in violation of this policy. Violations of this policy may lead to disciplinary action.
5. **Getting help:** If you are unsure, PLEASE get help. The TA will hold regular office hours. My office hours are ideal to get help from me. If you are unable to make it to office hours for a valid reason, please email me and we can set up an appointment.
6. **Communication Policy:** If you email me, please put PHRM 511 in the subject. I will not respond to email over the weekends or weekday nights.

Other Relevant Policies:

Please refer to the student handbook for the following policies:

- Academic Integrity
- Disability and equal access
- Dropping a course
- University tutoring services
- ITS Helpdesk
- MyCourses support
- Library services
- Counseling services

Course Objectives:

After completion of this course, the student should be able to:

1. Describe and apply statistical distributions to biological data.
2. Calculate and interpret descriptive statistics, including various measures of central tendency and variance.
3. Describe confidence intervals and perform common statistical tests (e.g. ANOVA, t-test, chi-square, etc.) and correctly interpret the results.
4. Interpret the graphical representation of numeric data from selected pharmacy / biological manuscripts.
5. Describe and interpret the statistical portions of selected pharmacy / biological manuscripts and be able to correctly interpret statistical findings.

Required Texts and Other Materials:

1. Sullivan, Lisa M. Essentials of Biostatistics in Public Health. Jones & Bartlett Learning, 2017. Access to this text will be made available through the “Library Course Reserves” within myCourses, however, this is a one-user (at any given time) access copy only. Students can print/download PDFs of chapters, etc. of the text. A physical copy of this text will be helpful --- being unable to access this online copy because another user was using it at any given time will not be accepted as an excuse for not fulfilling any course responsibilities.
2. Selected articles and other course materials will be posted on Blackboard.
3. Audience Response System/Clickers (iClicker).
4. Calculator (no graphing calculators).

Recommended Text:

Motulsky, Harvey. Intuitive Biostatistics: a Nonmathematical Guide to Statistical Thinking, Fourth Edition. Oxford University Press, USA, 2017.

Lecture notes/readings will be assigned prior to each lecture. It is essential that you read what is assigned before you come to class.

Course Assessment Methods:

Assessment	Percentage of Course Grade
Exams 1 and 2	40% (20% each)
Final Exam	30%
Embedded Assessment	5%
Homework	10%
Quizzes	12%
Attendance and participation	3%

Requirements to pass the course: A course percentage of 69.5% is required to pass this course.

Description of Assessment Formats:

Every in-class assessment including the two in-class exams, final, and quizzes are individual assessments.

Quizzes: The four quizzes (best three out of four count for 12%) will be written in-class during lecture. They will cover exhaustively the material since the last quiz (or the beginning of the course if quiz 1) with the understanding that some material from previous parts of the course is naturally cumulative.

Quiz 1 will cover material from class meetings 1 through 3 roughly. Quiz 2 will cover material from class meetings 4 through 6 roughly. Quiz 3 will cover material from class meetings 13 and 14 roughly. Quiz 4 will cover material from class meetings 22 through 24 roughly. These are subject to revision. The quizzes are closed book and held during class time.

All quizzes will be a combination of multiple choice, fill-in-the-blank, and short answer.

Exams: The two exams (20% each) will be written in-class during lecture time. They will cover exhaustively the material since the last exam (or the beginning of the course if exam 1) with the understanding that some material is naturally cumulative. The exams are closed book but students are allowed to bring in a 3” by 5” index card with formulas, etc. written on both sides.

The final exam is comprehensive. The exam is closed book but students are allowed to bring in two 3" by 5" index cards with formulas, etc. written on both sides.

All exams will be a combination of multiple choice, fill-in-the-blank, and short answer.

Homework: Two sets of homework (5% each) are due, one in class meeting 9, and the other in class meeting 19. Students are expected to hand in completed homework, however, only a portion of each homework will be graded.

Attendance/Participation: Physical attendance will be used to determine scores for this course component. Active learning assignments will be worked on in class in student groups. Students will be expected to actively participate in and contribute to the full class discussion.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
A	4.0	92.5 – 100
A-	3.7	89.5 – 92.4
B+	3.3	86.5 – 89.4
B	3.0	82.5 – 86.4
B-	2.7	79.5 – 82.4
C+	2.3	74.5 – 79.4
C	2.0	69.5 – 74.4
C-	1.7	66.5 – 69.4
D	1.0	59.5 – 66.4
F	0.0	< 59.5

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Important Dates To Remember: For important university wide dates to remember please refer to <https://www.binghamton.edu/about/university-calendar.html> for the Academic Calendar.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class time to active discussion, examples, and group exercises as deemed appropriate. It is the student’s responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings. Note: This schedule is subject to revision.

Date	Class Mtg.	Topic	Pre-Class Readings (Sullivan)

Jan 23, 2018	1.	Course overview, introduction to biostatistics, and study designs	Ch. 1, 2
Jan 28, 2018	2.	Study Designs and phases of clinical trials	Ch. 2
Jan 30, 2018	3.	Descriptive and visual summaries of data	Ch. 4
Feb 4, 2018	4.	Probability: sampling, conditional probability, sensitivity, and specificity. Quiz 1	Ch. 5
Feb 6, 2018	5.	Probability: binomial distribution, normal distribution, and statistical inference	Ch. 5
Feb 11, 2018	6.	Probability: distribution of sample vs. sampling distribution of a statistic and statistical inference	Ch. 5
Feb 13, 2018	7.	Confidence Intervals 1: Estimates and standard errors and Quiz 2	Ch. 6
Feb 18, 2018	8.	Confidence Intervals 2: proportions and means	Ch. 6
Feb 20, 2018	9.	Hypothesis tests 1: introduction and Type I and II errors; HW1 due	Ch. 7
Feb 25, 2018	10.	Hypothesis tests 2: one sample	Ch. 7, 10
Feb 27, 2018	11.	Review	
Mar 4, 2018	12.	Exam 1	
Mar 6, 2018	13.	Hypothesis tests 3: two independent samples, matched/paired samples; parametric and non-parametric methods 1	Ch. 7, 10
Mar 11, 2018	14.	Hypothesis tests 4: two independent samples, matched/paired samples; parametric and non-parametric methods 2	Ch. 7, 10
Mar 13, 2018	15.	Power calculations and sample size estimation and Quiz 3	Ch. 8
Mar 18 – Mar 22		NO CLASSES - Spring break	
Mar 25, 2018	16.	Superiority, equivalence, and non-inferiority designs	Lecture notes
Mar 27, 2018	17.	Hypothesis tests 5: 1-way ANOVA and non-parametric methods	Ch. 7, 10
Apr 1, 2018	18.	Hypothesis tests 6: 2-way ANOVA and ANCOVA	Lecture notes
Apr 3, 2018	19.	Hypothesis tests 7: wrap-up – HW2 due	Lecture notes
Apr 8, 2018	20.	Review	Lecture notes
Apr 10, 2018	21.	Exam 2	
Apr 15, 2018	22.	Hypothesis tests 7: Problem of multiple comparisons	
Apr 17, 2018	23.	Correlation and non-parametric measures of association	Ch. 9
Apr 22, 2018	24.	Regression 1 (linear)	Ch. 9
Apr 24, 2018	25.	Regression 2 (multiple) and Quiz 4	Ch. 9
Apr 29, 2018	26.	Logistic regression	Ch. 9
May 1, 2018	27.	Survival Analysis 1 - Embedded Assessment due	Ch. 11
May 6, 2018	28.	Survival Analysis 2	Ch. 11
May 8, 2018	29.	Wrap-up and review	
May 13 to May 17, 2018		Final Exams	

Note: The schedule is subject to revision.

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 613

Course Name: Critical Thinking and Communication in Research and Drug Development

Professional Year: Graduate Program in Pharmaceutical Sciences Credit Hours: 4

Semester: Spring

Academic Year (first offered): TBD

Date approved by the curriculum committee: Pending

Course Description:

This course will focus on the development of written and oral skills for communicating and evaluating scientific research and drug development ideas and findings to different audiences. Students will learn to link fundamental concepts in critical thinking to evaluate their own ideas/findings and those of others. Students will advance their skills in reading; evaluating and discussing selected articles and sources. Students in the 4-credit course will also learn about the grant proposal process and develop a full proposal.

Coordinator	Additional Faculty	Additional Faculty
<i>Kanneboyina Nagaraju, DVM PhD</i>	<i>Eric Hoffman, Ph.D.</i>	<i>Aaron Beedle, Ph.D.</i>
Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>
Email: nagaraju@binghamton.edu	Email: ehoffman@binghamton.edu	Email: xxxx@binghamton.edu
Telephone: 607-777-xxxx	Telephone: 607-777-xxxx	Telephone: 607-777-xxxx

Additional Faculty	Additional Faculty	Additional Faculty
<i>Yetrib Hathout, Ph.D.</i>	<i>XXXX, Ph.D.</i>	<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in Location yy</i> <i>Xxx by appointment in Location yy</i>

Email: xxxx@binghamton.edu	Email: xxxx@binghamton.edu	Email: xxxx@binghamton.edu
Telephone: 607-777-xxxx	Telephone: 607-777-xxxx	Telephone: 607-777-xxxx

The information contained in this syllabus is subject to change with prior notification via MyCourses. It is the responsibility of the student to refer to MyCourses for updates.

Course Meeting Times and Location: To be determined. 1 x 3hr/wk and 1 x 1hr/wk

Course Policies:

1. Attendance and Participation Policy: Students are expected to attend and participate in all classes. A student may forfeit his/her grade for any points assigned to a specific class session if the student fails to attend. Attendance to all assessments (group work/projects, exams, final exam) is required. If illness, personal emergency, or other exceptional problem of a serious nature causes a student to be absent from a required assessment, the student must notify the course coordinator immediately. Each request will be evaluated on its individual merit and the student must provide documentation/verification of the event. Make-up assignments may be given for excused absences at the discretion of the course coordinator and the involved instructors, and may be administered in a different format than the original activity. Scheduled or planned excused absences (eg. Professional meetings) must be approved in advance by the course coordinator.

2. Late Policy: Students are expected to arrive to class on-time as late arrivals are disruptive to the class. A student may forfeit any points assigned to the specific class session if the student arrives late. Late assignments will receive a 10% deduction for every day the assignment is late. Assignments more than 3 days late may not be accepted.

3. Use of technology/mobile devices in classroom: All electronic devices are to be in silent mode or turned off during class unless use of the device is part of a course activity. Cell phones, pagers, etc. should NOT be answered during class, except in case of emergency. It is the student's responsibility to notify the instructor before/at the start of class if a device needs to be monitored for an emergency. The use of any electronic device (eg. Computer, tablet, phone) is to be for classwork only. If a device is used in other, disruptive, manners, the instructor may require the student to remove or relinquish the device for the class period. Repeated disruptions may result in a loss of points and/or referring the student to the Academic and Professionalism committee.

4. Original Writing: Assessments in this course are primarily original writings. All written assignments must be in the student's own words, completed with integrity. When ideas and information are used from outside sources in the preparation of assignments, these sources must be referenced. No unauthorized assistance of any kind is permitted. Please see the Binghamton University Academic Honesty Code and Honor Code Policies (below) for further details.

5. Instructor Materials: Students are not allowed to sell materials posted on MyCourses or distribute the materials outside of the School of Pharmacy and Pharmaceutical Sciences.

Please refer to the student handbook for the following policies:

- Honor Code Policies
 - It is the responsibility of all students to understand and abide by the Binghamton University Academic Honesty Code. Information about and links to the policy are available at <https://www.binghamton.edu/academics/provost/honesty.html>. A student in violation of the Academic Honesty Code will be reported to SOPPS Committee for Awards and Progression.
 - Student Conduct and Misconduct During Examinations
 - Disability and equal access

"Disability-related Equal Access Accommodations - Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119."
- Dropping a course
 - University tutoring services
 - ITS Helpdesk
 - MyCourses support
 - Library services
 - Counseling services

Course Objectives:

1. Describe and employ key principles of written and oral scientific communication, including targeting of communication to different audiences.
2. Understand and identify steps in the scientific process of research.
3. Analyze publications/proposals/communications for scientific study design, rigor, and impact applying critical thinking skills.
4. Describe the drug development process and how it intersects with scientists vs. the public applying critical thinking skills.
5. Synthesize research ideas.
6. Explain the grant proposal process.
7. Develop and defend a project plan (beginner level) for the study of disease pathogenesis.

Required Texts and Other Materials:

1. Selected articles and other course materials will be posted on MyCourses.
2. From Bookstore:
 - a. i>clicker

3. Limited readings

- a) Analytic Thinking, 2nd edition, Richard Paul and Linda Elder, Foundation for Critical Thinking 2017
- b) Journal and Review articles on drug development

Course Assessment Methods:

Assessment	Percentage of Course Grade (PhD)
Participation/Discussion	8%
Homework/writing assignments	10%
In-class assessments	10%
Ethics and Rigor mini-project	14%
Drug Development Project	28%
Grant Writing: Specific Aims	8%
Grant Writing: Research Strategy	12%
Grant Writing: Peripherals	4%
Grant Writing: Round-table/panel discussions	6%

Requirements to pass the course:

A course percentage of 69.5% is required to pass this course.

Description of Assessment Formats:

Participation/paper discussions & In-class assessments: In-class participation/discussion and written and oral communications will be used to evaluate and analyze concepts and papers, and to extend/create new ideas.

Homework/writing assignments: Homework (typically writing exercises) will be assigned during the course. Homework assignments may be posted in MyCourses for students to download (and upload their completed assignment) or handed out in class and collected at a date/time/location specified.

Ethics and Rigor mini-project: Students will be required to submit an individual or group project. Detailed information on the assessment will be provided in week 6.

Drug Development project: Students will be required to submit an individual or group project and present the project to the class. Detailed information on the assessment will be provided in week 9. The assessment grade will include low stakes feedback on partial/draft components (deadlines announced in class), the written portion of the project, the oral portion of the project, and peer evaluations.

Grant writing: For the 4th credit of the course, graduate students will synthesize research ideas in the preparation of a research grant proposal in the format of the NIH F31 grant mechanism. Both formative (draft assignments for comment/discussion) and summative (graded assignments) are used.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
A	4.0	92.50 - 100
A-	3.7	89.50 - 92.49
B+	3.3	86.50 - 89.49
B	3.0	82.50 - 86.49
B-	2.7	79.50 - 82.49
C+	2.3	74.50 - 79.49
C	2.0	69.50 - 74.49
C-	1.7	66.50 - 69.49
D	1.0	59.50 - 66.49
F	0.0	< 59.50

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class time to active discussion, examples, and group exercises as deemed appropriate. It is the student's responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings.

4 credit PhD, 1 x 3hr/wk + 1 hr/wk (grant writing)

week	Topic	Readings	Instructor
1 (3hr)	Critical Thinking and the Scientific Method Defining/communicating a research question <i>Assign homework-writing a research question</i>		Beedle
1 (1hr)	Grants 101. How is research funded? What is a grant? Overview of grants, granting agencies, and grant process (investigator and agency), identify a study section. <i>Assign homework: identify a funding announcement</i>		Hoffman
2 (3hr)	Communicating Science: to scientist (abstract, poster, manuscript process) <i>Assign homework-writing a scientific abstract</i>	<i>Homework due (writing a research question)</i>	Hoffman

2 (1hr)	Principles of grant writing: compelling research question, novelty (NIH reporter, literature search), grounded in feasibility, communicate with clarity (write for the reviewer) <i>Assign homework-read sample proposal</i>		Hoffman
3 (3hr)	Communicating Science: to the public, to patient groups. Communicating Science: Research & drug development in the news <i>Assign homework-writing for the non-scientist</i>	<i>Writing assignment 1 due (scientific abstract)</i>	Hoffman and Katie Ellis
3 (1hr)	The Specific Aims page <i>Assign homework-draft Specific Aims research question/initial paragraph</i>		Hoffman
4 (3hr)	Experimental design: general principles, controls, sample size/power. Principles and Best Practices of data collection and interpretation I Special considerations for clinical vs preclinical vs exploratory/basic (GLP). <i>Assign homework/paper reading</i>	<i>Writing assignment 2 due (public/non-scientist)</i>	Beedle
4 (1hr)	Significance and Innovation <i>Assign homework-complete Specific Aims page, bullet Significance</i>	<i>Specific Aims draft</i>	Hoffman
5 (3hr)	Critical thinking – analysis/evaluation of research publications: Paper discussion Oral communication exercise/small group: communicating as an expert reviewer <i>Assign homework/reading & videos</i>	<i>In-class reflection assignment: effective oral communication</i>	Beedle
5 (1hr)	Specific Aims/Significance/Innovation round table discussion 1 <i>Assign homework: Specific Aims/Significance revision, Innovation</i>	<i>Due before class: Specific Aims page/Significance assignment</i>	Hoffman
6 (3hr)	Principles and Best Practices of data collection and interpretation II: NIH rigor & reproducibility papers/videos. Case studies in Rigor and Reproducibility -paper discussions <i>Introduce mini-project on Ethics and Rigor in Science</i>		Nagaraju
6 (1hr)	Specific Aims/Significance/Innovation round table discussion 2	<i>Due before class: revised Specific Aims page/Significance, Innovation</i>	Nagaraju
7 (3hr)	Preclinical studies. Ethics in Animal research. Ethics in Human research.		Nagaraju
7 (1hr)	The Research Strategy 1. Preliminary data/Rationale <i>Assign homework: draft/skeleton of Background/Preliminary data</i>		Hoffman

8 (3hr)	Clinical trial development. Clinical trial implementation.	<i>*Mini-project Ethics & Rigor due today</i>	Hoffman
8 (1hr)	The Research Strategy 2. Experimental Plan. Timeline. Human Subjects, Vertebrate Animals. <i>Assign homework: draft/skeleton of Experimental Plan</i>		Hoffman Nagaraju
9 (3hr)	Clinical trial considerations (case studies – complications) Regulatory affairs I – intro to compliance <i>Introduce Drug development project</i>		Hoffman
9 (1hr)	Research Strategy round-table: Discussion of ideas <i>Assign homework: revise/complete Experimental Plan</i>		Nagaraju
10 (3hr)	Regulatory affairs Clinical Trial/Regulatory affairs –visitor? <i>Assign reading – successful drugs</i>		Hoffman
10 (1hr)	Grant Peripherals – the Biosketch, letters, mentoring plan. <i>Assign homework – use myNCBI to create an NIH biosketch</i>	<i>Research Plan due</i>	Hathout
11 (3hr)	In-Depth Case studies: Successful drugs – design, implementation, regulatory process, scientific vs public communications. <i>Assign reading – failed drugs</i>	<i>In-class group assignment: draft a press release/statement for “Science”</i>	Nagaraju
11 (1hr)	Grant Peripherals – Facilities and Resources, Equipment, Budget, Budget justification, Authentication. <i>Assign peer grants to read/review</i>	<i>Biosketch due</i>	Nagaraju
12 (3hr)	In-Depth Case study: Failed drug or failed trial – design, implementation, regulatory process, scientific vs public communications	<i>In-class group assignment: draft a press release/statement for public</i>	Nagaraju
12 (1hr)	Mock review panel 1	<i>Peer evaluation</i>	Hoffman Nagaraju Hathout Beedle
13 (3hr)	Drug Development Project update/discussion		Nagaraju
13 (1hr)	Mock review panel 2	<i>Peer evaluation</i>	Hoffman Nagaraju Hathout Beedle
14 (3hr)	<i>Drug Development Project presentations</i>	<i>Final Project due</i>	Nagaraju
14 (1hr)	Grant wrap-up. Responding to critique – Strategies for grant revision and the Resubmission Statement		Hoffman

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 680a	
Course Name: Advances in Genomic and Proteomic Methods and Applications	
Program: Graduate Program in Pharmaceutical Sciences	Credit Hours: 3
Semester: TBD	Academic Year (first offered): tbd
Date approved by curriculum committee: Pending	

Course Description:

This course will provide students with fundamentals in Genomics and Proteomics and the application of these two technologies in biomedical and pharmaceutical science research. Students will learn about the most recent and cutting edge methods including next generation gene sequencing, gene expression profiling, mass spectrometry based proteomics, quantitative proteomics using stable isotope labeling and label free profiling approaches, characterization of post translational modifications of proteins and their implication in biological systems. Data analysis and statistical methods specific to analyses of very large highly parallel data sets will be taught.

PHRM 5XX Prerequisites/Corequisite: POD

Coordinator	Additional Faculty	Additional Faculty
<i>Yatrib Hathout, PhD</i>	<i>Eric P Hoffman, Ph.D.</i>	<i>XXXX, Ph.D.</i>
Office Hours: <i>by appointment in Location 303C</i>	Office Hours: <i>by appointment in Location yy</i>	Office Hours: <i>TBD Xxx by appointment in Location yy Xxx by appointment in Location yy</i>
Email: <i>yhathout@binghamton.edu</i>	Email: <i>ericphoffman@gmail.com</i>	Email: <i>xxxx@binghamton.edu</i>
Telephone: <i>607-777-5825</i>	Telephone: <i>607-777-5814</i>	Telephone: <i>607-777-xxxx</i>

The information contained in this syllabus is subject to change with prior notification via MyCourses. It is the responsibility of the student to refer to MyCourses for updates.

Course Meeting Times and Location: To be determined.

Course Policies:

1. Attendance and Participation Policy: Students are expected to attend and participate

in all classes. A student may forfeit his/her grade for any points assigned to a specific class session if the student fails to attend. Attendance to all assessments (group work/projects, exams, final exam) is required. If illness, personal emergency, or other exceptional problem of a serious nature causes a student to be absent from a required assessment, the student must notify the course coordinator immediately. Each request will be evaluated on its individual merit and the student must provide documentation/verification of the event. Make-up assignments may be given for excused absences at the discretion of the course coordinator and the involved instructors, and may be administered in a different format than the original activity. Scheduled or planned excused absences (eg. Professional meetings) must be approved in advance by the course coordinator.

2. Late Policy: Students are expected to arrive to class on-time as late arrivals are disruptive to the class. A student may forfeit any points assigned to the specific class session if the student arrives late. Late assignments will receive a 10% deduction for every day the assignment is late. Assignments more than 3 days late will not be accepted.

3. Use of technology/mobile devices in classroom: All electronic devices are to be in silent mode or turned off during class unless use of the device is part of a course activity. Cell phones, pagers, etc. should NOT be answered during class, except in case of emergency. It is the student's responsibility to notify the instructor before/at the start of class if a device needs to be monitored for an emergency. The use of any electronic device (eg. Computer, tablet, phone) is to be for classwork only. If a device is used in other, disruptive, manners, the instructor may require the student to remove or relinquish the device for the class period. Repeated disruptions may result in a loss of points and/or referring the student to the Pharmaceutical Sciences Graduate committee.

4. Exam policy: Students are required to move all personal items, course notes and materials to the front, side or back of the room during all closed-book, in-class assessments. No student should have a cell phone (or similar device) on his/her person during a quiz or exam. If there is an emergency or urgent need to monitor a phone during an assessment, it is the student's responsibility to make arrangements with the instructor before the exam. If ExamSoft is used for exam delivery, it is the student's responsibility to have a working computer ready for the assessment. Students must complete individual assessments (exams, homework, etc) with integrity. No unauthorized assistance of any kind is permitted. Please see the handbook "*Student Conduct/Misconduct During Examinations*" for further details.

5. Instructor Materials: Students are not allowed to sell materials posted on MyCourses or distribute the materials outside of the School of Pharmacy and Pharmaceutical Sciences.

Please refer to the student handbook for the following policies:

- Honor Code Policies
 - It is the responsibility of all students to understand and abide by the Binghamton University Academic Honesty Code. Information about and links to the policy are available at <https://www.binghamton.edu/academics/provost/honesty.html>. A student

in violation of the Academic Honesty Code will be reported to SOPPS Committee for Awards and Progression.

○ Student Conduct and Misconduct During Examinations

● Disability and equal access

"Disability-related Equal Access Accommodations - Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119."

- Dropping a course
- University tutoring services
- ITS Helpdesk
- MyCourses support
- Library services
- Counseling services

Course Objectives:

1. Learn principles of genomics, proteomics, mass spectrometry and bioinformatics.
2. Learn different methods in genomics and proteomics.
3. Learn how to interpret genomics and proteomics data using bioinformatic tools.
4. Summarize, evaluate, and synthesize new ideas from published literature.
5. Be able to design an experimental plan to solve a specific biological or biomedical question using genomics and proteomics methods.

Required Texts and Other Materials:

1. Selected articles and other course materials will be posted on MyCourses. Much of the material presented in this course will be prepared from existing literature.
2. From Bookstore:
 - a. i>clicker
 - b. Limited readings from AccessPharmacy e-learning suite
Introduction to Proteomics: Tools for the New Biology by Daniel C. Liebler.

Course Assessment Methods:

Assessment	Percentage of Course Grade
Exam 1	25%
Exam 2 (in-class final)	25%
Participation/Paper Discussions & Reflections (5)	5%
Homework (every week)	15%
Online quiz	5%

Genomic/Proteomic Project/Presentation	15%
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Requirements to pass the course:

A course percentage of 69.5% is required to pass this course.

Description of Assessment Formats:

For example

Quiz: There is one online timed quiz testing on material from the classes preceding the quiz. Questions may be multiple choice, short and/or long answer. The quiz is an independent exercise.

Exams: There are two in-class exams. Exam 1 is a mid-term that will cover the material presented in class up to that date, including content covered on previous course assessments (eg. homework, quiz). Exam 2 is a cumulative final exam. It covers new material (with extra emphasis) as well as a review of the material throughout the course. Question format may be multiple choice, short answer, and/or long answer. Both exams are closed book and taken during class time. Exam 2 (Final) is taken at the end of the 3 credit class (early in week 11) and marks the end of the PharmD course.

Homework: Homework exercises will be assigned every week. Homework assignments may be posted in MyCourses for students to download (and upload their completed assignment) or handed out in class and collected at a date/time/location specified.

Genomic/Proteomic Project/Presentation: Students will be required to submit an individual or group project and present the project to the class.

Participation/Paper Discussions & Reflections: Class participation/discussion and written reflections will be used to evaluate and analyze select papers, and to extend/create new ideas.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
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A-	3.7	89.50 - 92.49
B+	3.3	86.50 - 89.49
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C+	2.3	74.50 - 79.49
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C-	1.7	66.50 - 69.49
D	1.0	59.50 - 66.49
F	0.0	< 59.5

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class time to active discussion, examples, and group exercises as deemed appropriate. It is the student's responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings.

week	Topic	Readings	Instructor
1 (3hr)	Genomes and genome browsers		Hoffman
2 (3hr)	Highly parallel assays (DNA, RNA, miRNA)		Hoffman
3 (3hr)	Statistical approaches to large data sets		Dang; Hoffman
4 (3hr)	Data analysis, visualization, and data integration tools		Dang; Hoffman
5 (3hr)	Genomics of microbes and microbiomes		Hoffman
6 (3hr)	Class review		Hoffman, Dang
7 (3hr)	Exam 1		Hoffman, Dang
8 (3hr)	Introduction to Proteomics and Mass spectrometry		Hathout
9 (3hr)	Quantitative proteomics I (label free and stable isotope labeling approach)		Hathout
10 (3hr)	Quantitative proteomics II (SILAC and SILAM approach)		Hathout
11 (3hr)	Proteomics Project Presentations		Hathout
12 (3hr)	Targeted Proteomics and applications		Hathout
13 (3hr)	Characterization of Posttranslational modification of proteins using mass spectrometry		Hathout
14 (3hr)	Class review		Hathout
Final	<i>Final Exam</i>		Hoffman, Hathout

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 680b	
Course Name: Targeted Drug Delivery and Gene Therapy	
Program: Graduate Program in Pharmaceutical Sciences	Credit Hours: 3
Semester: TBD	Academic Year (first offered): TBD
Date approved by the curriculum committee: Pending	

Course Description:

This course will provide students an overview of nanotechnology that is on the market or in development for targeted drug delivery and gene therapy applications. Students will gain an appreciation for the complexity of these therapeutic agents and the challenges associated with their design and approval. Particular focus will be placed on technologies that have entered clinical development and are poised to have a significant impact on patients.

PHRM 680b Prerequisites/Corequisite: PHRM501&502 or PHRM601&602 or approval by the instructor.

Coordinator	Additional Faculty	Additional Faculty
<i>L. Nathan Tumey, PhD</i>	<i>XXXX, Ph.D.</i>	<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>By appointment in PB421</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in</i> <i>Location yy</i> <i>Xxx by appointment in</i> <i>Location yy</i>	Office Hours: <i>TBD</i> <i>Xxx by appointment in</i> <i>Location yy</i> <i>Xxx by appointment in</i> <i>Location yy</i>
Email: ntumey@binghamton.edu	Email: xxxx@binghamton.edu	Email: xxxx@binghamton.edu
Telephone: 607-777-5844	Telephone: 607-777-xxxx	Telephone: 607-777-xxxx

Additional Faculty
<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>Xxx by appointment in</i> <i>Location yy</i>
Email: xxxx@binghamton.edu
Telephone: 607-777-xxxx

The information contained in this syllabus is subject to change with prior notification via MyCourses. It is the responsibility of the student to refer to MyCourses for updates.

Course Meeting Times and Location: To be determined.

Course Policies:

1. Attendance and Participation Policy: Students are expected to attend and participate in all classes. A student may forfeit his/her grade for any points assigned to a specific class session if the student fails to attend. Attendance to all assessments (group work/projects, exams, final exam) is required. If illness, personal emergency, or other exceptional problem of a serious nature causes a student to be absent from a required assessment, the student must notify the course coordinator immediately. Each request will be evaluated on its individual merit and the student must provide documentation/verification of the event. Make-up assignments may be given for excused absences at the discretion of the course coordinator and the involved instructors, and may be administered in a different format than the original activity. Scheduled or planned excused absences (eg. Professional meetings) must be approved in advance by the course coordinator.

2. Late Policy: Students are expected to arrive to class on-time as late arrivals are disruptive to the class. A student may forfeit any points assigned to the specific class session if the student arrives late. Late assignments will receive a 10% deduction for every day the assignment is late. Assignments more than 3 days late will not be accepted.

3. Use of technology/mobile devices in classroom: All electronic devices are to be in silent mode or turned off during class unless use of the device is part of a course activity. Cell phones, pagers, etc. should NOT be answered during class, except in case of emergency. It is the student's responsibility to notify the instructor before/at the start of class if a device needs to be monitored for an emergency. The use of any electronic device (eg. Computer, tablet, phone) is to be for classwork only. If a device is used in other, disruptive, manners, the instructor may require the student to remove or relinquish the device for the class period. Repeated disruptions may result in a loss of points and/or referring the student to the Pharmaceutical Sciences Graduate committee.

4. Exam policy: Students are required to move all personal items, course notes and materials to the front, side or back of the room during all closed-book, in-class assessments. No student should have a cell phone (or similar device) on his/her person during a quiz or exam. If there is an emergency or urgent need to monitor a phone during an assessment, it is the student's responsibility to make arrangements with the instructor before the exam. If ExamSoft is used for exam delivery, it is the student's responsibility to have a working computer ready for the assessment. Students must complete individual assessments (exams, homework, etc) with integrity. No unauthorized assistance of any kind is permitted. Please see the handbook "*Student Conduct/Misconduct During Examinations*" for further details.

5. Instructor Materials: Students are not allowed to sell materials posted on MyCourses or distribute the materials outside of the School of Pharmacy and Pharmaceutical Sciences.

Please refer to the student handbook for the following policies:

- Honor Code Policies
 - It is the responsibility of all students to understand and abide by the Binghamton University Academic Honesty Code. Information about and links to the policy are available at <https://www.binghamton.edu/academics/provost/honesty.html>. A student in violation of the Academic Honesty Code will be reported to SOPPS Committee for Awards and Progression.
 - Student Conduct and Misconduct During Examinations

- Disability and equal access

"Disability-related Equal Access Accommodations - Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119."

- Dropping a course
- University tutoring services
- ITS Helpdesk
- MyCourses support
- Library services
- Counseling services

Course Objectives:

For example

1. Understand the breadth of technologies available for the targeted delivery of therapeutic agents.
2. Explain the strengths and weaknesses of various drug-delivery technologies.
3. Articulate the unique challenges that come with gene therapy and cellular therapy.
4. Recognize the strengths and weaknesses of various gene therapy and cell-therapy technologies.
5. Appreciate the ethical implications of gene therapy
6. Gain an appreciation of and proficiency in reading the primary scientific literature.

Required Texts and Other Materials:

1. Selected articles and other course materials will be posted on MyCourses.
2. From Bookstore: None
3. Limited readings from AccessPharmacy e-learning suite

Course Assessment Methods:

Assessment	Percentage of Course Grade
Exam 1	25%
Exam 2 (in-class final)	25%
Quizzes	25%
Class projects (two projects, 12.5% each)	25%

Requirements to pass the course:

A course percentage of 69.5% is required to pass this course.

Description of Assessment Formats:

Quizzes: Regular quizzes will be given throughout the semester to assess learning. (on average one per week). These quizzes may be multiple choice, short and/or long answer and may be open book or closed book. Generally, quizzes will not be announced.

Exams: There are two in-class exams. Exam 1 is a mid-term that will cover the material presented in class up to that date. Exam 2 will focus on material covered in the second half of the semester. While exam 2 is not cumulative, concepts in the class build on one another – so familiarity with the Exam 1 material will be essential. Question format may be multiple choice, short answer, and/or long answer. Both exams are closed book and taken during class time.

Homework: Homework exercises will be assigned at various times during the course. Homework will count towards the “quiz” portion of the overall grade. (25% total) Homework assignments may be posted in MyCourses for students to download (and upload their completed assignment) or handed out in class and collected at a date/time/location specified.

Class projects: Students will be required to prepare two short summaries of a new drug-delivery technology and a new gene-therapy technology. The written project will be 5 pages and the oral presentation will be ~10-15 minutes. The presentation can be based upon a scholarly review paper or on papers from the primary literature. The focus should be on technologies that have therapeutic promise, but have not yet been evaluated in the clinic. These projects each constitute 15% of the final grade. (30% total). Note that the specific focus of the research presentation can be tailored to fit the student’s interest and background. Specific guidance on this project will be given throughout the semester.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
A	4.0	92.50 - 100
A-	3.7	89.50 – 92.49
B+	3.3	86.50 – 89.49
B	3.0	82.50 – 86.49

B-	2.7	79.50 – 82.49
C+	2.3	74.50 – 79.49
C	2.0	69.50 – 74.49
C-	1.7	66.50 – 69.49
D	1.0	59.50 – 66.49
F	0.0	< 59.5

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class time to active discussion, examples, and group exercises as deemed appropriate. It is the student's responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings.

week	Topic	Readings	Instructor
1 (3hr)	Concepts and overview of targeted drug delivery		Tumey
2 (3hr)	The vectors of nanomedicine: Antibodies, nanoparticles, and viral particles.		Edwards
3 (3hr)	Passive targeting (EPR effect; ROS triggered)		Tumey
4 (3hr)	Metabolism-based targeting (Localized delivery of soft drugs; pH triggered targeting)		Tumey
5 (3hr)	Active targeting – ligand directed (ADC, SMDC)		Tumey
6 (3hr)	Active targeting – photodynamic & magnetic		DiPasqua
7 (3hr)	Project presentations and case studies		NA
8 (3hr)	Exam 1		Faculty
9 (3hr)	Intro to gene therapy		Brooks
10 (3hr)	<i>Gene repression (RNAi, siRNA, ribozymes, etc)</i>		Brooks
11 (3hr)	Gene delivery – viral vectors and non-viral vectors		Beedle
12 (3hr)	Gene repair – exon skipping, genome editing		Beedle
13 (3hr)	Gene repair		Beedle
14 (3hr)	Project presentations		Faculty
Final	<i>Final Exam</i>		

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 680c

Course Name: Biosensors and Bioanalytical Systems

Program: Graduate Program in Pharmaceutical Sciences

Credit Hours: 3

Semester: Fall

Academic Year: TBD

Date approved by the curriculum committee: Pending

Course Description:

This course will address a range of topics from biosensors used in point-of-care settings to complex laboratory-based bioanalytical systems, with specific examples including home glucometers, fluorescence resonance energy transfer, and surface plasmon resonance. A variety of biological molecules, ranging from antibodies and enzymes to lectins and aptamers, that permit specific recognition of the analyte of interest will be covered as well as various methods that transduce the analyte recognition event to a quantifiable signal. The application of selected biosensors and bioanalytical techniques in pharmaceutical product characterization and medical diagnostics will be explored using specific examples. Students will learn the fundamentals behind biosensors and bioanalytical techniques as well as address ethical and practical implementation considerations associated with analytical method development.

Prerequisite(s)/Co-requisite(s):

PHRM 5XX PhD Co-requisite: PHRM 5XX Pharmaceutical Sciences I, or POD

Coordinator	Additional Faculty	Teaching Assistants
Katie Edwards, PhD	Yetrib Hathout, PhD	TBD
Office Hours (Edwards): TBD by appointment in PB-418	Office Hours: TBD by appointment in PB-303C	Office Hours: TBD
Email: kedwards@binghamton.edu	Email: yhathout@binghamton.edu	Email: TBD
Telephone: 777-5842	Telephone: 777-5825	Telephone:

The information contained in this syllabus is subject to change with prior notification via MyCourses. It is the responsibility of the student to refer to MyCourses for updates.

Course Meeting Times and Location:

T/Th: TBD

Course Policies:

- Attendance and Participation Policy:** Students are expected to attend and participate in all classes (contributing to the course grade and possible extra-credit points). A student may forfeit his/her in class course grade and any extra-credit points assigned to the specific class session if the student fails to attend class. Attendance to all assessments (group work, quizzes, exams, final exam) is required. If illness, personal emergency, or other exceptional problem of a serious nature causes a student to be absent from a required assessment, the student must notify the course coordinator immediately. Each request will be evaluated on its individual merit and the student must provide documentation/verification of the event. Non-excused absences will result in a grade of 0

for the assessment with no possibility for makeup. Make-up assignments may be given for excused absences at the discretion of the course coordinator and the involved instructors, and may be administered in a different format (e.g. oral, essay) than the original activity. Scheduled or planned excused absences (e.g. Professional meetings) must be approved in advance by the course coordinator. Forms are available at the Office of Student Affairs for this purpose.

2. **Late Policy:** Students are expected to arrive to class on-time as late arrivals are disruptive to the class. A student may forfeit his/her attendance course grade and any extra-credit points assigned to the specific class session, if the student arrives late.
3. **Mobile/Electronic Devices Policy:** All electronic devices are to be in silent mode or turned off during class, unless the use of the device is part of a course activity. Cell phones, pagers, etc. should NOT be answered during class, except in case of emergency. It is the student's responsibility to notify the instructor before/at the start of class if a device needs to be monitored for an emergency.
4. **Exam Policy:** Students are required to move all personal items, course notes and materials to the front, side or back of the room during all closed-book, in-class assessments. No student should have a cell phone (or similar device) on his/her person during a quiz or exam. If there is an emergency or urgent need to monitor a phone during an assessment, it is the student's responsibility to make arrangements with the instructor before the exam. It is the student's responsibility to have a working computer ready for use for all assessments using ExamSoft. Exam attendance is mandatory, please see Attendance Policy (above).

Please refer to the student handbook for the following policies and services:

- Honor Code Policies
 - Student Conduct and Misconduct During Examinations
- Dropping a course
- University tutoring services
- ITS Helpdesk
- MyCourses support
- Library services
- Counseling services
- Disability and equal access

"Disability-related Equal Access Accommodations - Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119."

Course Objectives:

After completion of this course, the student should be able to:

1. Explain assay formats commonly used in biosensors and bioanalytical platforms
2. Describe the structure and function of proteins, enzymes, nucleic acids, aptamers, and enzymes in biorecognition
3. Explain the basis of commonly used bioanalytical techniques
4. Understand the applicability of each technique is towards different analytes
5. Identify common sample preparation techniques for biological and pharmaceutical samples
5. Recognize common analytical challenges and interferences that may occur in clinical samples

Required textbooks and other materials:

1. Selected articles and other course materials will be posted on MyCourses
2. Students will need to access articles available through the Binghamton University Library

Course Assessment Methods:

Assessment	Percentage of Course Grade
Exams	60% (20% each)
Group design project	25%
Quizzes	15% (5% each)

Requirements to pass the course: A course percentage of 69.5% is required to pass the course.

Description of Assessment Formats:

Quizzes: There are three quizzes, each testing on material preceding the quiz. Each quiz is worth 5% of the course grade, for a total of 15%.

Exams: There are three exams (each worth 20% of the total course grade, for a total of 60%); these will cover the material of the particular section of the course, including a review of content covered on the previous quiz. Exams are closed book and taken during class time.

Group project: Students will work together in groups to determine the most suitable technique for a clinical analyte of interest or characterization of a pharmaceutical product. The group project will consist of a written report and oral presentation, collectively contributing to 25% of the course grade.

Late Assignments: Submissions for grant funding, graduate programs, and employment applications have defined due dates which need to be adhered to or submissions are not accepted. Regardless of reason, assignments submitted late will receive a 10% deduction in possible points up to 24 hours following the due date, with an additional 10% deduction daily up to 5 days after the due date. Assignments submitted after this period will receive a 50% deduction in possible points.

Attendance/Participation: Your learning will depend on your active participation. You are expected to come to each class, and to inform the instructor and/or course director if you are unable to do so.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
A	4.0	92.5 - 100
A-	3.7	89.5 - 92.4
B+	3.3	86.5 - 89.4
B	3.0	82.5 - 86.4
B-	2.7	79.5 - 82.4
C+	2.3	74.5 - 79.4
C	2.0	69.5 - 74.4
C-	1.7	66.5 - 79.4
D	1.0	59.5 - 66.4
F	0.0	< 59.5

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class time to active discussion, examples, and group exercises as deemed appropriate. It is the student's responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings.

Note: The schedule is subject to revision.

Important Dates to Remember:

For important university wide dates to remember please refer to <https://www.binghamton.edu/about/university-calendar.html> for the Academic Calendar.

Date	(hr)	Topic	Instructor
Week 1	1.5	Introduction to Biosensors and Bioanalytical Techniques	Edwards
Week 1	1.5	Immunoassay formats	<i>Edwards</i>
29-Aug	1.5	Biorecognition elements I: Antibodies	<i>Edwards</i>
3-Sep	1.5	Biorecognition elements II: DNA/RNA/Aptamers	<i>Edwards</i>
5-Sep	1.5	Biorecognition elements III: Enzymes/Other biomolecules	<i>Edwards</i>
10-Sep	1.5	Immobilization Strategies	<i>Edwards</i>
12-Sep	1.5	Quantitative Considerations	<i>Edwards</i>
17-Sep	1.5	Exam 1 (through 9/12)	<i>Edwards</i>
19-Sep	1.5	Optical Detection I: UV/Vis	<i>Edwards</i>
24-Sep	1.5	Optical Detection II: Fluorescence/FRET/Time-Resolved Fluorescence	<i>Edwards</i>
26-Sep	1.5	Optical Detection III: Refractive Index/Light Scattering	<i>Edwards</i>
3-Oct	1.5	Bioanalytical Systems I: HPLC	<i>Edwards</i>
8-Oct	1.5	Bioanalytical techniques II: Surface Plasmon Resonance	<i>Edwards</i>
10-Oct	1.5	Electrochemistry Primer	<i>Edwards</i>
15-Oct		Bioanalytical techniques III: Electrophoresis and Blotting Techniques	<i>Edwards</i>
17-Oct	1.5	Bioanalytical techniques IV: Capillary electrophoresis	Edwards
22-Oct	1.5	Exam 2 (through 10/17)	
24-Oct	1.5	Bioanalytical techniques V: Mass spectrometry fundamentals	Hathout
29-Oct	1.5	Bioanalytical techniques VI: Mass spectrometry-applications	Hathout
31-Oct	1.5	Bioanalytical techniques VII: ICP-MS	<i>DiPasqua</i>
5-Nov	1.5	Clinical Sample Collection and Preparation	<i>Edwards</i>
7-Nov	1.5	Analytical versus Diagnostic Terminology	<i>Edwards</i>
12-Nov	1.5	Point of Care Diagnostics: Lateral Flow Assays	<i>Edwards</i>
14-Nov	1.5	Point of Care Diagnostics: Glucometers	<i>Edwards</i>
19-Nov	1.5	RNA/DNA Amplification Techniques	<i>Edwards</i>
21-Nov	1.5	Assay Interferences	<i>Edwards</i>
26-Nov	1.5	Exam 3 (through 11/21)	<i>Edwards</i>
3-Dec	1.5	<i>Group Project Presentations</i>	
5-Dec	1.5	<i>Group Project Presentations</i>	

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 518	
Course Name:	Analytical methods and instrumentation I
Program:	Graduate Program in Pharmaceutical Sciences Credit Hours: 3
Semester:	Fall Academic Year (first offered): tbd
Date approved by curriculum committee: Pending	

Course Description:

This course is designed to introduce students to common methodologies in pharmaceutical and biomedical research. Students will gain a theoretical understanding of experimental techniques, protocols, and associated equipment; apply their knowledge to various observation and/or practical laboratory experiments; and analyze and interpret associated experimental data. Methodologies in this course include cell and tissue analysis through sterile culture, FACS, microscopy, protein and nucleic acid quantification (eg. Western blot, ELISA, spectroscopy, electrophoresis).

Prerequisite(s)/Corequisite(s): Admission to Pharmaceutical Sciences graduate program or POD

Coordinator	Additional Faculty	Additional Faculty
<i>TBH4, PhD (OR Beedle)</i>	<i>XXXX, Ph.D.</i>	<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>By appointment in PB-xx</i>	Office Hours: <i>TBD</i> <i>By appointment in PB-xx</i>	Office Hours: <i>TBD</i> <i>By appointment in PB-xx</i>
Email: ntumey@binghamton.edu	Email: xxxx@binghamton.edu	Email: xxxx@binghamton.edu
Telephone: 607-777-xxx	Telephone: 607-777-xxxx	Telephone: 607-777-xxxx

Additional Faculty
<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>Xxx by appointment in</i> <i>Location yy</i>
Email: xxxx@binghamton.edu
Telephone: 607-777-xxxx

The information contained in this syllabus is subject to change with prior notification via MyCourses. It is the responsibility of the student to refer to MyCourses for updates.

Course Meeting Times and Location: To be determined.

Course Policies:

1. Attendance and Participation Policy: Students are expected to attend and participate in all classes. A student may forfeit his/her grade for any points assigned to a specific class session if the student fails to attend. Attendance to all assessments (group work/projects, exams, final exam) is required. If illness, personal emergency, or other exceptional problem of a serious nature causes a student to be absent from a required assessment, the student must notify the course coordinator immediately. Each request will be evaluated on its individual merit and the student must provide documentation/verification of the event. Make-up assignments may be given for excused absences at the discretion of the course coordinator and the involved instructors, and may be administered in a different format than the original activity. Scheduled or planned excused absences (eg. Professional meetings) must be approved in advance by the course coordinator.

2. Late Policy: Students are expected to arrive to class on-time as late arrivals are disruptive to the class. A student may forfeit any points assigned to the specific class session if the student arrives late. Late assignments will receive a 10% deduction for every day the assignment is late. Assignments more than 3 days late will not be accepted.

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4. Exam policy: Students are required to move all personal items, course notes and materials to the front, side or back of the room during all closed-book, in-class assessments. No student should have a cell phone (or similar device) on his/her person during a quiz or exam. If there is an emergency or urgent need to monitor a phone during an assessment, it is the student's responsibility to make arrangements with the instructor before the exam. If ExamSoft is used for exam delivery, it is the student's responsibility to have a working computer ready for the assessment. Students must complete individual assessments (exams, homework, etc) with integrity. No unauthorized assistance of any kind is permitted. Please see the handbook "*Student Conduct/Misconduct During Examinations*" for further details.

5. Instructor Materials: Students are not allowed to sell materials posted on MyCourses or distribute the materials outside of the School of Pharmacy and Pharmaceutical Sciences.

Please refer to the student handbook for the following policies:

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 - It is the responsibility of all students to understand and abide by the Binghamton University Academic Honesty Code. Information about and links to the policy are available at <https://www.binghamton.edu/academics/provost/honesty.html>. A student in violation of the Academic Honesty Code will be reported to SOPPS Committee for Awards and Progression.
 - Student Conduct and Misconduct During Examinations

- Disability and equal access

"Disability-related Equal Access Accommodations - Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119."

- Dropping a course
- University tutoring services
- ITS Helpdesk
- MyCourses support
- Library services
- Counseling services

Course Objectives:

1. Describe the principles and uses of cell culture including the culture of microorganisms and mammalian cells. Develop, analyze, or demonstrate experimental protocols.
2. Describe the principles and uses of FACS. Develop, analyze, or demonstrate experimental protocols.
3. Describe the principles and uses of microscopy for cells and tissues. Develop, analyze, or demonstrate experimental protocols.
4. Describe the principles and uses of protein extraction, quantification and analysis. Develop, analyze, or demonstrate experimental protocols.
5. Describe the principles and uses of nucleic acid extraction, quantification and analysis. Develop, analyze, or demonstrate experimental protocols.
6. Identify common technical issues associated with methodologies covered in the course.
7. Create figures and written text to present and analyze data obtained using methodologies covered in the course (as would be appropriate for a manuscript).

Required Texts and Other Materials:

1. Selected articles and other course materials will be posted on MyCourses.
2. Limited readings from AccessPharmacy e-learning suite

Course Assessment Methods:

Assessment	Percentage of Course Grade
Exam 1	25%
Exam 2	25%
In class assignments / homework / quizzes	15%
Experiment/data interpretation project	10%
Final Exam	25%

Requirements to pass the course:

A course percentage of 69.5% is required to pass this course.

Description of Assessment Formats:

Exams: There are two non-cumulative in-class exams, each worth 25% of the course grade, covering material of the particular section of the course. Exams questions may use a combination of multiple choice, short answer, long answer, and/or practical components. Technical materials or data may be provided to students for interpretation or analysis. The exam format will be announced by course faculty in advance.

Final Exam: A cumulative final exam (3 hour) will be scheduled during exam week and is worth 25% of the course grade. Exams questions may use a combination of multiple choice, short answer, long answer, and/or practical components. Technical materials or data may be provided to students for interpretation or analysis. The exam format will be announced by course faculty in advance.

In class assignments/lab exercise, homework, quizzes: Each method will have 1-2 assessments, each in the format of a class assignment, lab exercise, homework, and/or quiz. Exercises may be posted/delivered on MyCourses or handed out in class to be collected at a date/time/location specified.

Data interpretation/presentation project: Students will be given experimental data obtained from one or more methodologies covered in the course. Students will be responsible for analyzing the data through quantitative and/or qualitative means, creating tables/graphs/figures of the data (with statistical analysis, if indicated in the instructions), and providing a "Results" description of the data in manuscript format. The project format may be individual or small group; the format will be announced by the course coordinator early in the semester.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
A	4.0	92.50 - 100
A-	3.7	89.50 - 92.49
B+	3.3	86.50 - 89.49
B	3.0	82.50 - 86.49
B-	2.7	79.50 - 82.49
C+	2.3	74.50 - 79.49
C	2.0	69.50 - 74.49
C-	1.7	66.50 - 69.49
D	1.0	59.50 - 66.49
F	0.0	< 59.5

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class and lab time to active discussion, examples, observations and group exercises as deemed appropriate. It is the student's responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings.

week	Topic	Readings	Instructor
1 (3hr)	Introduction to cell culture and sterile technique	Handout	Nagaraju
2 (3hr)	Cell culture lab	Sample protocols and technical literature	Nagaraju
3 (3hr)	Microscopy (tissue/cell preparation for imaging, light & fluorescent microscopy)	Handout	Beedle
4 (3hr)	Microscopy lab	Sample protocols and technical literature	Beedle
5 (3hr)	FACS basics and applications	Handout	Nagaraju
6 (3hr)	FACS lab	Sample protocols and technical literature	Nagaraju
7 (3hr)	Exam 1 (110 min) , Spectrophotometry – UV/Vis/Fl class (60 min)	Handout	Multiple/Edwards
8 (3hr)	Protein extraction, quantification, and analysis (Western, ELISA, etc)	Handout	TBH4

9 (3hr)	Protein extraction, quantification, and analysis (Western, ELISA, etc) lab	Sample protocols and technical literature	TBH4
10 (3hr)	Nucleic acid extraction, quantitation, and analysis	Handout	TBH4
11 (3hr)	Nucleic acid extraction, quantitation, and analysis lab	Sample protocols and technical literature	TBH4
12 (3hr)	Exam 2 (110 min) , Intro to software tools (60 min)		Edwards/TBH4
13 (3hr)	Data interpretation and presentation		Multiple
14 (3hr)	Data interpretation and presentation		Multiple
Final	Final exam		Multiple

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 519

Course Name: Analytical methods and instrumentation II

Program: Graduate Program in Pharmaceutical Sciences **Credit Hours: 3**

Semester: Fall **Academic Year (first offered): tbd**

Date approved by curriculum committee: Pending

Course Description:

This course is designed to introduce students to common methodologies in pharmaceutical and biomedical research. Students will gain a theoretical understanding of experimental techniques, protocols, and associated equipment; apply their knowledge to various observation and/or practical laboratory experiments; and analyze and interpret associated experimental data. Methodologies in this course include centrifugation isolation, chromatography (small and large molecule), LCMS, proteomics, and methods for detection of protein binding/folding.

Prerequisite(s)/Corequisite(s): Admission to Pharmaceutical Sciences graduate program or POD

Coordinator	Additional Faculty	Additional Faculty
<i>TBH4, PhD (OR Beedle)</i>	<i>XXXX, Ph.D.</i>	<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>By appointment in PB-xx</i>	Office Hours: <i>TBD</i> <i>By appointment in PB-xx</i>	Office Hours: <i>TBD</i> <i>By appointment in PB-xx</i>
Email: ntumey@binghamton.edu	Email: xxxx@binghamton.edu	Email: xxxx@binghamton.edu
Telephone: 607-777-xxx	Telephone: 607-777-xxxx	Telephone: 607-777-xxxx

Additional Faculty
<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>Xxx by appointment in</i> <i>Location yy</i>
Email: xxxx@binghamton.edu
Telephone: 607-777-xxxx

The information contained in this syllabus is subject to change with prior notification via MyCourses. It is the responsibility of the student to refer to MyCourses for updates.

Course Meeting Times and Location: To be determined.

Course Policies:

1. Attendance and Participation Policy: Students are expected to attend and participate in all classes. A student may forfeit his/her grade for any points assigned to a specific class session if the student fails to attend. Attendance to all assessments (group work/projects, exams, final exam) is required. If illness, personal emergency, or other exceptional problem of a serious nature causes a student to be absent from a required assessment, the student must notify the course coordinator immediately. Each request will be evaluated on its individual merit and the student must provide documentation/verification of the event. Make-up assignments may be given for excused absences at the discretion of the course coordinator and the involved instructors, and may be administered in a different format than the original activity. Scheduled or planned excused absences (eg. Professional meetings) must be approved in advance by the course coordinator.

2. Late Policy: Students are expected to arrive to class on-time as late arrivals are disruptive to the class. A student may forfeit any points assigned to the specific class session if the student arrives late. Late assignments will receive a 10% deduction for every day the assignment is late. Assignments more than 3 days late will not be accepted.

3. Use of technology/mobile devices in classroom: All electronic devices are to be in silent mode or turned off during class unless use of the device is part of a course activity. Cell phones, pagers, etc. should NOT be answered during class, except in case of emergency. It is the student's responsibility to notify the instructor before/at the start of class if a device needs to be monitored for an emergency. The use of any electronic device (eg. Computer, tablet, phone) is to be for classwork only. If a device is used in other, disruptive, manners, the instructor may require the student to remove or relinquish the device for the class period. Repeated disruptions may result in a loss of points and/or referring the student to the Pharmaceutical Sciences Graduate committee.

4. Exam policy: Students are required to move all personal items, course notes and materials to the front, side or back of the room during all closed-book, in-class assessments. No student should have a cell phone (or similar device) on his/her person during a quiz or exam. If there is an emergency or urgent need to monitor a phone during an assessment, it is the student's responsibility to make arrangements with the instructor before the exam. If ExamSoft is used for exam delivery, it is the student's responsibility to have a working computer ready for the assessment. Students must complete individual assessments (exams, homework, etc) with integrity. No unauthorized assistance of any kind is permitted. Please see the handbook "*Student Conduct/Misconduct During Examinations*" for further details.

5. Instructor Materials: Students are not allowed to sell materials posted on MyCourses or distribute the materials outside of the School of Pharmacy and Pharmaceutical Sciences.

Please refer to the student handbook for the following policies:

- Honor Code Policies
 - It is the responsibility of all students to understand and abide by the Binghamton University Academic Honesty Code. Information about and links to the policy are available at <https://www.binghamton.edu/academics/provost/honesty.html>. A student in violation of the Academic Honesty Code will be reported to SOPPS Committee for Awards and Progression.
 - Student Conduct and Misconduct During Examinations

- Disability and equal access

"Disability-related Equal Access Accommodations - Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119."

- Dropping a course
- University tutoring services
- ITS Helpdesk
- MyCourses support
- Library services
- Counseling services

Course Objectives:

1. Describe the principles and uses of centrifugation methods. Develop, analyze, or demonstrate experimental protocols.
2. Describe the principles and uses of chromatography for small and large molecules. Develop, analyze, or demonstrate experimental protocols.
3. Describe the principles and uses of LCMS. Develop, analyze, or demonstrate experimental protocols.
4. Describe the principles and uses of mass spectroscopy (including proteomics and metabolomics). Develop, analyze, or demonstrate experimental protocols.
5. Describe the principles and uses of methods for analysis of protein binding and folding. Develop, analyze, or demonstrate experimental protocols.
6. Identify common technical issues associated with methodologies covered in the course.
7. Develop a strategy for use/apply analytical methodologies covered in the course.

Required Texts and Other Materials:

1. Selected articles and other course materials will be posted on MyCourses.

2. Limited readings from AccessPharmacy e-learning suite

Course Assessment Methods:

Assessment	Percentage of Course Grade
Exam 1	20%
Exam 2	20%
In class assignments / homework / quizzes	15%
Analytical methods and instrumentation project	20%
Final Exam	25%

Requirements to pass the course:

A course percentage of 69.5% is required to pass this course.

Description of Assessment Formats:

Exams: There are two non-cumulative in-class exams, worth 25% and 15% of the course grade, covering material of the particular section of the course. Exams questions may use a combination of multiple choice, short answer, long answer, and/or practical components. Technical materials or data may be provided to students for interpretation or analysis. The exam format will be announced by course faculty in advance.

Final Exam: A cumulative final exam (3 hour) will be scheduled during exam week and is worth 25% of the course grade. Exams questions may use a combination of multiple choice, short answer, long answer, and/or practical components. Technical materials or data may be provided to students for interpretation or analysis. The exam format will be announced by course faculty in advance.

In class assignments/lab exercise, homework, quizzes: Each method will have 1-2 assessments, each in the format of a class assignment, lab exercise, homework, and/or quiz. Exercises may be posted/delivered on MyCourses or handed out in class to be collected at a date/time/location specified.

Analytical methods and instrumentation project: Students will work to acquire, analyze and interpret data from one or more of the methodologies covered in the course. The project format may be individual or small group; the format will be announced by the course coordinator by mid-semester and students will work in advance to prepare protocols/plans for the project.

Grading Scale:

Letter Grade	Numeric Grade	Percentage Grade
A	4.0	92.50 – 100
A-	3.7	89.50 – 92.49

B+	3.3	86.50 – 89.49
B	3.0	82.50 – 86.49
B-	2.7	79.50 – 82.49
C+	2.3	74.50 – 79.49
C	2.0	69.50 – 74.49
C-	1.7	66.50 – 69.49
D	1.0	59.50 – 66.49
F	0.0	< 59.5

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Some of the required readings will not be covered in class. The instructor will devote class and lab time to active discussion, examples, observations and group exercises as deemed appropriate. It is the student's responsibility to complete assignments and review online postings for the course as assigned in order to be adequately prepared for the face-to-face class meetings.

week	Topic	Readings	Instructor
1 (3hr)	Centrifugation techniques (eg. density gradients, PBMC isolation)	Handout (sample protocols, technical literature)	Nagaraju
2 (3hr)	Basics in chromatography (small molecule)	Handout	TBH3
3 (3hr)	Chromatography lab	Sample protocols and technical literature	TBH3
4 (3hr)	Basics in chromatography (large molecule)	Handout	Hathout
5 (3hr)	Chromatography lab	Sample protocols and technical literature	Hathout
6 (3hr)	Exam 1 (90 min). Introduce Analytical methods and instrumentation project (90 min)		Multiple
7 (3hr)	Small molecule LCMS	Handout	Tumey
8 (3hr)	Small molecule LCMS lab	Sample protocols and technical literature	Tumey
9 (3hr)	Fundamentals in mass spectroscopy	Handout	Hathout
10 (3hr)	Proteomics/metabolomics	Handout	Hathout
11 (3hr)	Proteomics lab	Sample protocols and technical literature	Hathout
12 (3hr)	Exam 2 (90 min). Calorimetry/thermal technique, plasmon resonance, circular dichroism (90 min)	Handout	Edwards/Brooks

13 (3hr)	Calorimetry/thermal technique, plasmon resonance, circular dichroism, cont.	Sample protocols and technical literature	Edwards/Brooks
14 (3hr)	Analytical methods and instrumentation project		Multiple
Final	Final exam		Multiple

Binghamton University
School of Pharmacy and Pharmaceutical Sciences

Course Number: PHRM 597MS	
Course Name:	Independent Study
Program: Graduate Program in Pharmaceutical Sciences	Credit Hours: 1
Semester: Spring	Academic Year (first offered): tbd
Date approved by curriculum committee: Pending	

Course Description:

Students will develop an independent study under the guidance of a faculty mentor in a field/topic relevant to the faculty member’s expertise. Prior to registration, students must consult with and obtain a faculty mentor. The study will include reading and evaluation of scientific publications, technical materials/specifications, regulatory materials, clinical/administrative materials, online or sample datasets, and/or research protocols. The written study may be done in various formats (e.g. research plan/design, review/critique of emerging drugs or clinical trials, analysis of technical innovations in equipment/methodologies, mining of bioinformatics resources to address a research question, etc.). Students will submit a general topic area for approval in week 2 and a detailed study plan in week 4.

Prerequisite(s)/Corequisite(s): PHRM 601, PHRM 602

Coordinator	Additional Faculty	Additional Faculty
<i>TBH2, PhD (OR Edwards)</i>	<i>XXXX, Ph.D.</i>	<i>XXXX, Ph.D.</i>
Office Hours: <i>TBD</i> <i>By appointment in PB-xx</i>	Office Hours: <i>TBD</i> <i>By appointment in PB-xx</i>	Office Hours: <i>TBD</i> <i>By appointment in PB-xx</i>
Email: ntumey@binghamton.edu	Email: xxxx@binghamton.edu	Email: xxxx@binghamton.edu
Telephone: 607-777-xxx	Telephone: 607-777-xxxx	Telephone: 607-777-xxxx

The information contained in this syllabus is subject to change with prior notification via MyCourses. It is the responsibility of the student to refer to MyCourses for updates.

Course Meeting Times and Location: Various.

Course Policies:

1. Attendance and Participation Policy: Students are expected to attend and participate in all scheduled activities and mentor meetings. If illness, personal emergency, or other

exceptional problem of a serious nature causes a student to be absent from a required meeting or to miss a scheduled deadline, the student must notify the course coordinator immediately. Each request will be evaluated on its individual merit and the student must provide documentation/verification of the event. Alternate meetings/assignments may be given for excused absences at the discretion of the course coordinator and faculty mentor, and may be administered in a different format than the original activity. Scheduled or planned excused absences (eg. Professional meetings) must be approved in advance by the course coordinator.

2. Late Policy: Students are expected to arrive to scheduled activities on-time as late arrivals are disruptive. A student may forfeit points associated with a scheduled activity if the student arrives late. Late assignments will receive a 10% deduction for every day the assignment is late. Assignments more than 3 days late will not be accepted.

3. Use of technology/mobile devices: All electronic devices are to be in silent mode or turned off during scheduled activities or meetings unless use of the device is needed for a course-related activity. Cell phones, pagers, etc. should NOT be answered during scheduled activities, except in case of emergency. It is the student's responsibility to notify the instructor before/at the start of a session if a device needs to be monitored for an emergency. If a device is used in other, disruptive, manners, the instructor may require the student to remove or relinquish the device for the session. Repeated disruptions may result in a loss of points and/or referring the student to the Pharmaceutical Sciences Graduate committee.

4. Instructor Materials: Students are not allowed to sell materials posted on MyCourses or distribute the materials outside of the School of Pharmacy and Pharmaceutical Sciences.

Please refer to the student handbook for the following policies:

- Honor Code Policies
 - It is the responsibility of all students to understand and abide by the Binghamton University Academic Honesty Code. Information about and links to the policy are available at <https://www.binghamton.edu/academics/provost/honesty.html>. A student in violation of the Academic Honesty Code will be reported to SOPPS Committee for Awards and Progression.
 - Student Conduct and Misconduct During Examinations
- Disability and equal access

"Disability-related Equal Access Accommodations - Students needing accommodations to ensure their equitable access and participation in this course should provide the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they are aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, room 119."
- Dropping a course
- University tutoring services

- ITS Helpdesk
- MyCourses support
- Library services
- Counseling services

Course Objectives:

1. Obtain any requisite regulatory training necessary for completion of the study.
2. Identify and explain general approaches to address a research question in the field of study.
3. Perform activities of reading, evaluation, assessment of materials or tasks for the study.
4. Compile a detailed bibliography or list of publications and resources used in the study.
5. Prepare written drafts of the study and respond to critiques and comments.
6. Submit the written study and discuss the final outcomes of the study activities.

Required Texts and Other Materials:

1. Selected articles and other course materials will be posted on MyCourses and/or provided by the faculty mentor.
2. Limited readings from AccessPharmacy e-learning suite

Course Assessment Methods:

Assessment	Percentage of Course Grade
Study description	10%
Detailed study outline/plan and schedule	20%
Draft 1/intermediate assessment 1	15%
Draft 2/intermediate assessment 2	15%
Final study	40%

Requirements to pass the course:

A course percentage of 80% (Pass) is required to pass this course.

Description of Assessment Formats:

Study description: the student will create a basic study description detailing the project title, study question/goals, faculty mentor, and a brief explanation of the approach (10% of course grade). The project description must be approved by the faculty mentor and course coordinator.

Detailed study outline/plan and schedule: The student will meet with the faculty mentor to discuss the activities necessary for study completion. The student will prepare and submit a detailed study outline/plan with specific sub-questions or aims that provide a framework for development of the full study. A detailed timeline of activities necessary to meet

required outcomes must be provided and the drafts/intermediate assessments and final study format and requirements should be clearly defined. The study description must be approved by the faculty mentor and course coordinator.

Draft/intermediate assessments: The faculty mentor will specify the format and nature of intermediate assessments and/or study drafts to ensure that the student is on track to complete the study. Students are expected to receive and respond to comments/critiques on these assessments from the faculty mentor and/or course coordinator.

Final study: The student will submit the final written study document at the end of the semester, according to format/guidelines established with the faculty mentor and course coordinator. The student will also participate in a final study discussion with all course students.

Grading Scale: Pass/Fail

Disclaimer

This syllabus, course calendar, reading schedule, grading, and assignments in this course are subject to change by the instructor in the event of extenuating circumstances, or by mutual agreement between the instructor and the students. Be sure to refer to the most current version of these important documents.

Course Itinerary/Schedule

This course is designed with individualized learning. Students are expected to meet at least 3 times during the semester with the faculty mentor and attend scheduled course sessions. Expectations for time and location of project activities will be discussed with the faculty mentor at enrollment and with the class in week 1.

week	Topic	Readings	Instructor
1 (1hr)	Introduction to the independent study *CLASS MEETING*	Handout	TBH2
1-14	Independent study activities, variable	variable	variable
2	Submit study description		variable
4	Submit detailed study plan/outline and schedule		variable
14 (1hr)	Final study discussion *CLASS MEETING*		Multiple

Appendix D-external examiners report



AUBURN UNIVERSITY
HARRISON SCHOOL OF PHARMACY

December 14, 2019

Dr. Donald G. Nieman
Executive Vice President for
Academic Affairs & Provost
Binghamton University
State University of New York

Dr. Aondover Tarhule
Vice Provost & Dean of the Graduate School
Binghamton University
State University of New York

RE: External Evaluation of Pharmaceutical Sciences Graduate Program

Dear Drs. Nieman and Tarhule,

I am writing this letter as an External Evaluator for the proposal to establish a graduate (M.S. and Ph.D.) program in Pharmaceutical Sciences within the School of Pharmacy at Binghamton University, SUNY. In February 2019 I received an email from your offices asking me to serve as an outside academic reviewer. Prior to my visit, I was contacted a number of times to schedule the onsite review, and was provided the existing copy of the Program Proposal: Graduate Degree Program, Form 2B. On November 13th I traveled to Binghamton University for the onsite review and departed Binghamton, NY on Friday November 15th. Below is a copy of my evaluation as well as the signed External Evaluation Report, Form 2D (attached).

As you are aware I am a Professor and Interim Head of the Department of Drug Discovery and Development, Harrison School of Pharmacy at Auburn University. I received my B.S. Biochemistry (honors) at SUNY College at Plattsburgh (1994) as well as my doctorate (Ph.D.) in Pharmaceutical Sciences at the School of Pharmacy and Pharmaceutical Sciences, the University at Buffalo, SUNY (2004). After completing postdoctoral training at Roswell Park Cancer Institute and University at Buffalo I initiated my academic career as an Assistant Professor in the Department of Pharmaceutical and Biomedical Sciences at the College of Pharmacy at the University of Georgia, prior to moving to the Harrison School of Pharmacy at Auburn University at the rank of Associate Professor (2012), tenure (2015), and promotion to Professor (2018). I am an industrially (Wyeth-Ayerst Research) and academically trained pharmaceutical scientist with >20 years expertise in research and teaching within Schools and Colleges of Pharmacy. My research has focused on experimental therapeutics and cancer nanomedicines, specifically developing and optimizing dosing schedules and novel lipid-nanoparticles as drug carriers for the treatment of cancers. During this time I have served as PI, MPI and Co-I on over 50 awards totaling \$13.8M in research funding. I have also

served on school-wide strategic planning, curricular, and numerous committees related to professional (Pharm.D.) and graduate (M.S. and Ph.D.) education. I believe that I have the background and expertise to provide an impartial evaluation of the proposed application to establish a graduate program in Pharmaceutical Sciences.

I am pleased that after review of all the material provided and on-site visit, I enthusiastically support Binghamton University's proposal to establish a graduate program in Pharmaceutical Sciences. I believe that all of the parties involved have invested considerable effort and resources, as well as careful thought to develop a rigorous program that will complement existing graduate programs at Binghamton University, as well as strengthen the health-sciences core and add value to Binghamton University and the SUNY system. Furthermore, I believe that the faculty and staff in this program have the resources and expertise to advanced basic and translational research, as well as develop the next generation of pharmaceutical and biomedical scientists. As requested I have succinctly addressed specific questions provided in the External Evaluation Report, Form 2D, below. If you have any questions or need further clarifications please do not hesitate to contact me.

Sincerely,



Robert D. Arnold, Ph.D.
Interim Department Head & Professor
Dept. of Drug Discovery & Development
Director of the AU Specialized
Pharmaceutical and Experimental Center
for Translational Research & Analysis
Auburn University

Senior Scientist, Experimental Therapeutics
UAB O'Neal NIH Comprehensive Cancer Center




The External Evaluation Report is an important component of a new academic program proposal. The external evaluator's task is to examine the program proposal and related materials, visit the campus to discuss the proposal with faculty and review related instructional resources and facilities, respond to the questions in this Report form, and submit to the institution a signed report that speaks to the quality of, and need for, the proposed program. The report should aim for completeness, accuracy and objectivity.

The institution is expected to review each External Evaluation Report it receives, prepare a single institutional response to all reports, and, as appropriate, make changes to its program proposal and plan. Each separate External Evaluation Report and the Institutional Response become part of the full program proposal that the institution submits to SUNY for approval. If an external evaluation of the proposed program is required by the New York State Education Department (SED), SUNY includes the External Evaluation Reports and Institutional Response in the full proposal that it submits to SED for registration.

Institution: Binghamton University, SUNY

Evaluator Name (Please print.): Robert D. Arnold, Ph.D.

Evaluator Title and Institution: Professor & Interim Dept Head, Auburn University

Evaluator Signature: 

Proposed Program Title: Pharmaceutical Sciences

Degree: M.S. & Ph.D.

Date of evaluation: 11/13/2019 - 11/15/2019

I. Program

1. Assess the program's **purpose, structure, and requirements** as well as formal mechanisms for program **administration and evaluation**. Address the program's academic rigor and intellectual coherence.

This proposal seeks to establish graduate programs in Pharmaceutical Sciences at Binghamton University. The overarching goal is to train and develop students with the ability to conduct and lead research, and enter careers in the pharmaceutical and biomedical sciences. The program falls under Dr. Aondover A. Tarhule, Ph.D., Vice Provost and Dean of the Graduate School, and administered and taught primarily by faculty within the Department of Pharmaceutical Sciences and Department of Health Outcomes and Administrative Sciences at the School of Pharmacy and Pharmaceutical Sciences (SOPPS) at Binghamton University, SUNY.

This application includes the establishment of a Master of Science (M.S.) and a Doctor of Philosophy (Ph.D.) programs. The M.S. program is focused on providing foundational knowledge as well as technical expertise and expected to be completed in 1.5 years. It includes a minimum of 33 credits and provides for opportunities for students to conduct a research project or internships, if available. While the focus of the M.S. program is to provide a base knowledge, in the future the program could benefit by allowing the students the ability to initiate research earlier and be given the option of a thesis based Master degree. This would provide students with greater opportunity

to develop research expertise as well as contribute to larger projects sufficient for publication. Overall the curriculum is well described and has courses that appropriate for degree and skills sought by pharmaceutical and biotech laboratories.

The Ph.D. program includes a minimum of 67 credits and predicted to take ~5 years. It includes additional advanced didactic course offering, greater depth of study including experimental design and mentored research as well as foundational knowledge. The foundational classes and course description represent a contemporary program that will provide students with sufficient breadth and expertise to work in interdisciplinary teams as well as providing flexibility to seek our higher level elective classes based on career aspirations. Doctoral level students are required to pass comprehensive examination (qualifiers) that include grasp of base knowledge in pharmaceutical and biomedical sciences as well as proficiency in scientific (grant and publication). Completion of the Ph.D. program requires a successful public defense of the candidate's dissertation research.

Admission criteria is in alignment with requirements at Binghamton University Graduate School, as well as other graduate programs in pharmaceutical and biomedical sciences. Pre-requisites include 12 credits in core sciences related to health, chemical, biomedical and pharmaceutical sciences. Admission to the graduate program is holistic and includes undergraduate grades, GRE and TOEFL scores as well as letters of recommendation and statement of purpose. The curriculum for the doctoral degree (Ph.D.) includes both foundational as well as advanced instruction in cellular and molecular biology, statistics, pharmaceutical sciences, critical thinking and communications, as well as opportunity for electives. The M.S. program is more focused on core classes that will prepare students for further graduate education or various laboratory and research positions. Based on my experiences, many companies seek applicants that have training in pharmaceutical and biomedical analysis. The inclusion of these requirements as part of the M.S. and as elective in Ph.D. program is a strength of the program and will likely be a competitive advantage for students that seek employment after completing an M.S. degree.

It is not clear if onsite interviews will be required. It is recommended that if onsite interviews are not possible, that team based tele- or video-interviews be conducted.

2. Comment on the **special focus** of this program, if any, as it relates to the discipline.

The program has traditional course work that focuses on foundational knowledge associated with pharmaceutical and biomedical sciences. While the "pharmaceutical sciences" are broad, this program has been developed with a focus on drug target discovery and drug development. While many programs provide instruction in these areas, there are few programs that have curriculum and faculty who are advancing early drug discovery with goal of identifying lead compounds for translation to the clinic. This is a lofty goal, but the organization and faculty hires are aligned with this mission (discussed later). Advances in molecular techniques have led to possibility of precision based medicine approaches, however the ability to identify and validate targets in discovery are critical. The program includes faculty who have experience and/or conducting research throughout the entire drug development process, from drug discovery through early Phase I and II clinical studies. The integration of professional, PharmD. students into the labs also provides greater clinical insights that are useful when developing and framing health-sciences research programs and grant applications. While the faculty have diverse research interests and expertise, this program has a unique focus on drug target identification and the translation to the clinic. This focus is unique and complements the University at Buffalo's, SUNY program that has reputation for excellence in the application of pharmacokinetic and pharmacodynamic principle and models to advance development of drugs and biologics. This is more in-line with their stated objectives and is more in line with securing extramural funding from sources such as, NIH and DOD. This is also in contrast to Long Island University and St. John's University that are known to produce graduate that are experts in industrial pharmacy (basic pharmaceuticals, e.g., film coating, tableting).

3. Comment on the plans and expectations for **self-assessment and continuous improvement**.

In keeping with requirements associated with professional Pharm.D. program, the SOPPS has full time personnel responsible for coordinating and assisting faculty with self-assessment and improving their curriculum. Based on our discussions this coordinator has both an educational and research background. While this role is evolving with the advancement of the professional program, there was interest in working with graduate faculty in evaluating their course content and methods of instruction, as well as a process for adjusting and improving the curriculum. In addition, there are a variety of programs and resources available to support faculty development and curricular review at Binghamton University. It should be noted that there appears to be much greater and earlier integration with a “curriculum specialist” than other programs that I am familiar with. Based on our discussion, there appears to be a desire to develop programs to facilitate faculty development as well as improve the curriculum.

Overall the quality and rigor of the program will be evaluated by assessing the student’s knowledge, technical skills and overall competency. The overall learning objectives are well described in the application as well as articulated by the Dean, Department Head, faculty and staff that we interacted with. Doctoral students will be assessed via course work, qualifying examinations, presentation of dissertation research and final defense. Feedback will be provided often by individual faculty as well as from a student’s dissertation committee. Overall their appears to be well thought out and coherent plan to assess the program and make adjustments as necessary.

4. Discuss **the relationship** of this program to other programs of the institution and collaboration with other institutions, and assess available support from related programs.

The graduate program in Pharmaceutical Sciences complements the existing graduate programs at Binghamton University as well as the professional, Doctorate of Pharmacy (Pharm.D.) program within the School of Pharmacy and Pharmaceutical Sciences. This is evident by the number of faculty in the Department of Pharmaceutical Sciences that have adjunct and affiliate positions across Binghamton University and other Institutions. Specifically a number of faculty have active collaborations with faculty from Chemistry and Biomedical Engineering. As well as graduate students (primarily from Biomedical Engineering) and undergraduate students from various science programs in the Harpur College of Arts & Sciences that are conducting research and being mentored by faculty in SOPPS.

While the SOPP was only recently established (2017), it appears to be embraced by University of Binghamton and various of its units. The faculty have established collaborations with faculty from variety of departments, as well as support graduate (MS and PhD) students from other programs that complement the proposed program. Currently faculty from Biomedical Engineering program have received courtesy appointments. Faculty also discussed the sharing of SOPPS research resources as well as their access to variety of resources throughout the university. While I did not have the opportunity to talk with faculty from other units, graduate students we met with discussed how supportive their “home” departments were and the excitement about the ongoing and potential for future collaborations.

5. What is the evidence of **need** and **demand** for the program locally, in the State, and in the field at large? What is the extent of occupational demand for graduates? What is the evidence that demand will continue?

Graduates with training and expertise in pharmaceutical and biomedical sciences are in high demand and sought by a variety of sectors, including academia (as faculty as well as researchers and core staff), government, public and private research institutions as well as the pharmaceutical and biotechnology industries. Much pharmaceutical innovation has been attributed to start-up companies, many that have been associated with translation of intellectual property developed in academic laboratories. The existing faculty in Pharmaceutical Sciences not only have diverse and complementary expertise related to pharmaceutical and biomedical sciences, a number of have a

track record of translating and/or licensees research findings. These entrepreneurial skills are a strong asset to this program and have educational and potential for monetary benefits.

Prior to completing my graduate training I worked for Wyeth-Ayerst Research (now Pfizer) in the Pharmaceutical Science Research and Development Group. While that was over 20 years ago, I continue to receive calls from my former supervisors, former colleagues as well as scientific recruiters that are looking to identify qualified applications. Many positions with the pharmaceutical and biotech industries were filled with graduates with Bachelors of Pharmacy (B.S. R.Ph.). With the transition of the B.S. Pharmacy program to the more clinical, practice ready Doctorate of Pharmacy (Pharm.D.) degree, these graduate typically seek our more clinically relevant positions and not those in drug discovery and drug development. The pharmaceutical and biotech industries have been trying to fill this gap with applicants from biology, chemistry, engineering and other health science programs. While these applicants are well-trained, they tend to lack the breadth of knowledge that is obtained from interdisciplinary graduate programs in Pharmaceutical Sciences. The demand for qualified graduates is growing with increasing number of retirees, and growth of start-up and small “boutique” companies that are taking advantage of rapid growth in areas associated with precision medicine (application of human genomic/bioinformatics), targeted and nanomedicine, 3D-pharmaceuticals, just to name a few. As our understanding of biology and underlying causes of disease advances, there will be a need for pharmaceutical and biomedical scientist who are able to identify and validate appropriate drug targets and translate these findings from bench to clinic. Based on my discussions with the program leadership as well as faculty, this is one of the focuses of this proposed program.

While it is not the goal of this program, it is generally not recognized that graduates with expertise in pharmaceutical and biomedical sciences also are sought out by food, nutritional, cosmetic, veterinary, and numerous other health-wellness areas that discover and develop products to benefit human (and animal) health. Numerous individuals I worked with while employed in industry and currently through collaborations have worked in diverse industries throughout their career. The interdisciplinary nature combined with focus on intellectual and scientific development are strengths of the program.

II. Faculty

- 6. Evaluate the faculty**, individually and collectively, with regard to training, experience, research and publication, professional service, and recognition in the field.

The Graduate School and its leadership at Binghamton University are well established and oversee a variety of recognized graduate programs. The School of Pharmacy and Pharmaceutical Sciences (SOPPS) is led by Dean Gloria E. Meredith, Ph.D., an established researcher and administrator who developed successful extramurally funded neuroscience program, specifically related to neuroprotection, in both HRB - Ireland as well as NIH - US. As a researcher she has received numerous accolades as well as communicating her research in high-tier journals of her field. As the Founding Dean, Dr. Meredith was responsible largely for initial faculty hires and setting the “academic tone” of the SOPPS. Dr. Kanneboyina Nagaraju, DVM, MVSc, PhD is the Founding Chair, Department of Pharmaceutical Sciences and in conjunction with Dean Meredith was responsible for hiring the current faculty and developing plans for future hires. Dr. Nagaraju is also internationally recognized and extramurally funded investigator and administer, who led and developed successful research program at George Washington University School of Medicine and Health Sciences and Children's National Medical Center. His area of expertise is in neuroscience, related to inflammation and Duchenne muscular dystrophy, as well as drug development. He has strong publication record as well as a track record of generating intellectual property and translating academic research. He has co-founded two biotech companies, ReveraGen BioPharma and AGADA BioSciences with Dr. Hoffman. Dr. Eric Hoffman is the Associate Dean, Research and Research Development. He was the director of

the Center for Genetic Medicine at the Children's National Medical Center, and Professor and Chair of the Department of Integrative Systems Biology at George Washington University. He has a strong track record of extramural funding related to his background in human genetics, with focus on neuromuscular diseases, as well as developing and “spinning-off” companies from academic research. Together Drs. Meredith, Nagaraju, and Hoffman represent an established team of investigators with strong-track records of research excellence; together they have assembled faculty with necessary expertise to meet educational and research goals of this program. It should also be noted that faculty from Health Outcomes and Administrative Sciences will also participate in graduate program.

As outlined in the proposal, the faculty have broad expertise in pharmaceutical sciences, ranging from drug discovery through clinical development. While not typical, there is approximately a 1:1 ratio of male to female faculty. The faculty include scholars with academic as well as industrial experience. The faculty include scholars who have conducted research at schools of medicine as well as pharmacy. Based on interviews with individual faculty they are enthusiastic about the formation and establishment of the graduate program, and have been actively engaged with its development. While it is difficult to comment on the ability of faculty to teach, students who we visited with described course work as challenging, but fair, and the faculty being available. Overall the department has recruited faculty who are mostly established with demonstrated record (publication and/or grant funding). The faculty also includes more junior faculty who have strong credentials and show potential for future success.

- 7. Assess the faculty in terms of number and qualifications and plans for future staffing.** Evaluate **faculty responsibilities** for the proposed program, taking into account their other institutional and programmatic commitments. Evaluate faculty **activity in generating funds** for research, training, facilities, equipment, etc. Discuss any **critical gaps and plans for addressing them**.

The Department of Pharmaceutical Sciences has 12 faculty and plans to hire an additional 5 faculty by end of 2021. The new hires, 4 Assistant Professors and 1 lecturer, are expected to complement existing faculty and have expertise in genetics/biomedical pharmaceutical, pharmacology and medicinal chemistry. Faculty from Health Outcomes and Administrative Sciences, SOPPS will also participate in graduate program and bring total faculty up to ~20. The department has strength in neuroscience and less so in oncology. While many programs are aligned based on core pharmaceutical disciplines (medicinal chemistry, pharmacology and pharmaceuticals), the faculty here are aligned more along a drug development path and take into account the interdisciplinary nature of identifying investigational agents and developing them.

The number and expertise of the faculty has grown as the SOPPS was in process of enrolling the P1-P3 classes into the professional curriculum. While initial efforts were focused on developing, revising, updating lectures to support the professional program, they were now largely completed. Overall, much of the content developed for the professional program, combined with faculty previous experiences in teaching at other institutions can be adapted easily for the graduate program. Furthermore, with addition of new faculty the overall teaching effort will decrease and provide additional time for research.

As with all faculty positions, there are additional responsibilities other than teaching and scholarship, including service on dept, school and university committees, as well as participation and leadership in professional organizations. At this point the Dean and Department Chair have taken efforts to minimize the impact of such service on individual faculty, while encouraging participation in professional associations. Overall, no concerns are noted.

While the establishment of the graduate program is ongoing, the faculty have established their research programs and already shown success in securing funding. This has included \$1M SUNY Empire Innovation Program grant as well as receiving \$4.2M in grant funding. To put this in context this would put this program in top ~1/3 of all pharmacy schools and top ~1/2 of those who have received federal funding. This is great accomplishment, especially since this is prior to the establishment of a graduate program, during the transition to a new building,

and without full complement of faculty (AACP Funding Rankings, 2018). While individual disciplines have different potential for generating extramural funding, the faculty all showed drive and expectations to lead and or support the research mission of the program, as well as the teaching. Overall, I was impressed with the planning and initial success that the program has achieved. I do not foresee any major obstacles with their continued success, based on the program described.

8. Evaluate credentials and involvement of adjunct faculty and support personnel.

In addition to the primary faculty, the Department of Pharmaceutical Sciences has a number of faculty that have Courtesy Appointments. Currently, this includes three faculty, Chair, Graduate Program Director and Undergraduate Program Director from the Department of Biomedical Engineering at Binghamton University. We did not have an opportunity to meet with these faculty, but based on review of their credentials available online they are all well qualified and appropriate. Based on discussions with faculty, it was indicated that faculty from Biomedical Engineering whom they were collaborating with and/or overseeing undergraduate and graduate placement had been given Courtesy appointments.

III. Students

9. Comment on the student population the program seeks to serve, and assess plans and projections for student recruitment and enrollment.

Binghamton University, SUNY has a strong reputation of academic and research excellence. The graduate program seeks to admit students that have completed bachelor's degree and have appropriate prerequisites to succeed in graduate program in pharmaceutical sciences. Overall, they are seeking those interested in conducting, leading or managing various activities related to pharmaceutical and/or biomedical research. As described in the application they are expecting to reach approximately 20 students in the M.S. and 22 in the PhD. program at the end of 5 years. Given the number of faculty, these numbers are reasonable, but likely will grow as additional funding (GRA and training grants) are secured.

10. What are the prospects that recruitment efforts and admissions criteria will supply a sufficient pool of highly qualified applicants and enrollees?

Based on my experiences there is an unmet need for additional interdisciplinary graduate programs in the pharmaceutical and biomedical sciences. There are 143 colleges and schools of pharmacy in the U.S., as per the Accreditation Council for Pharmacy Education (ACPE) and only 79 offer graduate programs in pharmaceutical sciences. Due to high demand for training in this area, many universities have developed programs (minors or areas of focus) that complement this area, but do not contain the full extent of course offerings or research expertise. Furthermore, most SOPPS do not offer direct acceptance into MS programs. This has represented a challenge to industry that is seeking individuals with training in pharmaceutical sciences (e.g., bioanalytical method development and formulation development and evaluation) without the need for doctoral degree. The MS degree also provides opportunity for those interested in pharmaceutical sciences to obtain additional training that can aid in their decision to enter the workforce, seek additional graduate (Ph.D.) or professional (MBA, MPH, MD, etc.,).

Currently undergraduate and graduate students from chemistry, biomedical engineering, and other units are being mentored and trained by from the Department of Pharmaceutical Sciences and SOPPS. Based on previous experience, many of these students will seek out professional schools (MD, DO, DVM, etc.), but many also seek out graduate degrees. While there are a number of other Schools of Pharmacy in the North East and across the country, the number of applicants (both domestic and foreign) far exceed the number of available positions. At the

Harrison School of Pharmacy, Auburn University, we tend to have >100 applicants for ~6-8 positions each year. The competitiveness of the applicant pool further strengthens the research program and ability to obtain training and center grants from federal agencies.

Overall, this program is proposing to offer competitive stipends (TA or GA) with tuition waivers that will assist with recruitment of local students who attend Binghamton University, as well as nationally and internationally. Given Binghamton University's location they are also likely to draw students throughout the entire north east where there is a strong presence of pharmaceutical and biotech industries.

11. Comment on provisions for encouraging participation of persons from underrepresented groups. Is there adequate attention to the needs of part-time, minority, or disadvantaged students?

Generally in the "hard-sciences" the recruitment of women and minorities has been considered a challenge. However, the number of women applicants has grown considerably within Schools of Pharmacy and related graduate programs. Women now outnumber men in many professional programs (Pharm.D.). This shift has also been observed in graduate programs with the number of women graduate students and faculty growing annually. However, the recruitment and graduation of African American, Latino and Native Americans is limited. The SOPPS at Binghamton University has provided review of their student population showing greater percentage of African American students (18.2% compared to the NY state ethnic distribution as well as 5.2% enrollment at Binghamton University).

The administration and faculty have acknowledged this disparity and have faculty with a history of collaborating with HBCU's (Howard University) as well as initiating discussions with other HBCU's to identify and recruit students. While this program should be commended for these activities, it wasn't clear if any additional resources are available to assist these students if accepted. As faculty I have trained 2 students from HBCU's that joined my laboratory, and I was not adequately prepared to mentor them fully (with respect to course load and selection). These students were academically qualified and had done well on GRE's but, some of their previous course work did not prepare them as well for the rigors of graduate school. In all candor, I am not familiar with any programs that have adequately addressed this issue, other than being aware and supportive. Most importantly, based on my discussions with the faculty, I found them to be inclusive and supportive of a diverse faculty and student population. I believe this to be one of the more important determinants when recruiting applicants, especially those from unrepresented minorities. Overall, the school and university had faculty with minority recruitment and diversity issues, no concerns noted.

12. Assess the system for monitoring students' progress and performance and for advising students regarding academic and career matters.

As with most graduate program, individual faculty advisor and dissertation committee will be the primary means for monitoring student progress, performance and advising. The Pharmaceutical Sciences graduate program includes a Graduate Director, Dr. Yetrib Hathout, Professor. Dr. Yetrib is a well-qualified investigator with strong publication and research history. Both faculty and students had positive comments and expressed gratitude for his time and energy. Based on our limited interactions he was very enthusiastic, encouraging and yet described high standards they were establishing for the program. In addition to the faculty advisor and Graduate Director, students will establish a dissertation committee that will assist with advising and evaluating individual students' academic and research progress. Students can also receive support and guidance from the SOPPS Office of Student Affairs. During the onsite tour of the campus a center for professional development was observed where students can also get additional professional guidance as well as support in preparing resumes, dedicated space for onsite, tele- or video-interviews. It should be noted that the undergraduate and graduate students whom we spoke described a very open and collaborative environment where they were encouraged to interact and question faculty outside their primary advisors; they indicated this was one of the benefits of working in SOPPS.

13. Discuss prospects for graduates' post-completion success, whether employment, job advancement, future study, or other outcomes related to the program's goals.

Graduates with a M.S. or Ph.D. in Pharmaceutical Sciences are likely to be recruited actively and secure employment prior to or within reasonable time from graduation. Based on my experience many students interview and are offered positions prior to their graduation. While the program is new, many of the faculty have established relationships within academia, government and industry and would be able to provide sound guidance and support in this area. Further, based on discussions with faculty and students, they are encouraged (required by some labs) to attend regional and national meetings. These offer additional opportunities for students to network with investigators and recruiters. I was impressed with the interactions with the graduate students the faculty were currently mentoring. They were able to articulate their research interest, challenges, as well as future direction of their projects.

IV. Resources

14. Comment on the adequacy of physical resources and facilities, e.g., library, computer, and laboratory facilities; practica and internship sites or other experiential learning opportunities, such as co-ops or service learning; and support services for the program, including use of resources outside the institution.

The resources at SOPPS and University at Binghamton were excellent. The SOPPS moved into a new 105,000 ft² building that houses the Professional and proposed graduate program in Pharmaceutical Sciences. This is part of a new Health Sciences Campus that is under development in Johnson City, N.Y. This site is located near the UHS Wilson Medical Center and Lourdes Hospital and in close proximity to the main campus. Adjacent to SOPPS is the future University's Decker College of Nursing and Health Sciences. One area of concern was the lack of a small animal research vivarium in the new SOPPS. The building was purpose built and well organized. There was adequate collaborative research space as well as contained space for specialized research, e.g., mass spectrometry, imaging, mammalian cell culture, etc. The laboratories were well equipped with state of the art instrumentation. In addition to research space and instrumentation, student space and faculty offices were in close proximity. The educational, research and student spaces were also well equipped with appropriate technology to facilitate learning and research, including video conferencing and personal and networked computing.

It was noted that the University was in the process of constructing a building that was to be connected to the SOPPS dedicated for research and house a modern vivarium to support biomedical research. Further, it was identified that the University was providing some additional research space on the main campus, with ancillary research equipment, to support ongoing research involving small animals prior to the building completion and certification.

Binghamton University is an established university with a national and international reputation. The university has a variety of modern library resources, including online as well as four physical locations. In addition to the physical resources, Binghamton University is part of the SUNY Open Access system and has Interlibrary Loan Service to large breadth of resources needed to conduct research. Students in this program would have access of library instruction and reach assistance.

Overall, the resources are excellent and no concerns other than those described above were noted or observed. In addition to the direct support from the Governor (Health Sciences and building money) and University, they have been successful at obtaining gifts to support students as well as instrumentation.

15. What is the **institution's commitment** to the program as demonstrated by the operating budget, faculty salaries, the number of faculty lines relative to student numbers and workload, and discussions about administrative support with faculty and administrators?

Based on information provided, Binghamton University has shown strong support. The faculty have indicated that their salaries are competitive. A number of faculty indicated that start-up funding was less than at other institutions, but that much of the instrumentation and resources (including software licenses) are provided and supported by the department, school and university. This is a growing trend as start-up packages with expensive instrumentation dedicated for single investigator is not feasible. All the faculty that I spoke with indicated that they had resources necessary to conduct research. The primary limitation was the lack of graduate program. While some faculty did indicate that they had courtesy appointment in other departments and graduate students from those department, others indicated that was not appropriate and they were working with technicians and undergraduates. As indicated above, the hiring of faculty has been staggered with the enrollment of the Pharm.D. program. Overall teaching loads will decrease with projected hiring of new five new faculty. The number of graduate students for number of faculty is appropriate. In comparison my department has 18 faculty (17 who do research) and we have 85 (graduate and undergraduate students).

Furthermore, there is evidence that long-term commitment to the program and its success are evident. The construction of new building for SOPPS and a new vivarium with research support. This is critical to supporting pharmaceutical and biomedical sciences and being competitive for federal extramural (NIH, DOD, etc.,) funding.

V. Summary Comments and Additional Observations

16. Summarize the **major strengths and weaknesses** of the program as proposed with particular attention to feasibility of implementation and appropriateness of objectives for the degree offered.

Overall this is a strong proposal to establish a graduate program in pharmaceutical sciences. It addresses clear demand for interdisciplinary trained researchers in drug discovery through translational research. A major strength is the leadership team, including support from Graduate School, Dean SOPPS and senior faculty. They have assembled a group of well-established scholars with productive records in academia, as well as translational research. The program has been well constructed and offers students both MS and PhD options in areas that are in high demand. The facilities and instrumentation and support services at SOPPS and Binghamton University are excellent. There is strong support and enthusiasm from faculty and existing students, and evidence that local community (local donations) to support program. The program will be part of the expanding health-sciences coordinator that has the potential to lead in pharmaceutical research as well as complement rural health initiatives. While the graduate program is still in development, the faculty have shown ability to secure extramural funding and submit competitive applications (scored NIH).

One weakness is the potential for long-term commitment to support instrumentation. Many pharmaceutical and biomedical instruments require annual calibration and preventative maintenance. While service contracts are typically purchased initially, plans for long-term instrumentation support and replacement are costly. Note, this is NOT unique to this program, rather this is a challenge in academia in general where the life-cycle of critical infrastructure and replacement costs are not adequately budgeted after initial expenses.

17. If applicable, particularly for graduate programs, comment on the ways that this program will make a **unique contribution** to the field, and its likelihood of achieving State, regional and/or national **prominence**.

The program includes faculty with expertise in various disciplines that encompass the pharmaceutical and biomedical sciences. They have hired faculty with research interests that span the major health diseases that are faced in the U.S., but have strengths in neurosciences, specifically Duchenne Muscular Dystrophy. This expertise

will support their future goals of competing for larger center, program and training grants from NIH. Furthermore, a number of faculty in this area have experience with advancing products into clinical trial and spin-off of companies. This combination provides an opportunity to mentor faculty who wish to advance their research, while also providing a unique experience for graduate and undergraduate students to be exposed to entrepreneurship. Based on the overall expertise of the faculty and their ongoing collaborations, they are building a program that has potential to achieve national prominence in the area of neuroscience and may serve as a model for academic entrepreneurship in pharmaceutical sciences.

18. Include any further observations important to the evaluation of this program proposal and provide any **recommendations** for the proposed program.

During our onsite visit Drs. Meredith and Nagaraju clearly articulated their desire to establish a world-class School of Pharmacy, largely in part with development of rigorous and internationally recognized research program in the pharmaceutical sciences. It should be noted that the Provost and Associate Provost also articulated this vision and support for SOPPS. Based on documentation provided, my observations during the on-site evaluation, and my experience I enthusiastically support this program. While many new Schools of Pharmacy are established with a focus on professional education, this program is unique and laid the foundation for competitive research and education in the pharmaceutical sciences, as well as teaching professional students.

Minor Comment: Binghamton University offers a variety of opportunities for students to further their education outside of the research laboratory. While it is not necessary to document them all in the application, it would be beneficial to collect and make resource packages available to incoming and existing students. The creation of a graduate handbook, specific for students within this program may be helpful and assist with clarifying overall responsibilities and deadlines.

I would like to thank all the senior leadership, faculty and students who took time to meet with myself and Dr. Xiong. I was thoroughly impressed, and found everyone to be enthusiastic about their potential to train and mentor graduate students as well as advance the pharmaceutical sciences.



External Reviewer Conflict of Interest Statement

I am providing an external review of the application submitted to the State University of New York by:
Binghamton University, SUNY

(Name of Institution or Applicant)

The application is for (circle A **or** B below)

A) New Degree Authority

B) Registration of a new academic program by an existing institution of higher education:

Pharmaceutical Sciences
(Title of Proposed Program)

I affirm that I:

1. am not a present or former employee, student, member of the governing board, owner or shareholder of, or consultant to the institution that is seeking approval for the proposed program or the entity seeking approval for new degree authority, and that I did not consult on, or help to develop, the application;
2. am not a spouse, parent, child, or sibling of any of the individuals listed above;
3. am not seeking or being sought for employment or other relationship with the institution/entity submitting the application?
4. do not have now, nor have had in the past, a relationship with the institution/entity submitting the application that might compromise my objectivity.

Name of External Reviewer (please print):

Robert D. Arnold, Ph.D.

Signature:



External Evaluation Report

Form 2D

Version 201-08-02

The External Evaluation Report is an important component of a new academic program proposal. The external evaluator's task is to examine the program proposal and related materials, visit the campus to discuss the proposal with faculty and review related instructional resources and facilities, respond to the questions in this Report form, and submit to the institution a signed report that speaks to the quality of, and need for, the proposed program. The report should aim for completeness, accuracy and objectivity.

The institution is expected to review each External Evaluation Report it receives, prepare a single institutional response to all reports, and, as appropriate, make changes to its program proposal and plan. Each separate External Evaluation Report and the Institutional Response become part of the full program proposal that the institution submits to SUNY for approval. If an external evaluation of the proposed program is required by the New York State Education Department (SED), SUNY includes the External Evaluation Reports and Institutional Response in the full proposal that it submits to SED for registration.

Institution: Binghamton University

Evaluator Name (Please print.): Dr. May Xiong, PhD

Evaluator Title and Institution: Associate Professor of Pharmaceutical & Biomedical Sciences, University of Georgia

Evaluator Signature:

Proposed Program Title: Pharmaceutical Sciences

Degree: MS and PhD

Date of evaluation: 11/13/2019-11/15/2019

I. Program

1. Assess the program's **purpose, structure, and requirements** as well as formal mechanisms for program **administration and evaluation**. Address the program's academic rigor and intellectual coherence.

The program purpose, structure and requirements are aligned with PhD programs at other institutions. In summary, per the report, the purpose of the MS and PhD programs in Pharmaceutical Sciences at Binghamton University is to provide students with foundational knowledge and critical skills in pharmaceutical and biomedical sciences relevant to industry, academic, private or federal agencies. The structure of the proposed 1.5-year MS program is designed to provide students with work-ready skills through foundational courses in the first year followed by either a research project, internship, or additional elective coursework in the final semester. The proposed 5-year PhD program consists of 2 years of foundational coursework followed by 3 years of dedicated mentored research. To successfully complete the MS program, students are required to enroll in a minimum of 33 credits, with the entire program designed to be completed in 1.5 years (detailed on pg. 18 of the report). The PhD program requires a minimum of 66 credits completion (detailed on pg. 19-20 of the report). Foundational courses are taken in the first 4 semesters followed by a comprehensive exam (consisting of a written proposal and an oral presentation) which must be passed satisfactorily. Student learning outcomes is assessed at regular intervals by the advising faculty

(MS) and dissertation committee (PhD). Feedback from the assessment process is then used to modify and improve courses, practicum, and curriculum design.

Although MS programs in Pharmaceutical Sciences typically take students 2 years to complete at other institutions offering similar degrees, a 1.5-year MS program may be particularly attractive to those students especially motivated to rapidly gain specific skills to compete in the Pharmaceutical Sciences job market. It is unclear from the MS curriculum, however, how foundational courses taught directly relate to current industry needs and the competitive edge, if any, the program offers in comparison to MS programs offered at other institutions.

2. Comment on the **special focus** of this program, if any, as it relates to the discipline.

Per the report, pre-clinical and clinical research is currently not emphasized by Pharmaceutical Sciences programs at other SUNY institutions thereby the need for the special focus of this program. It is unclear, however, how the clinical aspect of the program would be supported since there is no medical school in Binghamton. It was brought up that there is a clinical faculty who is uniquely situated to indirectly facilitate clinical research by networking faculty with appropriate clinicians in the State of New York, however details of this mechanism was not communicated explicitly in the report.

3. Comment on the plans and expectations for **self-assessment and continuous improvement**.

Per the report, success of the proposed MS/PhD programs will be assessed based on graduation rates, student placement in subsequent doctoral or postdoctoral programs, and job placement in industries aligned with student career objectives. Other indicators of programmatic success will include measuring lab productivity (e.g. publication in high impact peer-reviewed scientific journal) and increased grant awards from both federal and private agencies. Placement data will be compiled and evaluated every year and will form part of the program review. Continuous programmatic improvement will focus on meeting the needs of the market to ensure continued success and relevancy of the training programs offered – it isn't clear from the report what the training needs of the market are and how the special focus of this program will continuously address these skills sufficiently to produce highly qualified graduates ready to compete in the job market. Overall the proposed self-assessment plan is satisfactory and aligned with MS/PhD programs in Pharmaceutical Sciences at other institutions although the continuous plan regarding relevant work-ready training of MS students in particular lacks sufficient details. Please describe more thoroughly how learning outcomes in foundational courses proposed tie in with these work-ready skills.

4. Discuss **the relationship** of this program to other programs of the institution and collaboration with other institutions, and assess available support from related programs.

The proposed MS/PhD program appears highly collaborative compared to similar programs at other institutions, and already include collaborations with graduate programs in nursing, biomedical anthropology, biomedical engineering, chemistry, psychology, and biology. This is noteworthy since such a collaborative environment could provide students with access to a wide range of expertise and inter-professional learning experiences. Notably, a significant number of Biomedical Engineering (BME) graduate students are already performing research under the direction of SOPPS faculty and currently the faculty collectively supervise and train a total of 10 undergraduate students from Chemistry, Biochemistry, Neuroscience, and Biology. Overall, there does appear to be strong support from the graduate school, other graduate programs, and students at the institution for this new MS/PhD program.

5. What is the evidence of **need** and **demand** for the program locally, in the State, and in the field at large? What is the extent of occupational demand for graduates? What is the evidence that demand will continue?

Based on the report provided, only 3 graduate programs in pharmaceutical sciences exist in the state of New York. Currently, the only full graduate program in Pharmaceutical Sciences (MS and PhD) within the SUNY system is

located at the University at Buffalo. According to the data, recently only 9% of the 339 applicants to the University at Buffalo - SUNY Pharmaceutical Sciences program were admitted. Assuming the pool of applicants was qualified, this strongly indicates that there may be a high unmet demand by students in the State of New York for the program. Although the exact overall demand for employees with degrees in Pharmaceutical Sciences is not available, the 10-year projected job growth rate from 2016-2026 does demonstrate continued employment opportunities in this field.

II. Faculty

- 6. Evaluate the faculty**, individually and collectively, with regard to training, experience, research and publication, professional service, and recognition in the field.

A total of 13 individuals currently make up the full-time faculty involved in the program (see pg. 22-23 for specific training details). Currently, the faculty is comprised of 4 full professors (Hathout, Rattinger, Hoffman, Nagaraju), 3 associate professors (Cosler, Beedle, Ali), 5 assistant professors (Brooks, Tumey, Edwards, di Pasqua, Dang) and 1 lecturer (Peterson). Tumey and Edwards are also respectively listed as having 5 and 15 years of industry experience and 3 faculty members (Hoffman, Nagaraju, and di Pasqua) already serve as CEOs of their own successful startup companies. All faculty possess PhDs indicative of their ability to conduct successful original research programs and to train students in research.

- 7. Assess the faculty in terms of number and qualifications and plans for future staffing.** Evaluate **faculty responsibilities** for the proposed program, taking into account their other institutional and programmatic commitments. Evaluate faculty **activity in generating funds** for research, training, facilities, equipment, etc. Discuss any **critical gaps and plans for addressing them**.

In terms of research training, the senior faculty (Hathout, Hoffman, Nagaraju) collectively bring impressive research expertise, high impact publications, and funding experience to the program. Regarding teaching, however, there is some concern that collectively the senior faculty may not possess sufficient teaching experience -- the teaching load at research hospitals, for example, tends to be significantly less than typical of graduate programs. Of the 3 associate professors listed (Cosler, Beedle, Ali), only Beedle has previously worked and taught graduate courses in a Pharmaceutical Sciences degree program.

The two main thrusts of a graduate program in Pharmaceutical Sciences are to conduct original research and competently teach courses in the areas of medicinal chemistry, pharmaceuticals, and pharmacology. Faculty with specific expertise in these areas should be hired to competently cover and teach all aspects of pharmaceutical sciences at levels appropriate to a graduate program. The makeup of the faculty currently lacks the necessary expertise to deeply cover pharmaceuticals. For example, in some areas of the curriculum, there is overlap in discipline and expertise between the faculty such that some topics can be covered by several faculty as needed, however critical topics related to pharmaceuticals (e.g. solid state, solubility and dissolution, partitioning and interfacial phenomena, drug delivery and targeting, pharmacokinetics) need to be taught at graduate levels. It is highly recommended that 1-2 of the new faculty hires be in the area of Pharmaceuticals, preferably at the associate or full-professor level, to fill in this critical gap of Pharmaceutical Sciences.

Collectively, funding activities by the faculty are excellent, and several faculty have already been successful at obtaining individual federal grants to support their research programs. Many faculty are additionally pursuing training (e.g. T32) and center grants to further support their research programs.

- 8. Evaluate credentials and involvement of adjunct faculty and support personnel.**

N/A

III. Students

9. Comment on the **student population the program seeks to serve**, and assess plans and projections for student recruitment and enrollment.

Until national recognition of the program is established, the majority of students are expected to be drawn from the institution and from the State of New York. No concerns noted regarding the student population the program seeks to serve. Based on discussions with students (currently from other graduate programs) conducting research under SOPPS faculty, there does appear to be significant interest in a PhD in Pharmaceutical Sciences. An estimated 10 MS and 7 PhD students are expected to enroll in the program the first year. Since PhD enrollment of new students in subsequent years will be tied to funding success for each faculty, the estimate of 2-3 new PhD students per year is conservative and reasonable. This also appears to be aligned with the 16 dedicated TA positions available to support PhD students throughout the duration of the 5-year program should faculty be unable to obtain external funding to support students.

10. What are the prospects that recruitment efforts and admissions criteria will supply a **sufficient pool of highly qualified applicants and enrollees**?

Prospects appear good that the pool of applicants will be highly qualified. It's my understanding that the admission rate for undergraduates is 20% at Binghamton therefore recruitment of highly qualified grad students into the program from the undergraduate pool should guarantee the applicants will likely be qualified. Additionally, since the MS degree is currently not tied to faculty funding success, the recruitment of promising PhD students could also come from these self-funded MS students if a mechanism is set in place for those MS students to transition for approximately 3 years into the PhD program.

11. Comment on provisions for encouraging participation of **persons from underrepresented groups**. Is there adequate attention to the needs of part-time, minority, or disadvantaged students?

The recruitment of a native Nigerian with competitive academic credentials to join the faculty is a step in the right direction. Targeting promising underrepresented students early on as discussed and providing them with summer research internship experiences in faculty labs are excellent ideas to encourage underrepresented students to apply to the program.

12. Assess the system for monitoring **students' progress and performance** and for **advising students** regarding academic and career matters.

No major concerns noted regarding the program's method to monitor MS and PhD student progress. The comprehensive exam as proposed is aligned with other institutions; UW-Madison's Department of Pharmaceutical Sciences and the University of Georgia's Pharmaceutical and Biomedical Sciences department similarly require students to submit a research proposal and to pass an oral exam related to the proposal.

13. Discuss prospects for graduates' post-completion success, whether **employment, job advancement, future study, or other outcomes related to the program's goals**.

Employment prospects for students with a MS/PhD in Pharmaceutical Sciences remain excellent. At UW-Madison, the majority of graduates typically find employment with pharmaceutical companies or federal agencies immediately or within a year of graduation; a lower number of graduates continue on to postdoctoral work to pursue academic careers or to teach in Pharmacy schools. At the University of Georgia, our graduates primarily continue on to postdoctoral studies, followed by employment in industry and in private and public federal agencies. Employment opportunities in this area over the next 10 years remain quite good overall.

IV. Resources

14. Comment on the adequacy of physical **resources** and **facilities**, e.g., library, computer, and laboratory facilities; practica and internship sites or other experiential learning opportunities, such as co-ops or service learning; and support services for the program, including use of resources outside the institution.

Resources and facilities at Binghamton are excellent. The SOPPS is housed in a \$65M newly constructed, dedicated 4-floor building that opened in Fall 2018. In addition, dedicated space and plans for a new vivarium next to the new SOPPS building are in progress and will provide state of the art facilities for small animal work. The department's shared instrumentation model and flexible fume hoods and workbench space is efficient and sensible at this stage of program development. More dedicated fume hoods and workbench space may be preferable for faculty with chemistry-focused research programs. Overall, discussions with faculty indicated they had access to all resources and facilities necessary to competitively pursue their research programs.

15. What is the **institution's commitment** to the program as demonstrated by the operating budget, faculty salaries, the number of faculty lines relative to student numbers and workload, and discussions about administrative support with faculty and administrators?

Institutional commitment to ensure the success of the new program is outstanding. No major concerns noted.

V. Summary Comments and Additional Observations

16. Summarize the **major strengths and weaknesses** of the program as proposed with particular attention to feasibility of implementation and appropriateness of objectives for the degree offered.

Major strengths include senior faculty makeup consisting of well-recognized and respected scientists (Hathout, Hoffman, Nagaraju) with impressive research programs, high impact publications and funding experience and entrepreneurial expertise. The recruitment of junior faculty with ties to industry (Tumey, Edwards), high level of inter-department collaborations, excellent institutional commitment and support, outstanding resources and facilities, and institutional pool of highly qualified applicants to the new program are major strengths.

Major weaknesses include concerns regarding senior faculty lacking teaching experience. Furthermore, of the 3 associate-level professors (Cosler, Beedle, Ali), only Beedle has previously worked and taught graduate courses in a Pharmaceutical Sciences degree program. Importantly, the department currently lacks the necessary expertise to cover special topics in the field of pharmaceuticals in depth - lecturers may be suitable for foundational courses but graduate level courses can only be taught by faculty with higher level expertise. Finally, the special focus of this program includes clinical research but there is no medical school in Binghamton, and it would be advisable to describe in more details how the program plans on formally addressing this gap.

17. If applicable, particularly for graduate programs, comment on the ways that this program will make a **unique contribution** to the field, and its likelihood of achieving State, regional and/or national **prominence**.

N/A

18. Include any **further observations** important to the evaluation of this program proposal and provide any **recommendations** for the proposed program.

Special topics in pharmaceuticals (e.g. solid state, solubility and dissolution, partitioning and interfacial phenomena, drug delivery and targeting, pharmacokinetics) need to be taught at appropriate graduate levels and faculty expertise in this area is missing. Lecturers are not suitable for teaching graduate level courses. It is highly recommended that 2 out of the 4 new faculty hires be in the area of Pharmaceuticals, preferably at least 1 hire at the associate or full-professor level.



External Reviewer Conflict of Interest Statement

I am providing an external review of the application submitted to the State University of New York by:

Binghamton University

(Name of Institution or Applicant)

The application is for (circle A or B below)

A) New Degree Authority

B) Registration of a new academic program by an existing institution of higher education:

Pharmaceutical Sciences

(Title of Proposed Program)

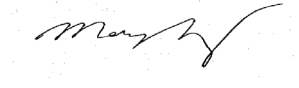
I affirm that I:

1. am not a present or former employee, student, member of the governing board, owner or shareholder of, or consultant to the institution that is seeking approval for the proposed program or the entity seeking approval for new degree authority, and that I did not consult on, or help to develop, the application;
2. am not a spouse, parent, child, or sibling of any of the individuals listed above;
3. am not seeking or being sought for employment or other relationship with the institution/entity submitting the application?
4. do not have now, nor have had in the past, a relationship with the institution/entity submitting the application that might compromise my objectivity.

Name of External Reviewer (please print):

May P. Xiong

Signature:

A handwritten signature in black ink, appearing to be 'M. Murphy', is centered between two horizontal lines. The signature is written in a cursive style with a large, sweeping 'M' and a long, trailing flourish.

Appendix E: Institutional Response to External Evaluator's Reports

We are very grateful to Dr. Robert Arnold (Auburn University) and Dr. May Xiong (University of Georgia) for their thorough and thoughtful evaluation of our proposal to establish a PhD and MS program at Binghamton University School of Pharmacy and Pharmaceutical Sciences.

The external reviewers noted several strengths of our proposal. Dr. Arnold wrote, "I enthusiastically support Binghamton University's proposal to establish a graduate program in Pharmaceutical Sciences. I believe that all of the parties involved have invested considerable effort and resources, as well as careful thought to develop a rigorous program that will complement existing graduate programs at Binghamton University, as well as strengthen the health-sciences core and add value to Binghamton University and the SUNY system." Dr. Xiong wrote, "The proposed MS/PhD program appears highly collaborative compared to similar programs at other institutions, and already include collaborations with graduate programs in nursing, biomedical anthropology, biomedical engineering, chemistry, psychology, and biology. This is noteworthy since such a collaborative environment could provide students with access to a wide range of expertise and inter-professional learning experiences."

Here, we respond to weaknesses of the proposed program identified by the reviewers, and respond to these.

Dr. Arnold noted mostly strengths, including emphasizing the broadening gap in national employee pool for trained pharmaceutical scientists that the proposed program would help fill. He noted very minor weaknesses.

I.1. Program structure and requirements.

"It is not clear if onsite interviews will be required. It is recommended that if onsite interviews are not possible, that team based tele- or video-interviews be conducted."

This is our oversight in the proposal. We plan to conduct on site interviews for national and regional MS and PhD applicants, and remote interviews for international applicants. This has been clarified in the revised proposal.

V.16. Summary

"One weakness is the potential for long-term commitment to support instrumentation. Many pharmaceutical and biomedical instruments require annual calibration and preventative maintenance."

We also recognize and have voiced this challenge to the reviewers. Typically funds for expensive service contracts are managed through cost-sharing of grants, donations, and institutional support. As SOPPS is a very new school, we are working towards achieving this distributed shared balance of support. Funds to cover the cost of the service contracts can be partially budgeted on grants when available but we have also established a charge back mechanism that will help with partially covering service contract and consumable. For example, just last year we have generated \$25 K from charge backs that we will use to cover the annual service contract for Thermo Scientific™ Q Exactive™ HF hybrid quadrupole-Orbitrap mass spectrometer.

V.18. Summary

"Minor Comment: Binghamton University offers a variety of opportunities for students to further their education outside of the research laboratory. While it is not necessary to document them all in the application, it would be beneficial to collect and make resource packages available to incoming and

existing students. The creation of a graduate handbook, specific for students within this program may be helpful and assist with clarifying overall responsibilities and deadlines.”

This is an excellent suggestion, and we will now plan to implement this suggestion by adding it to our graduate handbook specific for students within this program.

Dr. Xiong listed more suggestions and concerns. These are addressed as follows.

I.1. Program structure and requirements

“It is unclear from the MS curriculum, however, how foundational courses taught directly relate to current industry needs and the competitive edge, if any, the program offers in comparison to MS programs offered at other institutions.”

The 2nd reviewer, Dr. Arnold, disagreed with this opinion, stating, “this program has been developed with a focus on drug target discovery and drug development. While many programs provide instruction in these areas, there are few programs that have curriculum and faculty who are advancing early drug discovery with goal of identifying lead compounds for translation to the clinic.” Dr. Arnold continued to compare/contrast the proposed Binghamton SOPPS Masters with other programs in New York State, pointing out the unique strengths of the proposed training plan at SOPPS.

2. Special focus. *“.. is a clinical faculty who is uniquely situated to indirectly facilitate clinical research by networking faculty with appropriate clinicians in the State of New York, however details of this mechanism was not communicated explicitly in the report”*

SOPPS includes the Department of Pharmacy Practice, and about half of all faculty at SOPPS are clinical faculty. Furthermore, the majority of our faculty at the Department of Pharmaceutical Sciences has established strong collaborations with our clinical practice faculty within the school as well as clinicians in the New York State (Upstate Medical School, University of Rochester Medical Center) and beyond (Children’s National Health System, Washington DC, University of Pittsburgh School of Medicine, UC Davis medical center, Ann & Robert H. Lurie Children’s Hospital of Chicago). Our future graduate students will have opportunities to work on different clinical and translation research projects and gain expertise in the field It is not clear how Dr. Xiong felt this was not clear.

II. Faculty

7. Qualifications. *“Regarding teaching, however, there is some concern that collectively the senior faculty may not possess sufficient teaching experience -- the teaching load at research hospitals, for example, tends to be significantly less than typical of graduate programs.”*

Dr. Hoffman established one of the 3 basic science departments, Integrative systems biology and successfully ran the PhD training program in Molecular Genetics and Biochemistry at George Washington University School of Medicine for about 5 years prior to joining Binghamton. Drs. Hoffman, Nagaraju and Hathout not only extensively thought in PhD programs at multiple premier institutions in the United States but have graduated over 40 PhD students as primary mentors and 100 PhD students as co-mentors over the last 2 decades. All faculty carry a full teaching load for PharmD students as well.

While research hospital teaching, on average, is less, this has not been the case with some senior faculty.

“It is highly recommended that 1-2 of the new faculty hires be in the area of Pharmaceutics, preferably at the associate or full-professor level, to fill in this critical gap of Pharmaceutical Sciences.”

This is indeed planned in our staged hiring process. Our current plan is to have pharmaceutics faculty recruited before starting our MS/PhD program.

V. Summary Comments and Additional Observations

16. *“Major weaknesses include concerns regarding senior faculty lacking teaching experience. Furthermore, of the 3 associate-level professors (Cosler, Beedle, Ali), only Beedle has previously worked and taught graduate courses in a Pharmaceutical Sciences degree program. Importantly, the department currently lacks the necessary expertise to cover special topics in the field of pharmaceutics in depth - lecturers may be suitable for foundational courses but graduate level courses can only be taught by*

faculty with higher level expertise. Finally, the special focus of this program includes clinical research but there is no medical school in Binghamton, and it would be advisable to describe in more details how the program plans on formally addressing this gap.”

All these weaknesses were addressed in specific comments above. Drs. Hoffman, Nagaraju and Hathout, bring extensive PhD training experience in his directorship of a successful PhD program at George Washington University School of Medicine. Dean Meredith has also a long record in mentoring and training graduate and medical school students in neurology related research. Faculty in Pharmaceutics are planned to be hired, as suggested. Clinical research is afforded by the many clinical faculty at SOPPS, interactions with regional, national, and international collaborative clinical trials and clinical research, and leadership roles of faculty in many pre-clinical and clinical drug development programs.