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March 25, 2020

Dr. James D. Fielder, Jr.
Secretary of Higher Education
Maryland Higher Education Commission
6 North Liberty Street
Baltimore, MD 21201

Dear Secretary Fielder:

The Department of Chemistry create a new Area of Concentration: Pre-Pharmacy within the Chemistry major as a pathway to prepare students for admission to professional schools of pharmacy and for graduate studies in pharmaceutical sciences, medicinal chemistry, and related fields. The MD Department of Labor, Licensing, and Regulation estimates the need for 320 new or replacement pharmacists each year through 2026. PharmD programs in MD are only producing an average of 250 graduates per year. This program provides a solid core Chemistry experience while optimizing the other courses in the program to closely match pharmacy program pre-requisites. Students who complete this program and do not matriculate into PharmD programs will still be well-prepared for employment or graduate studies in chemistry, biochemistry, medicinal chemistry, pharmacology, toxicology, and other related fields.

Proposal Type:	Area of Concentration New
Program:	Chemistry
Title of Proposed Program:	Bachelor of Science in Chemistry, Pre-Pharmacy Concentration
Award Level:	Bachelor's Degree
CIP:	400501
HEGIS:	190500

We would appreciate your support for this request. Enclosed please find the completed proposal and cover sheet. If you have any questions, please do not hesitate to contact me or our Assistant VP for Analytics, Dr. Sara-Beth Bittinger at sbittinger@frostburg.edu.

Yours truly,

A handwritten signature in black ink that reads 'Elizabeth A. Throop'.

Dr. Elizabeth Throop
Provost and Vice President for Academic Affairs

pc: Dr. Emily Dow, Assistant Secretary. Academic Affairs, MHEC
Dr. Antoinette Coleman, Associate Vice Chancellor for Academic Affairs, USM
Dr. Sara-Beth Bittinger, Interim Assistant VP for Analytics, FSU
Dr. Kim Hixson, Dean of the College of Liberal Arts and Sciences, FSU



Cover Sheet for In-State Institutions

New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	Frostburg State University
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Each action below requires a separate proposal and cover sheet.

- | | |
|--|---|
| <input type="radio"/> New Academic Program | <input type="radio"/> Substantial Change to a Degree Program |
| <input checked="" type="radio"/> New Area of Concentration | <input type="radio"/> Substantial Change to an Area of Concentration |
| <input type="radio"/> New Degree Level Approval | <input type="radio"/> Substantial Change to a Certificate Program |
| <input type="radio"/> New Stand-Alone Certificate | <input type="radio"/> Cooperative Degree Program |
| <input type="radio"/> Off Campus Program | <input type="radio"/> Offer Program at Regional Higher Education Center |

Payment <input type="radio"/> Yes	Payment <input checked="" type="radio"/> R*STARS	Payment 250.00	Date 3/25/2020
Submitted: <input type="radio"/> No	Type: <input type="radio"/> Check	Amount:	Submitted:

Department Proposing Program	Chemistry		
Degree Level and Degree Type	40 Bachelor's Degree		
Title of Proposed Program	Bachelor of Science in Chemistry, Pre-Pharmacy Concentration		
Total Number of Credits	120		
Suggested Codes	HEGIS: 190500	CIP: 400501	
Program Modality	<input checked="" type="radio"/> On-campus <input type="radio"/> Distance Education (<i>fully online</i>) <input type="radio"/> Both		
Program Resources	<input checked="" type="radio"/> Using Existing Resources <input type="radio"/> Requiring New Resources		
Projected Implementation Date	<input checked="" type="radio"/> Fall <input type="radio"/> Spring <input type="radio"/> Summer Year: 2020		
Provide Link to Most Recent Academic Catalog	URL: https://www.frostburg.edu/academics/undergraduate-catalog.php		
Preferred Contact for this Proposal	Name: Robert Larivee		
	Title: Professor and Chair of Chemistry		
	Phone: (301) 687-4091		
	Email: laviree@frostburg.edu		
President/Chief Executive	Type Name: Ronald Nowaczyk		
	Signature: <i>Ronald H. Nowaczyk</i>		Date: 03/25/2020
	Date of Approval/Endorsement by Governing Board:		

Revised 12/2018

A. Centrality to Institutional Mission and Planning Priorities:

1. Program description and relationship to mission:

Frostburg State University (FSU) is proposing a new Pre-Pharmacy Concentration within the Bachelor of Science in Chemistry to be approved beginning fall 2020.

The proposed Pre-Pharmacy Concentration would require 86-87 undergraduate semester hours of credit. Professional schools in pharmacy require an interdisciplinary preparation in chemistry and biology with supporting coursework in physics, mathematics, composition, speech, and economics. This Concentration would include 38-39 hours of chemistry coursework, including the chemistry program's capstone sequence featuring an option for research or internship. Coursework in other disciplines includes biology (20 hours), mathematics (11 hours), physics (8 hours), composition (3 hours), speech (3 hours), and economics (3 hours). These requirements are based on supplementing FSU's core curriculum in chemistry (general chemistry, organic chemistry, and analytical chemistry, physical chemistry, and research methods) with the common courses in biology and other disciplines required for admission to graduate and professional programs in pharmacy.

The Concentration would be housed within the BS in Chemistry since the plurality of the semester hours are in chemistry, including the capstone sequence. The Concentration would be administered by the Department of Chemistry within the College of Liberal Arts and Sciences.

The proposed Pre-Pharmacy Concentration supports FSU's mission to address the workforce needs in the region and state. The MD Department of Labor, Licensing, and Regulation estimates 3,200 new and replacement pharmacist positions will need be filled in Maryland by 2026. Additionally, this Concentration is being proposed in anticipation of creating articulation agreements for dual-degree programs with professional schools in pharmacy. These agreements will create accelerated pipelines for students to enter and complete PharmD programs while also completing a BS from FSU.

2. Explain how the proposed program supports the institution's strategic goals and provide evidence that affirms it is an institutional priority.

As part of the overall strategic plan of the institution to meet workforce demands, FSU has focused in recent years on development of health professions programs. Since 2010, FSU has initiated a Health Science major, RN to BSN program, Master of Science in Nursing program, MS in Athletic Training, MS in Physician Assistant Studies, and Healthcare Management Concentration within our existing MBA. This proposed Pre-Pharmacy Concentration joins these other programs as a pathway to prepare students for careers in the health professions.

Specifically, this proposed Concentration supports the following institutional goal (FSU Strategic Plan, <https://www.frostburg.edu/about-frostburg/strategic-plan-2018-2023/strategic-goals.php>):

Goal IV. Align university resources – human, fiscal, and physical – with strategic priorities:

A. Ensure academic programs meet student and workforce expectations.

3. Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation. (Additional related information is required in section L.

This Concentration will be offered within existing resources. The courses in this Concentration are all existing courses serving the General Education Program as well as existing programs in Chemistry, Biology, and Health Science.

4. Provide a description of the institution's a commitment to:
 - a) ongoing administrative, financial, and technical support of the proposed program

This Concentration is being offered within the BS in Chemistry, a program that has been offered continuously at FSU since 1964. The institution is committed to the continuance of this degree program. This Concentration will utilize existing courses within the BS in Chemistry as well as existing Biology, Physics, Mathematics, and GEP courses. Existing resources dedicated to these programs and courses will be extended to cover the additional projected enrollment projected for this program.

- b) continuation of the program for a period of time sufficient to allow enrolled students to complete the program.

FSU will offer this Concentration for an initial period of at least 7 years. At the end of the first three-year period, the program will be reviewed to determine if enrollment projections are being met. If enrollment projections are not being met, the Department of Chemistry will develop a recovery plan to increase enrollment.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan:

1. Demonstrate demand and need for the program in terms of meeting present and future needs of the region and the State in general based on one or more of the following:
 - a) The need for the advancement and evolution of knowledge
N/A

- b) Societal needs, including expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education

FSU fulfills a unique role as the only public comprehensive university west of the Baltimore-Washington corridor in providing educational opportunities to students in western Maryland. During fall 2018, FSU served 42.5% undergraduate minority students (FSU Office of Assessment & Institutional Research, <https://www.frostburg.edu/academics/air/files/pdfs/fast-facts/factsheetfsu2018.pdf>). This Concentration provides this student population with a preparation pathway into professional schools of pharmacy.

- c) The need to strengthen and expand the capacity of historically black institutions to provide high quality and unique educational programs

N/A

2. Provide evidence that the perceived need is consistent with the [Maryland State Plan for Postsecondary Education](#).

While Bachelor's degree programs in Chemistry are numerous in the state and many institutions provide pre-pharmacy advising, this proposed Concentration will be the first program in the state to explicitly prepare students for advanced study in pharmacy while leading to the Bachelor's degree. The program is being proposed in anticipation of developing articulation agreements and/or dual degree arrangements with schools of pharmacy in the state and region. This outcome is consistent *The 2017-21 Maryland State Plan for Postsecondary Education* Strategy 6 to provide better options designed to facilitate prompt degree completion. This Concentration will prepare students for matriculation into graduate and professional programs without completion of extraneous courses outside the program, and articulation agreements based on it may lead to accelerated dual degree programs.

Additionally, Strategy 4 outlines the need for access to affordable educational opportunities for all Marylanders. Frostburg State University is committed to students graduating with low or no student debt. As the only public four-year institution west of the Baltimore-Washington Corridor, FSU provides access to educational opportunities otherwise nonexistent in Western Maryland. Finally, FSU serves a diverse undergraduate student population (42.5% minority in 2018).

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State:

1. Describe potential industry or industries, employment opportunities, and expected level of entry (*ex: mid-level management*) for graduates of the proposed program.

Graduates of this proposed Concentration will be well-prepared to enter Master's and Doctorate programs in pharmacy, pharmaceutical sciences, pharmacology, medicinal chemistry, or biomedical science. These professions are highly trained research specialists and care providers working in the healthcare, pharmaceutical manufacturing, and biomedical research industries.

2. Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program.

The MD Department of Labor, Licensing, and Regulation (DLLR) provides long-term employment projections in the state (<https://www.dllr.state.md.us/lmi/iandoproj/maryland.shtml>). Relevant occupation titles include Pharmacist and Medical Scientist (except epidemiologists), both of which are expecting growth in the state through 2026. In total, between 2016 and 2026, over 7,500 positions in these occupations will need to be filled. Annually, an average of 320 new pharmacists and 435 new medical scientists.

		Employment			Separations			
Occ. Code	Occupational Title	2016	2026	Change	Exits	Transfers	Total	Education Value
29-1051	Pharmacists	6,223	6,716	493	1,477	1,232	3,202	Doctoral or professional degree
19-1042	Medical Scientists, Except Epidemiologists	4,645	5,090	445	879	3,033	4,357	Doctoral or professional degree
TOTAL		10,868	11,806	938	2,356	4,265	7,559	

- Discuss and provide evidence of market surveys that clearly provide quantifiable and reliable data on the educational and training needs and the anticipated number of vacancies expected over the next 5 years.

The “Pharmacist Demand Index” (PDI) produced by [Pharmacymanagerpower.com](https://pharmacymanagerpower.com) (<https://pharmacymanagerpower.com/>) is an analysis of a quarterly market survey of pharmacists and those who hire pharmacists. The index is rated on a five-point scale, with 5 indicating demand for pharmacists vastly outweighing supply, 1 indicating supply vastly outweighing demand, and 3 indicating a balanced between supply and demand. The nationwide average PDI for 4th quarter of 2018 currently 2.91 when weighted by state population, indicating a small surplus of pharmacists. The PDI was higher for more specialized positions including pharmacy managers. In this survey, MD is grouped into the South Atlantic region, which also includes DC, DE, FL, GA, NC, SC, VA, and WV (<https://pharmacymanagerpower.com/region.php>). The South Atlantic region is experiencing a slightly larger pharmacist surplus with a PDI of 2.69. However, MD is also often grouped by other organizations into the Middle Atlantic, which in this survey is NJ, NY, and PA. The Middle Atlantic Region has almost no pharmacist surplus with a PDI of 2.98.

As the proposed Concentration is for a 4-year Bachelor’s degree preparing students to enter a 2- or 4-year graduate program or 4-year professional doctorate program, it is very unlikely that students starting this program will be employed to meet workforce needs over the next five years. Since these students will be entering the workforce in 6-8 years after implementation, a current surplus should not be viewed negatively.

Long term projections are rarer, but the US Bureau of Labor Statistics (<https://www.bls.gov/ooh/healthcare/pharmacists.htm#tab-6>) projects a 6% growth in the number of pharmacists from 2016-2026, in part because of the increase in incidence in chronic disease and the ageing of the US population as a whole. Both of these factors will increase the amount of medication needed and require more pharmacists to dispense them. DLLR projects almost 8% growth in number of pharmacist positions in the same time period. In addition to new positions over the next 6-8 years, retirements among the ageing baby-boomer population will create numerous additional openings.

- Provide data showing the current and projected supply of prospective graduates.

Current Master's and Doctorate programs produce around 350 graduates in pharmacy and biomedical science. These graduates are not sufficient to meet the expected workforce growth. If these programs expand to meet workforce demand, additional students with appropriate Bachelor's degrees will be needed to matriculate into these programs.

Institution	Program	Degree Type	Degrees Award in 2017-2018 (IPEDS)
Hood College	Biomedical Sciences	Master's	12
Johns Hopkins University	Biomedical Sciences	Master's	16
Johns Hopkins University	Pharmacology	Master's	2
University of Maryland, Baltimore	Molecular Medicine	Master's	11
University of Maryland, Baltimore	Pharmaceutical Sciences	Master's	3
University of Maryland, Baltimore	Pharmaceutics and Drug Design	Master's	11
University of Maryland, Eastern Shore	Pharmaceutical Sciences	Master's	1
Notre Dame of Maryland University	Pharmacy	Doctorate	53
Johns Hopkins University	Biomedical Sciences	Doctorate	5
Johns Hopkins University	Pharmacology	Doctorate	5
University of Maryland, Baltimore	Molecular Medicine	Doctorate	13
University of Maryland, Baltimore	Pharmaceutical Sciences	Doctorate	15
University of Maryland, Baltimore	Pharmacy	Doctorate	149
University of Maryland, Eastern Shore	Pharmaceutical Sciences	Doctorate	0
University of Maryland, Eastern Shore	Pharmacy	Doctorate	51
Total Master's Degrees Awarded			56
Total Professional Doctorates (Pharmacy) Awarded			253
Total Research Doctorates Awarded			58
Total Degrees Awarded			347

Students typically prepare for pharmacy by pursuing Bachelor's degrees in Chemistry or Biochemistry, although other Bachelor's programs, including biology, may be used. Last year, Chemistry and Biochemistry programs at institutions in MD produced 475 Bachelor's degrees (IPEDS data). However, these programs also prepare students for a wide range of other occupations and graduate and professional degree programs. A significant fraction of current graduates would need to matriculate into relevant graduate and professional programs to meet workforce demands in pharmacy and biomedical science. This is likely not the case, and additional Bachelor's prepared students will be needed.

The following institutions offer Bachelor's degrees in chemistry or biochemistry:

Institution	Program	Degree Type	Degrees Award in 2017-2018 (IPEDS)
Coppin State University	Chemistry	Bachelor's Degree	0
Frostburg State University	Chemistry	Bachelor's Degree	13
Goucher College	Chemistry	Bachelor's Degree	9

Goucher College	Molecular Biology & Biochemistry	Bachelor's Degree	9
Hood College	Chemistry	Bachelor's Degree	4
Hood College	Biochemistry	Bachelor's Degree	2
Johns Hopkins University	Chemistry	Bachelor's Degree	24
Loyola University Maryland	Chemistry	Bachelor's Degree	7
McDaniel College	Chemistry	Bachelor's Degree	6
Morgan State University	Chemistry	Bachelor's Degree	4
Mount St. Mary's University	Biochemistry	Bachelor's Degree	14
Mount St. Mary's University	Chemistry	Bachelor's Degree	6
St. Mary's College of Maryland	Biochemistry	Bachelor's Degree	15
St. Mary's College of Maryland	Chemistry	Bachelor's Degree	6
Stevenson University	Biochemistry	Bachelor's Degree	40
Stevenson University	Biochemistry	Bachelor's Degree	6
Towson University	Molecular Biology, Biochemistry, Bioinformatics	Bachelor's Degree	28
Towson University	Chemistry	Bachelor's Degree	47
United States Naval Academy	Chemistry	Bachelor's Degree	33
University of Baltimore	Medicinal and Pharmaceutical Chemistry	Bachelor's Degree	0
University of Maryland, Eastern Shore	Biochemistry	Bachelor's Degree	4
University of Maryland, Eastern Shore	Biochemistry	Bachelor's Degree	3
University of Maryland, Baltimore County	Biochemistry & Molecular Biology	Bachelor's Degree	72
University of Maryland, Baltimore County	Chemistry	Bachelor's Degree	13
University of Maryland, College Park	Biochemistry	Bachelor's Degree	62
University of Maryland, College Park	Chemistry	Bachelor's Degree	40
Washington Adventist University	Biochemistry	Bachelor's Degree	2
Washington Adventist University	Chemistry	Bachelor's Degree	1
Washington College	Chemistry	Bachelor's Degree	5
Total Bachelor's Degrees Awarded			475

Five institutions offer Bachelor's degrees in Health Sciences, including FSU. Like programs in chemistry and biochemistry, these programs also prepare students for other occupations, including medicine/physician, physician assistantship, optometry, veterinary medicine, occupational therapy, physical therapy, and public health. Even if all 140 or so graduates from these programs annually went on to pharmacy school, these programs do not meet current demand.

Institution	Program	Degree Type	Degrees Award in 2017-2018 (IPEDS)
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Coppin State University	Health Sciences	Bachelor's Degree	9
Frostburg State University	Health Science	Bachelor's Degree	21
Mount St. Mary's University	Health Sciences	Bachelor's Degree	18
University of Maryland, Baltimore County	Health Science and Policy	Bachelor's Degree	92
Washington Adventist University	Health Science	Bachelor's Degree	2
Total Bachelor's Degrees Awarded			142

D. Reasonableness of Program Duplication:

1. Identify similar programs in the State and/or same geographical area. Discuss similarities and differences between the proposed program and others in the same degree to be awarded.

The only similar program to the proposed Concentration is the Bachelor's degree in Medicinal and Pharmaceutical Chemistry approved by MHEC at the University of Baltimore. However, this program is not listed in the current University of Baltimore academic catalog (<http://www.ubalt.edu/academics/academic-programs.cfm>) and awarded zero degrees in the last few academic years. This program may have been suspended. For this reason, FSU is not concerned about duplicating this program.

Programs that lead to a Bachelor's degree in Chemistry or Biochemistry without a specialization in pharmacy are numerous within the state. This program specializes in coursework that prepares students for pharmacy while providing a strong foundation in chemistry. Existing Bachelor's degree in Chemistry programs tend to not include the biology courses required for preparation for pharmacy and other health professions. Programs in Biochemistry typically have additional biology courses, but do not always include anatomy and physiology as this proposed program does. This program also includes the economics and oral communication courses that are generally required as for pharmacy admissions.

Many institutions provide "Pre-Pharmacy" or "Pharmacy Preparation" course lists to their students for advising purposes, but these course sequences do not lead to degrees. This Concentration leads to the awarding of a Bachelor's Degree, and so is significantly different from "Pre-Pharmacy" or "Pharmacy Preparation" sequences at other institutions.

FSU and four other institutions offer bachelor's degrees in Health Science. These programs prepare students more generally for careers in the health sciences and usually do not include the upper-level chemistry coursework needed for pharmacy. For example, FSU's Health Science program only includes organic chemistry and biochemistry as electives, while pharmacy programs require or strongly suggest them for admission. Additionally, FSU's program in Health Science does not include courses in economics and oral communication, which are required for pharmacy, and instead focuses on psychology and sociology for social and behavioral science electives.

2. Provide justification for the proposed program.

This Pre-Pharmacy Concentration will prepare students to attend professional schools of pharmacy or graduate programs in pharmaceutical sciences or medicinal chemistry. Existing

programs at FSU may prepare students for graduate and professional studies in chemistry or the health professions more broadly, but no program specifically prepares students for the study of pharmacy or pharmaceutical science.

In particular, this program is being proposed in anticipation of creating articulation agreements with professional schools of pharmacy to enable FSU students to matriculate into PharmD programs after three years at FSU. The curriculum in this program (see below) is structured so that students will complete all pre-pharmacy courses during their first three years. Other programs at FSU, including the BS in Health Science, the Biochemistry Concentration in the BS in Chemistry, and the Pre-Health Option in the BS in Biology are not structured with this purpose in mind. Students in those programs may not be able to take advantage of accelerated pathways to PharmD programs.

E. Relevance to High-demand Programs at Historically Black Institutions (HBIs)

1. Discuss the program's potential impact on the implementation or maintenance of high-demand programs at HBIs.

Bachelor's degrees in Chemistry are numerous in MD, at both HBIs and non-HBIs. The specialization in pharmacy does not exist within any Bachelor's degree in Chemistry in MD, and so this proposed Concentration will not duplicate or impact unique or high-demand programs at HBIs.

F. Relevance to the identity of Historically Black Institutions (HBIs)

1. Discuss the program's potential impact on the uniqueness and institutional identities and missions of HBIs.

We anticipate this program will have a positive impact on at least one program at a HBI. This proposed Pre-Pharmacy Concentration is being developed to provide pathways into professional pharmacy programs in MD. One such program is at the University of Maryland, Eastern Shore. Given FSU's diverse undergraduate student population (42.5% minority in 2018), we are expecting that some graduates of this program will seek matriculation at UMES. In the long term, this program could become the basis for an articulated dual-degree pathway between FSU and UMES for students interested in pharmacy and pharmaceutical sciences.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning

Outcomes (as outlined in COMAR 13B.02.03.10):

1. Describe how the proposed program was established, and also describe the faculty who will oversee the program.

This Pre-Pharmacy Concentration was developed by the faculty in FSU's Department of Chemistry in response to interest in articulation agreements by schools of pharmacy within the geographic region. The program is structured to support the admission requirements that are generally in common between the various professional pharmacy programs while

providing core courses in chemistry. This program will be overseen by the faculty of the Department of Chemistry led by the department's chair.

2. Describe educational objectives and learning outcomes appropriate to the rigor, breadth, and (modality) of the program.

This program will share the learning outcomes of FSU's Bachelor's degree in Chemistry:

- A. Oral Communication – Chemistry graduates will
 1. properly use scientific vocabulary and properly communicate ideas orally
 2. clearly articulate key topics and goals
 3. effectively and clearly use charts, pictures, models, equations, and graphing techniques
- B. Written Communication – Chemistry graduates will
 1. properly use scientific vocabulary and properly communicate ideas in written form
 2. clearly articulate key topics and goals
 3. effectively and clearly use charts, pictures, models, equations, and graphing techniques
- C. Holistic Thinking – Chemistry graduates will
 1. comprehend the relationship between their work and the world
 2. relate the work to the progression and development of the field
 3. apply chemical principles to other fields
 4. evaluate the interdisciplinary aspects of the work
 5. align theoretical concepts to experimental results or observations
 6. explain why the work is important in a broader context
- D. Application of the Scientific Method – Chemistry graduates will
 1. conduct comprehensive literature searches
 2. model a particular system
 3. design and execute proper experiments or simulations
 4. use laboratory techniques and instrumentation
 5. use data and statistical analyses

These learning goals are linked to FSU's institutional learning goals.

3. Explain how the institution will:
 - a) provide for assessment of student achievement of learning outcomes in the program

The assessment plan in the Department of Chemistry focuses on the evaluation of student work on key assignments (artifacts) in CHEM 305 Research Methods and CHEM 492 Capstone Experience. CHEM 492 is one of the last courses students take prior to graduation, and CHEM 305 serves as a midpoint in our curricular sequence. The artifacts are assessed anonymously by an assessment committee of faculty from the Department of Chemistry. These assessments use common rubrics in both courses to allow for pre- and post-assessment. In addition, the Chemistry Department participates in the assessment of institutional learning goals through General Education assessment using institutional rubrics based on the AAC&U LEAP rubrics.

- b) document student achievement of learning outcomes in the program

Annual learning outcome reports are deposited with and evaluated by the College of Liberal Arts and Sciences Assessment Council using a common report hosted by FSU's implementation of Campus Labs' Compliance Assist platform. The institution-wide Student Learning Assessment Advisory Group annually reviews the state of learning assessment campus-wide based on college-level assessment committee reports and recommendations.

Additionally, like all academic programs at FSU, the Bachelor's degree in Chemistry undergoes an intensive review every seven years. Student learning outcomes and the appropriateness of program learning goals and resources are a major component of this review. The most recent review for the Bachelor's in Chemistry occurred in 2018. This Concentration will be reviewed as part of the next review in 2025. These reviews are coordinated at FSU by the office of Assessment and Institutional Research and the final reports are maintained by that office.

4. Provide a list of courses with title, semester credit hours and course descriptions, along with a description of program requirements

The courses required for this program are as follows. All of these courses are existing courses at FSU. No new courses are required by this program. Course descriptions are found in Appendix A.

Required Chemistry Courses (33 semester hours of credit):

Course	Title	Semester Hours of Credit
CHEM 201	General Chemistry I	4
CHEM 202	General Chemistry II	4
CHEM 304	Computational Techniques	2
CHEM 305	Research Methods in Chemistry	3
CHEM 311	Organic Chemistry I	3
CHEM 312	Organic Chemistry Laboratory I	1
CHEM 320	Quantitative Chemical Analysis	4
CHEM 321	Organic Chemistry II	3
CHEM 322	Organic Chemistry Laboratory II	1
CHEM 441	Physical Chemistry I	3
CHEM 445	Physical Chemistry Laboratory I	1
CHEM 455	Biochemistry I	3
CHEM 492	Capstone Experience	1

Chemistry Experiential Course Sequence (2 semester hours of credit):

Students must complete two hours from among the following:

Course	Title	Semester Hours of Credit
CHEM 491	Seminar in Chemistry	1
CHEM 493	Advanced Chemical Research	Variable
CHEM 495	Internship in Chemistry	Variable

Chemistry Elective Courses (3-4 semester hours of credit):

Students must choose one of the following courses:

Course	Title	Semester Hours of Credit
CHEM 330	Medicinal Chemistry	3
CHEM 411	Inorganic Chemistry	4
CHEM 421	Instrumental Analysis	4

CHEM 438	Advanced Organic Chemistry	3
CHEM 442	Physical Chemistry II	3
CHEM 456	Biochemistry Lab	3
CHEM 457	Biochemistry II	3

Required Biology Courses (20 semester hours of credit):

Course	Title	Semester Hours of Credit
BIOL 149	General Biology I	4
BIOL 304	Microbiology	4
BIOL 310	Cell Biology	4
BIOL 321	Anatomy & Physiology I	4
BIOL 322	Anatomy & Physiology II	4

Required Calculus Courses (8 semester hours of credit):

Course	Title	Semester Hours of Credit
MATH 236	Calculus I	4
MATH 237	Calculus II	4

Statistics (3 semester hours of credit):

Students must choose one of the following courses

Course	Title	Semester Hours of Credit
MATH 109	Elements of Applied Probability & Statistics	3
MATH 110	Honors: Elements of Applied Probability & Statistics	3
MATH 280	Introductory Applied Statistics and Data Analysis	3

Oral Communication (3 semester hours of credit):

Students must choose one of the following courses

Course	Title	Semester Hours of Credit
CMST 102	Introduction to Human Communication	3
CMST 112	Honors: Introduction to Human Communication	3
CMST 122	Introduction to Public Speaking	3

Written Communication (3 semester hours of credit):

Students must choose one of the following courses

Course	Title	Semester Hours of Credit
ENGL 338	Technical Writing	3
ENGL 339	Scientific Writing	3

Economics (3 semester hours of credit):

Students must choose one of the following courses

Course	Title	Semester Hours of Credit
ECON 200	Basic Economics	3
ECON 201	Principles of Economics (Macro)	3
ECON 211	Honors: Principles of Economics (Macro)	

Physics I (4 semester hours of credit):*Students must choose one of the following courses*

Course	Title	Semester Hours of Credit
PHYS 215	General Physics I	4
PHYS 261	Principles of Physics I	4

Physics II (4 semester hours of credit):*Students must choose one of the following courses*

Course	Title	Semester Hours of Credit
PHYS 216	General Physics II	4
PHYS 262	Principles of Physics II	4

- Discuss how general education requirements will be met, if applicable.

Students in this Concentration will be required to meet FSU's established general education program. Several courses required for the Concentration are part of FSU's general education program.

Course	FSU GEP Component
ENGL 338/339	Core Skills 2 (Advanced Composition)
MATH 109/110	Core Skills 3 (Mathematics / Quantitative Reasoning)
MATH 236	Core Skills 3 (Mathematics / Quantitative Reasoning)
BIOL 149	Mode of Inquiry C (Natural Sciences)
CHEM 201	Mode of Inquiry C (Natural Sciences)
PHYS 215/261	Mode of Inquiry C (Natural Sciences)
ECON 200/201/211	Mode of Inquiry D (Social and Behavior Sciences)

In addition to the courses required for the program, students in the Concentration will complete 21 additional credits of general education in first-year composition, fine and performing arts, humanities, social and behavioral sciences, identity and difference, and interdisciplinary studies. Although students in the program will have their choice of available courses for the remainder to the GEP requirements, professional schools of pharmacy sometimes require specific humanities and social science courses. Students will be advised to take general education courses appropriate to their plans.

- Identify any specialized accreditation or graduate certification requirements for this program and its students.

N/A

- If contracting with another institution or non-collegiate organization, provide a copy of the written contract.

N/A

- Provide assurance and any appropriate evidence that the proposed program will provide students with clear, complete, and timely information on the curriculum, course and degree requirements, nature of faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, learning management system,

availability of academic support services and financial aid resources, and costs and payment policies.

FSU provides all students with sufficient information on curriculum, course and degree requirements, cost financial aid, method of delivery, technology requirements, the Canvas learning management system, and support services through the Undergraduate and Graduate Catalogs, the FSU website, FSU admissions and recruiting materials, and FSU's student information system. All undergraduate students are also provided with an 8-semester plan of study for their chosen academic program(s). First-time students take ORIE 101 Introduction to Higher Education, which provides additional information about advising, registration, and campus resources. Transfer students receive this information through advising and orientation with the department chair or program representative. FSU also complies with the Higher Education Opportunity Act of 2008 (HEOA) related to disclosure requirements for postsecondary institutions.

9. Provide assurance and any appropriate evidence that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available.

All program materials will clearly represent the proposed program and services available. All such materials are checked by the Department of Chemistry, the Admissions Office, and the Office of Publications for accuracy.

H. Adequacy of Articulation

1. If applicable, discuss how the program supports articulation with programs at partner institutions. Provide all relevant articulation agreements.

This program supports no current articulation agreements, but it is being created in anticipation of developing new articulation agreements.

I. Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11).

1. Provide a brief narrative demonstrating the quality of program faculty. Include a summary list of **faculty with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, adjunct) and the course(s) each faculty member will teach in the proposed program.**

This program will be supported by all faculty members in the Department of Chemistry teaching the required and elective chemistry courses.

Name	Appointment Type	Terminal Degree	Rank	Status	Courses
Biser, Peggy	Tenured/Tenure-Track	PhD in Pharmacology	Professor	Full-Time	CHEM 201, CHEM 455, CHEM 456, CHEM 457, CHEM 493

Crawford, Matthew	Tenured/Tenure-Track	PhD in Chemistry	Associate Professor	Full-Time	CHEM 202, CHEM 311, CHEM 312, CHEM 320, CHEM 493
Currie, Holly	Tenured/Tenure-Track	PhD in Chemistry	Assistant Professor	Full-Time	CHEM 201, CHEM 202, CHEM 305, CHEM 421, CHEM 455, CHEM 491, CHEM 492, CHEM 493
Gares, Katie	Non-Tenure Track	PhD in Chemistry	Lecturer	Full-Time	CHEM 201, CHEM 493
Larivee, Robert	Tenured/Tenure-Track	PhD in Chemistry	Professor	Full-Time	CHEM 202, CHEM 421, CHEM 491, CHEM 492, CHEM 493, CHEM 495
Norris, Benjamin	Tenured/Tenure-Track	PhD in Chemistry	Associate Professor	Full-Time	CHEM 305, CHEM 312, CHEM 321, CHEM 322, CHEM 330, CHEM 493, CHEM 438
Senese, Fred	Tenured/Tenure-Track	PhD in Chemistry	Professor	Full-Time	CHEM 201, CHEM 441, CHEM 442, CHEM 445, CHEM 491, CHEM 492, CHEM 493
Simon, Jerald	Tenured/Tenure-Track	PhD in Chemistry	Associate Professor	Full-Time	CHEM 201, CHEM 202, CHEM 304, CHEM 322, CHEM 411, CHEM 441, CHEM 442, CHEM 455, CHEM 493

The required courses in Biology will be supported by the faculty in the Biology Department.

Name	Appointment Type	Terminal Degree	Rank	Status	Courses
Hughes, Frank	Tenured/Tenure-Track	Doctor of Chiropractic	Assistant Professor	Full-Time	BIOL 321 BIOL 322
Keller, Karen	Tenured/Tenure-Track	PhD in Physiology	Associate Professor	Full-Time	BIOL 321 BIOL 322
Taylor, Rebekah	Tenured/Tenure-Track	PhD in Immunology and Molecular Pathogenesis	Associate Professor	Full-Time	BIOL 149 BIOL 310
Munasinghe. Kumudini	Tenure-Track	PhD in Microbiology	Assistant Professor	Full-Time	BIOL 304

The courses in Mathematics, English composition, Communication Studies, Physics, and Economics are general education courses or other high demand service courses taught by a variety of instructors in those departments.

2. Demonstrate how the institution will provide ongoing pedagogy training for faculty in evidenced-based best practices, including training in:
 - a) Pedagogy that meets the needs of the students

Free training and professional development in pedagogy is provided by FSU's Center for Teaching Excellence which hosts an annual regional conference on teaching and learning each January, annual teaching orientations for new faculty, and periodic workshops on various topics throughout the academic year. In May of each, the office of Information Technology hosts a regional conference on best practices in educational technology. Additionally, the Department of Chemistry is committed to supporting its faculty development through the attendance at other conferences like the Biennial Conference on Chemical Education.

- b) The learning management system

FSU uses Canvas as its LMS. The office of Instructional Design and Technology provides support and training through the onboarding process for new faculty as well as regularly throughout the year. Additionally, one faculty member in the Department of Chemistry was part of the Canvas selection and pilot group and provides internal training to the department.

- c) Evidenced-based best practices for distance education, if distance education is offered.

N/A

J. Adequacy of Library Resources (as outlined in COMAR 13B.02.03.12).

1. Describe the library resources available and/or the measures to be taken to ensure resources are adequate to support the proposed program.

The proposed Pre-Pharmacy Concentration will make use of existing library resources for the programs in Chemistry, Biology, and Health Science. Library resources for those programs are adequate to cover this new Concentration, and we anticipate no need for new library resources.

K. Adequacy of Physical Facilities, Infrastructure and Instructional Equipment (as outlined in COMAR 13B.02.03.13)

1. Provide an assurance that physical facilities, infrastructure and instruction equipment are adequate to initiate the program, particularly as related to spaces for classrooms, staff and faculty offices, and laboratories for studies in the technologies and sciences.

The proposed Pre-Pharmacy Concentration will be offered within existing resources. The chemistry and biology courses that comprise the majority of the program utilize dedicated laboratory space with appropriate and modern equipment. These laboratory spaces are sufficient to hold the number of sections currently offered with room to accept the initial cohort of students in this program. Should the program grow, there are sufficient and appropriate laboratory spaces for additional sections to be offered.

As this program requires no additional faculty positions, existing faculty office space is sufficient.

2. Provide assurance and any appropriate evidence that the institution will ensure students enrolled in and faculty teaching in distance education will have adequate access to:

- a) An institutional electronic mailing system, and

N/A

- b) A learning management system that provides the necessary technological support for distance education

N/A

L. Adequacy of Financial Resources with Documentation (as outlined in COMAR 13B.02.03.14)

1. Complete [Table 1: Resources and Narrative Rationale](#). Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also provide a narrative rationale for each resource category. If resources have been or will be reallocated to support the proposed program, briefly discuss the sources of those funds.

TABLE 1: PROGRAM RESOURCES					
Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated Funds	0	0	0	0	0

2. Tuition/Fee Revenue (c + g below)	19,200	29,664	76,478	89,266	129,862
a. Number of F/T Students – In-state	2	3	5	6	7
a. Number of F/T Students – Out of state	0	0	1	1	2
b. Annual Tuition/Fee Rate In-state	9,600	9,888	10,185	10,491	10,806
b. Annual Tuition/Fee Rate Out of state	24,086	24,809	25,553	26,320	27,110
c. Total F/T Revenue (a x b)	19,200	29,664	76,478	89,266	129,862
d. Number of P/T Students	0	0	0	0	0
e. Credit Hour Rate – In state	281	289	298	307	316
e. Credit Hour Rate – Out of state	598	616	634	653	673
f. Annual Credit Hour Rate	0	0	0	0	0
g. Total P/T Revenue (d x e x f)	0	0	0	0	0
3. Grants, Contracts & Other External Sources	0	0	0	0	0
4. Other Sources	90	195	310	420	365
TOTAL (Add 1 – 4)	19,290	29,859	76,788	89,686	130,227

Budget Narrative:

1. Reallocated funds – There are no relocated funds. This program is being offered within existing resources using courses that already support other academic programs. Those courses can support the additional enrollment from this program without the need to schedule new sections or hire additional instructors.
2. Tuition and Fee Revenue – Revenue is calculated using annual undergraduate tuition and fee schedules with a projected 3% increase each year.
3. Grants, Contracts, & Other External Sources – None projected.
4. Other Sources - Additionally, certain chemistry lab courses charge an additional special instructional fee to cover lab consumables beyond the fees charged to all students. Those additional fees are estimated basic on a suggested course sequence.

2. Complete **Table 2: Program Expenditures and Narrative Rationale**. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also provide a narrative rationale for each expenditure category.

Expenditure Narrative:

This proposed program utilizes existing courses and resources and requires no new faculty or staff positions dedicated to the program. Thus no additional expenditures are projected beyond the lab course consumables (listed in #7 below) required for the few additional students.

TABLE 2: PROGRAM EXPENDITURES:					
Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b + c below)	0	0	0	0	0
a. Number of FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
2. Admin. Staff (b + c below)	0	0	0	0	0
a. Number of FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b + c below)	0	0	0	0	0
a. Number of FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Technical Support and Equipment	0	0	0	0	0

5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	90	195	310	420	365
TOTAL (Add 1 – 7)	90	195	310	420	365

M. Adequacy of Provisions for Evaluation of Program (as outlined in COMAR 13B.02.03.15).

1. Discuss procedures for evaluating courses, faculty and student learning outcomes.

Faculty members in the Department of Chemistry are evaluated annually by a peer evaluation process that includes student evaluation of instruction data for each course. The student evaluation instrument is common to all courses at FSU and is administered by the office of Assessment and Institutional Research. Student learning outcomes for the program are assessed as part of two courses, CHEM 305 and CHEM 492, using common departmental rubrics evaluated by a committee of departmental faculty. Learning outcomes for individual courses are assessed by individual instructors.

2. Explain how the institution will evaluate the proposed program's educational effectiveness, including assessments of student learning outcomes, student retention, student and faculty satisfaction, and cost-effectiveness.

Like all academic programs at FSU, the Bachelor's degree in Chemistry undergoes an intensive review every seven years as required by the USM. This review covers educational and cost effectiveness, assessment of learning outcomes, and adequacy of human, capital, and fiscal resources. The most recent review for the Bachelor's in Chemistry occurred in 2018. This Concentration will be reviewed as part of the next review in 2025.

Halfway through this cycle, FSU's Office of Assessment and Institutional Research collects information on enrollment and assessment activities using a midterm review template. Also at this time, FSU's Institutional Priorities and Resources Committee of the Faculty Senate will review the program to determine if the program is meeting its enrollment projections and receiving appropriate resources.

N. Consistency with the State's Minority Student Achievement Goals (as outlined in COMAR 13B.02.03.05).

1. Discuss how the proposed program addresses minority student access & success, and the institution's cultural diversity goals and initiatives.

FSU is a public institution committed to a campus environment that values human diversity, equity, and inclusion. FSU has a diverse undergraduate student body (42.5%) and this

diversity is reflected in the increasing diversity of graduating classes of Chemistry students in the last few years.

Graduating Class Year	Percent Minority
2014	33.3%
2015	23.5%
2016	7.1%
2017	41.7%
2018	50.0%

We expect this new Pre-Pharmacy Concentration to continue to attract the same diverse student population, and we are committed to the success of all students enrolled in the program.

O. Relationship to Low Productivity Programs Identified by the Commission:

1. If the proposed program is directly related to an identified low productivity program, discuss how the fiscal resources (including faculty, administration, library resources and general operating expenses) may be redistributed to this program.

The Bachelor's degree in Chemistry is being monitored by FSU. While the program produced 13 graduates in academic year 2017-2018, it only produced 3 graduates in academic year 2018-2019. This proposed Pre-Pharmacy Concentration within the Bachelor's in Chemistry is being developed utilizing the existing resources of the Bachelor's in Chemistry in part to increase recruitment into the Chemistry major and increase the number of graduates produced.

P. Adequacy of Distance Education Programs (as outlined in COMAR 13B.02.03.22)

1. Provide affirmation and any appropriate evidence that the institution is eligible to provide Distance Education.
N/A
3. Provide assurance and any appropriate evidence that the institution complies with the C-RAC guidelines, particularly as it relates to the proposed program.
N/A

Appendix A

Undergraduate Course Descriptions

Chemistry courses

CHEM 201 General Chemistry I 4 cr.

Atomic and molecular structure, theories of covalent and ionic bonding, chemical reactions, states of matter, gas laws, solutions, reaction rates, stoichiometry and thermochemistry. Two hrs. lecture, 2 hrs. discussion and one 2-hr. lab. Every semester. You cannot earn credit for both CHEM 101 and 201. *Prerequisites: C or better in CHEM 103 or placement at Math Level II or higher. Corequisite: MATH 102/119, placement at Math Level III or higher, or permission of instructor. GEP Group C.*

CHEM 202 General Chemistry II 4 cr.

Acid-base concepts, equilibria, thermodynamics, electrochemistry, reaction rates, coordination compounds and organic, nuclear and descriptive chemistry. Three hrs. lecture, one 3-hr. lab. Every semester. You cannot earn credit for both CHEM 102 and 202. *Prerequisites: CHEM 201 and MATH 102/119.*

CHEM 304 Computational Techniques 2 cr.

Introduction to and application of the fundamental methods, tools and techniques essential to solve problems in the physical sciences. Regular topics include statistical, mathematical and computational tools; and data analysis. LabView software as applied to instrumentation. Additional topics explored will augment student needs and supplement area of current interest in science. One hour lecture, one 2-hr. lab integrated. Fall. Also offered as ENES 304 and PHYS 304. *Prerequisites: CHEM 201 and 202 or COSC 240 or ENEE 114 equivalent, or permission of the instructor.*

CHEM 305 Research Methods in Chemistry 3 cr.

Introduction to independent research related to chemistry using modern analysis techniques, methods, and instrumentation. Searching and critically reading scientific literature. Analysis of safety issues and environmental impact. Spring. Two 3-hr. integrated lecture and lab. *Prerequisite: CHEM 312.*

CHEM 311 Organic Chemistry I 3 cr.

Chemistry of the compounds of carbon. Classes and nomenclature of compounds, structure, reactions, mechanisms, spectroscopy and stereochemistry. Three hrs. lecture. Every semester. Not open to students who have credit for former CHEM 301. *Prerequisites: CHEM 201 and 202 or equivalent. Corequisite: CHEM 312.*

CHEM 312 Organic Chemistry Laboratory I 1 cr.

Introduction to techniques of experimental organic chemistry: separations, purifications, spectroscopy, mechanistic analysis. One 3-hr. lab. Every semester. Not open to students who have credit for former CHEM 301. *Prerequisite: CHEM 202 or equivalent. Corequisite: CHEM 311.*

CHEM 320 Quantitative Analytical Chemistry 4 cr.

Theory, methods and treatment of data pertaining to chemical analysis. Gravimetric, volumetric, potentiometric, electroanalytical and spectrophotometric applications in the laboratory. Three

hrs. lecture, one 3-hr lab. Fall. *Prerequisites: CHEM 201 and 202, MATH 120 or equivalent or permission of instructor.*

CHEM 321 Organic Chemistry II 3 cr.

Continued study of compounds of carbon. Three hrs. lecture. Every semester. Not open to students who have credit for former CHEM 302. *Prerequisites: CHEM 311 and CHEM 312 or equivalent.*

CHEM 322 Organic Chemistry Laboratory II 1 cr.

Application of techniques of experimental organic chemistry. Organic reactions and synthesis. One 3-hr. lab. Every semester. Not open to students who have credit for former CHEM 302. *Prerequisites: CHEM 311 and CHEM 312 or equivalent. Corequisite or prerequisite: CHEM 321.*

CHEM 330 Medicinal Chemistry 3 cr.

Mechanism of drug action through interaction with biomolecule targets. Drug discovery, design, and development. Introduction to pharmacokinetics, pharmacodynamics, and quantitative structure-activity relationships. Fall, even-numbered years. *Prerequisites: BIOL 310 and CHEM 311.*

CHEM 411 Advanced Inorganic Chemistry 4 cr.

Covers the application of symmetry operations and group theory to elucidate the bonding and spectroscopy of transition metal complexes. Selected topics in inorganic reaction mechanisms, photochemistry, catalysis and bio-inorganic chemistry will then be examined using these theoretical approaches. Three hrs. lecture, one 3-hr. lab weekly. Spring, odd-numbered years. *Prerequisite: CHEM 321 or permission of instructor.*

CHEM 421 Instrumental Analysis 4 cr.

Theory and applications of modern instruments for chemical analysis. Electronics, spectroscopic, electrochemical and chromatographic techniques. Laboratory use of NMR, IR, UV, AA and GC instruments. Three hrs. lecture, one 3-hr. lab. Spring. *Prerequisite: CHEM 320 or permission of instructor.*

CHEM 438 Advanced Organic Chemistry 3 cr.

Structure and bonding in organic compounds, reactivity, mechanisms of reactions and application to reaction types. Three hrs. lecture. Variable. *Prerequisite: CHEM 321.*

CHEM 441 Physical Chemistry Lecture I 3 cr.

Application of thermodynamic principles to chemical systems. Gas laws, state functions, calorimetry, phase changes, partial molar properties, equilibrium and other topics. Three hrs. lecture. Fall. *Prerequisites: CHEM 320 and 321, MATH 238 and PHYS 215 and 216 or equivalent or permission of instructor.*

CHEM 442 Physical Chemistry Lecture II 3 cr.

The development of quantum theory for simple confined particles, one-electron atoms, multi-electron atoms and molecules. Use of quantum theory to understand and interpret results from chemically important spectroscopic techniques. Three hrs. lecture. Spring. *Prerequisite: CHEM 441.*

CHEM 445 Physical Chemistry Laboratory I 1 cr.

Experimental physical chemistry. One 3-hr. lab. Fall. *Prerequisite or corequisite: CHEM 441.*

CHEM 455 Biochemistry I**3 cr.**

The chemistry and metabolism of biological compounds, biochemical thermodynamics, enzyme mechanisms and kinetics. Three hrs. lecture. Fall. *Prerequisite: CHEM 311, BIOL 310 or permission of the instructor.*

CHEM 456 Biochemistry Laboratory**3 cr.**

Qualitative and quantitative laboratory experiments on the nature and properties of biological materials. Two three-hr. labs. Spring. *Prerequisites or corequisites: CHEM 322 and 455.*

CHEM 457 Biochemistry II**3 cr.**

A continuation of Biochemistry I. Metabolic processes and their conservation among widely divergent organisms. Cell processes, their interrelation and regulation. Biochemical techniques and their applications to a variety of current biological problems. Three hrs. lecture. Spring. *Prerequisite: CHEM 321 and CHEM 455 or equivalent.*

CHEM 491 Seminar in Chemistry**1 cr.**

Current topics in chemistry presented by students, faculty and invited guests. One period weekly. Required for majors. Every semester. *Prerequisites: CHEM 305 and CHEM 320.*

CHEM 492 Capstone Experience**1 cr.**

An integrated senior-year experience that requires students to use their accumulated skills, knowledge and experiences to present their own research and a portfolio demonstrating important laboratory skills. Required for all chemistry majors. Every semester. *Prerequisite: CHEM 491 or CHEM 493 or CHEM 495 or permission of instructor.*

CHEM 493 Advanced Chemical Research 1 to 8 cr.

Original student investigations in analytical, inorganic, physical, organic, and biochemistry involving both library and laboratory work, planned and executed under faculty guidance. A formal, publication-quality report and a seminar presentation are required. Research projects must be approved by the department and the instructor prior to registration in the course. Repeatable for a maximum of 8 credits. *Prerequisite: CHEM 305, CHEM 320, and permission of department chair.*

CHEM 495 Internship in Chemistry**1 to 6 cr.**

Guided work experience. Work must be directly related to academic program. Grade P/F. Variable. *CHEM 305 and CHEM 320; in good academic standing; submission of Agreement Form to Department Chair prior to registering, departmental approval.*

Biology courses

BIOL 149 General Biology I**4 cr.**

Biological principles and concepts. The life processes, development and relationship among organisms. Three hrs. lecture, 2 hrs. lab. Every semester. *GEP Group C.*

BIOL 159 Honors: General Biology I**4 cr.**

Biological principles and concepts. The life processes, development and relationship among organisms. Additional expectations required. Three hrs. lecture, 2 hrs. lab. Every Fall. Credit cannot be earned for both BIOL 159 and BIOL 149. *GEP Group C.*

BIOL 304 Microbiology 4 cr.

Microorganisms, especially their form, structure, reproduction, physiology, metabolism, and identification, will be studied with emphasis on their distribution in nature, their beneficial and detrimental effects on humans, and the physical and chemical changes they make in the environment. Two hrs. lecture and two 2-hr. labs. Every semester. *Prerequisites: BIOL 149.*

BIOL 310 Cell Biology 4 cr.

Dynamics of cells and their life processes. Ultrastructure, organization, thermodynamic and metabolic processes. Recommended for biology majors immediately following BIOL 150. Three hrs. lecture, one 2-hr. lab. Fall. *Prerequisites: BIOL 149, CHEM 202. Corequisites: CHEM 311 and CHEM 312 or permission of instructor.*

BIOL 321 Anatomy and Physiology I 4 cr.

Structure and function of the human body. Includes its organization, the musculoskeletal system and the nervous system. Two hrs. lecture and two 2-hr. labs. Fall. Not open to students who have credit for former BIOL 201. *Prerequisite: BIOL 149.*

BIOL 322 Anatomy and Physiology II 4 cr.

Structure and function of the human body. Includes the endocrine, circulatory, respiratory, digestive, excretory and reproductive systems, and human development. Two hrs. lecture and two 2-hr. labs. Spring. Not open to students who have credit for former BIOL 202. *Prerequisite: BIOL 321 or permission of instructor.*

Physics courses

PHYS 215 General Physics I 4 cr.

Non-calculus introduction to the theoretical and experimental foundations of physics, topics to include mechanics and heat, the fundamental concepts, principles, and laws of physics. Three hrs. lecture and 3 hrs. lab. Either an introduction to the field for prospective majors or a self-contained survey for others. Fall. *A familiarity with high school mathematics including algebra and geometry is assumed. GEP Group C.*

PHYS 216 General Physics II 4 cr.

A continuation of PHYS 215. Non-calculus introduction, topics to include electricity, magnetism, and light. The fundamental concepts, principles, and laws of physics. Three hrs. lecture and 3 hrs. lab. Spring. *Prerequisite: PHYS 215.*

PHYS 261 Principles of Physics I: Mechanics 4 cr.

Calculus-based introduction to the theoretical and experimental foundations of physics focusing on mechanics. Topics to include kinematics, dynamics, energy, momentum, rotational dynamics, and continuum mechanics. Intended primarily for physical science, engineering and math majors. Six hours of integrated lecture/lab, two hours discussion per week. Fall. *Corequisite: MATH 236. GEP Group C.*

PHYS 262 Principles of Physics II: Thermodynamics, Electricity and Magnetism 4 cr.

Calculus-based introduction to the theoretical and experimental foundations of physics focusing on thermodynamics, electricity and magnetism. Topics to include heat, thermodynamics, kinetic, theory, electrostatics, electrodynamics, magnetostatics, and electromagnetic induction. Six hours of integrated lecture/lab/discussion per week. Spring. *Prerequisite: PHYS 261. Corequisite: MATH 237.*

Mathematics courses

MATH 109 Elements of Applied Probability and Statistics 3 cr.

For the non-math major; less rigorous than MATH 380. Elementary probability theory; collection, organization and analysis of data; descriptive statistics; the normal and binomial distributions; introduction to inferential statistics; and applications. Every semester.

Prerequisite: a passing score on the Mathematics Placement test administered by the University or DVMT 095. MAY NOT BE USED TO SATISFY THE REQUIREMENTS FOR A MAJOR OR MINOR IN MATHEMATICS. MAY BE USED TO FULFILL CORE SKILL 3.

MATH 110 Honors: Elements of Appl. Probability & Statistics 3 cr.

Introduction to statistics, with emphasis on probability theory and inferential statistics.

More rigorous and broader than MATH 109/209. Use of the computer as a tool in statistical analyses. Probability theory, sampling distributions, estimation, hypothesis testing, parametric and nonparametric tests, correlation, regression and analysis of variance. Written research project required. Credit cannot be earned for both MATH 109/209 and MATH 110/219. Spring.

Prerequisite: acceptance into the University Honors Program or permission of the instructor. MAY NOT BE USED TO SATISFY THE REQUIREMENTS FOR A MAJOR OR MINOR IN MATHEMATICS. MAY BE USED TO FULFILL CORE SKILL 3.

MATH 280 Introductory Applied Statistics and Data Analysis 3 cr.

An introduction to applied data analysis, designed to enable students to effectively collect data, describe data, and make appropriate inferences from data. Students are expected to communicate effectively about statistical results and to use a statistical software package for data analysis. Every Fall. *Prerequisite: MATH 120.*

MATH 236 Calculus I 4 cr.

Limits and continuity, the derivative, antiderivatives and definite integrals. Credit may not be earned for both MATH 236 and MATH 226. Every semester. *Prerequisite: A passing score on the Mathematics Placement Test administered by the University or a grade of C or better in MATH 120. MAY BE USED TO FULFILL CORE SKILL 3.*

MATH 237 Calculus II 4 cr.

Techniques and applications of integration, introductory differential equations, infinite series. Credit may not be earned for both MATH 237 and either MATH 227 or MATH 228. Every semester. *Prerequisite: a grade of C or better in MATH 236.*

Communication courses

CMST 102 Introduction to Human Communication 3 cr.

Fundamental theory and practice of human communication in dyadic, small-group and public situations. Every semester.

CMST 112 Honors: Introduction to Human Communication 3 cr.

Fundamental theory and practice of human communication in dyadic, small-group and public situations. Student-led discussions, activities. Variable. *Prerequisite: admission to Honors Program or written permission of instructor.*

CMST 122 Introduction to Public Speaking 3 cr.

Introduction to, and guided application of, basic principles which underlie effective public speaking and listening in informative, persuasive, and ceremonial speeches. Spring.

Economics courses

ECON 200 Basic Economics 3 cr.

Introductory survey course covering both Macro and Microeconomics designed to provide minimum competence for majors other than business, accounting and economics. Not open to students who have already completed ECON 201 and ECON 202 with grades of C or above. Every semester. *GEP Group D.*

ECON 201 Principles of Economics (Macro) 3 cr.

An introduction to Principles of Economics focusing primarily on the forces determining the economy-wide levels of production, employment, and prices. Examines monetary and fiscal policy and alternative views of how the economy should be managed. Every semester. *GEP Group D.*

ECON 211 Honors: Principles of Macroeconomics 3 cr.

An introduction into the forces at work in the national economy including income, employment, and the monetary system. A variety of written research assignments on current topics in macroeconomics required. Credit cannot be earned for both ECON 201 and 211. Fall. *Prerequisite: acceptance into the Honors program or permission of the instructor. GEP Group D.*

English composition courses

ENGL 338 Technical Writing 3 cr.

Principles and practice of writing related to science, industry and government. Effective style, organization and mechanics of writing reports. Every semester. *Prerequisites: C or better in ENGL 101 or 111; and at least 42 credits or permission of Chair. Core Skill 2.*

ENGL 339 Scientific Writing 3 cr.

Introduction to formats, prose, and style specifications for Natural Science curricula. Focuses on language, research, critical analysis and interdisciplinary impact of scientific discoveries. Variable. *Prerequisites: C or better in ENGL 101/111; at least 42 credits or permission from Chair. Core Skill 2.*