

Winthrop University

Program Modification

to the

Bachelor of Science in Chemistry

To include concentrations in

ACS Chemistry
ACS Biochemistry
ACS Engineering-Physics
ACS Forensic Chemistry
ACS Chemistry-Business
Biochemistry
Multidisciplinary Chemistry

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Program Overview

Classification

Name of Program with Proposed Concentrations

Bachelor of Science in Chemistry
ACS Chemistry
ACS Biochemistry
ACS Engineering-Physics
ACS Forensic Chemistry
ACS Chemistry-Business
Biochemistry
Multidisciplinary Chemistry

Academic Unit

Department of Chemistry, Physics, and Geology in the College of Arts and Sciences

Designation, Type, and Level

Baccalaureate; Bachelor of Science; Four-year program

Proposed Date of Implementation

This is an update to the South Carolina Council on Higher Education *Inventory of Approved Programs* to indicate all options in chemistry that have been developed and approved over time. These concentrations should be added to the inventory immediately.

Classification of Instructional Programs (CIP) code

General Chemistry 400501

Type of Proposal

Existing program for review related to CHE *Inventory of Approved Programs*.

Program qualifies for supplemental Palmetto Fellows and LIFE scholarship awards?

Yes

Delivery Mode

Traditional

Justification for Program

Program Purpose and Long Range Goals

The focus of the programs in chemistry at Winthrop University is to meet American Chemical Society standards for approved programs at a level of excellence that is recognized as being among the best nationally. The design of the program, use of resources, and direction of faculty work is centered on the philosophical value that students learn best through active engagement in experimental science. The department sustains a 12-month, pedagogically intense program focused on active student learning through the pursuit and dissemination of national-caliber undergraduate research. The department is becoming a national leader in matriculation of chemistry and biochemistry students from historically underrepresented groups into Ph.D. science programs.

The program and department have a set of core values that include:

- a) The pursuit and dissemination of national-caliber undergraduate research
- b) A dynamic learning environment enriched by diverse cultural and intellectual perspectives
- c) Effective student-faculty and student-student interactions
- d) Dedicated students and colleagues who are excited about learning
- e) Academically rigorous coursework throughout the curriculum
- f) Ethical behavior and best practices for human health, sustainability, and chemical hygiene
- g) Intellectual development in all five disciplines of chemistry
- h) Strategic partnerships with contacts in academia, industry, and government
- i) On-campus collaborations and collegiality with contemporaries from all disciplines
- j) Balanced lifestyles, engagement in meaningful activities, and informed citizen service
- k) Faculty as recognized experts in their fields

The program has established one Program Goal and four Student Learning Outcomes that are program specific, linked to best practices in chemistry education, aligned with ACS standards, and tied to Winthrop's University Level Competencies. These PGs and SLOs are measured each year and data is reviewed on a four-year cycle. Chemistry goals and student outcomes are:

Program Goal: Students gain hands-on experience using relevant and modern laboratory instruments and research tools to prepare themselves for professional chemistry positions in industry, graduate school, and governmental scientific research centers. In laboratory work involving all five areas of chemistry (for ACS degree concentrations) or involving at least three areas of chemistry (for other degree concentrations), students demonstrate competent scientific professional skills in understanding and using modern sophisticated instrumentation, in designing and conducting chemistry experiments, in quantitatively analyzing experimental data, in properly recording experimental results, and in interpreting chemistry experimental results.

Student Learning Outcome 1: During their Winthrop learning experience, students will demonstrate intellectual and professional development in chemistry; develop a firm scientific foundation; and demonstrate technical competence in problem solving, critical thinking, and analytical reasoning involving all five areas of chemistry (for ACS concentrations) or involving at least three areas of chemistry (for other degree concentrations).

Student Learning Outcome 2: Chemistry students demonstrate personal and social responsibility by adhering to proper chemical hygiene and safety procedures in laboratory experiments involving toxic substances and by properly disposing of hazardous chemical wastes. Chemistry students achieve excellence, demonstrate a sense of responsibility to the broader community, and contribute to the greater good by actively participating in research or internships to improve the quality of modern human life.

Student Learning Outcome 3: Chemistry students demonstrate an understanding of the interconnected nature of the world and the time in which they live by conducting and interpreting molecular modeling computations; by mathematically analyzing complex multivariate instrument-generated data; and by effectively using modern software to control analytical instrumentation, establish/alter experiments, and collect data. Students are able to use modern chemical literature search/retrieval methods to obtain information on a given chemistry topic and to recognize chemistry's role as the central science inextricably linked to so many other fields.

Student Learning Outcome 4: Students encounter numerous learning opportunities to strengthen verbal and written technical communication skills. Students are able to effectively communicate experimental plans and scientific results through written works and through oral presentations.

Direction of Individual Chemistry Degree Concentrations

BS Chemistry, ACS Chemistry Concentration

This is the core ACS degree concentration designed to prepare students for PhD graduate work in a chemical science or for professional chemistry positions in industry or government.

BS Chemistry, ACS Biochemistry Concentration

This program is accredited by the American Society of Biochemistry and Molecular Biology (ASBMB) and prepares students for PhD programs in Biochemistry/Molecular Biology as well as Chemical Biology. The ACS CPT separately approved this degree concentration in 2006; at the time, this was one of three ACS-approved biochemistry programs in South Carolina.

BS Chemistry, ACS Engineering-Physics Concentration

This degree option was added to meet prospective and current student interests in engineering, nanotechnology, and physical chemistry. This degree concentration provides Winthrop chemistry graduates with the opportunity to directly matriculate into graduate

engineering programs such as chemical engineering, biomedical engineering, and materials engineering.

BS Chemistry, ACS Forensic Chemistry Concentration

This degree option was added to meet prospective and current student interests in forensic chemistry. This degree concentration provides Winthrop chemistry graduates with the opportunity to directly matriculate into graduate STEM programs.

BS Chemistry, ACS Chemistry-Business Concentration

This option meets ACS guidelines and requires a set of recommended courses for entry into subsequent MBA programs. The combination of a professionally certified ACS degree with these business related courses well prepares students for the many professional chemist positions in business and industry.

BS Chemistry, Biochemistry Concentration

This option is designed to offer students a sequence of courses that is more flexible and that better accommodates those wishing to combine the chemistry major with other majors such as biology. This will appeal to students interested in double majoring and health professional opportunities.

BS Chemistry, Multidisciplinary Chemistry Concentration

This option provides students with a broad exploration of chemistry and other sciences. The multidisciplinary chemistry program of study is designed for maximum flexibility to meet a broad array of student interests or needs.

Need for the Program

The chemistry programs at Winthrop University are increasingly becoming known as a pipeline to graduate degree programs especially for students from underrepresented groups in chemistry. This chemistry program, with its varied choices for students, is an important option for South Carolina students. The program's focus on engaging students in real research experiences provides individuals in all concentrations with a rich foundation on which to build, regardless of whether the student chooses graduate study or employment upon matriculation.

The program size allows for more individualized attention and research opportunities for all students. Programs such as Winthrop SC-INBRE, EagleSTEM Scholars, and ChemSTEM Scholars target students from underrepresented groups, are focused on preparing students for the demands of graduate study or employment, and support the [core values](#) of the program.

Centrality of the Program to the Institutional Mission

The mission of the program is congruent with that of the University and the College of Arts and Sciences. The University mission statement includes the following: "The University provides personalized and challenging undergraduate, graduate, and continuing professional education

programs of national caliber within a context dedicated to public service to the state of South Carolina.” The mission statement of the College of Arts and Sciences states: “The College of Arts and Sciences provides educational opportunities for students to gain knowledge, insights, and skills in order to grow more sensitive to the significance of the human heritage, to participate and contribute knowledgeably and effectively as citizens, and to lead rewarding, productive and enriched lives within the contemporary world.” The [core values](#) of the department are directly related to these missions as they are student-focused, require standards that meet national expectations, and result in graduates that are prepared for both graduate study and entry into the workforce.

Relationship of the Program to other Programs

Program Comparison

This program modification is not changing the existing programs at Winthrop nor increasing options in the state and region. Instead this proposal updates the degree options available. In a review of institutions in South Carolina (see Table 1), Winthrop is one of the few programs that has ACS certified options and the only program that has ACS certified programs with such a variety of focus options. General chemistry, biochemistry, and forensic chemistry are the most common in the state and Winthrop is the only state institution to offer concentrations in Chemistry-Business and Engineering-Physics. Although expanding the review of programs beyond South Carolina increases the variety of options available, Winthrop still remains a leader in the variety of experiences available and for instrumentation availability.

Table 1. South Carolina institutions with undergraduate chemistry degree programs listed in CHE searchable database.

Institution	Type of UG Degree	Degree Title in CHE Academic Programs Searchable Database	CIP	Concentrations
Allen University	BS	Chemistry, General	400501	<i>Biochemistry</i>
Benedict College	BS	Chemistry, General	400501	
	BS	Radio Chemistry	400599	
Bob Jones University	BS	Biochemistry & Molecular Biology	260205	
	BS	Chemistry	400501	
Charleston Southern University	BS	Biochemistry	260202	
	BS	Chemistry, General	400501	
The Citadel	BA	Chemistry	400501	Broad Field Certification General
	BS	Chemistry	400501	<i>Biochemistry</i>
Claflin University	BS	Biochemistry	260202	<i>Pre-pharmacy</i>
	BS	Chemistry	400501	<i>Pre-pharmacy</i>
Clemson University	BS	Biochemistry	260202	
	BA	Chemistry	400501	
	BS	Chemistry	400501	

Institution	Type of UG Degree	Degree Title in CHE Academic Programs Searchable Database	CIP	Concentrations
Coastal Carolina University	BS	Biochemistry	260202	
	BS	Chemistry	400501	Classical Chemistry Environmental Chemistry Biochemistry
Coker College	BA	Chemistry, General	400501	
	BA1	Chemistry, General	400501	
	BAH	Chemistry, General	400501	
College Of Charleston	BA	Chemistry	400501	
	BS	Chemistry	400501	
	AB	Chemistry	400501	
	AB	Biochemistry	400599	
	BS	Biochemistry	400599	
Columbia College	BA	Chemistry, General	400501	
	BS	Chemistry, General	400501	
Erskine College	BS	Chemistry	400501	<i>Biochemistry</i>
	BA	Chemistry	400501	<i>Biochemistry</i>
Francis Marion University	BS	Chemistry	400501	General Environmental Science ACS
Furman University	BS	Chemistry, General	400501	ACS accredited programs General Environmental Chemistry Biochemistry
Lander University	BS	Chemistry	400501	
Limestone College	BS	Chemistry, General	400501	
Newberry College Forensic	BS	Chemistry, General	400501	<i>Biochemistry</i> <i>Forensic</i> <i>Secondary Certification</i>
Presbyterian College	BS	Biochemistry	260202	
	BS	Chemistry, General	400501	<i>Pre-pharmacy</i>
South Carolina State University	BS	Chemistry	400501	General Secondary Education Pre-Health Career Graduate School/Industry Radio Chemistry Environmental Science
Southern Wesleyan University	BA	Chemistry, General	400501	
	BS	Chemistry, General	400501	
USC-Columbia	BS	Biochemistry & Molecular Biology	260210	
	BS	Chemistry	400501	
	BSCHEM	Chemistry	400501	
USC-Aiken	BS	Chemistry	400501	
USC-Upstate	BS	Chemistry	400501	<i>Forensic Focus</i>
Wofford College	BS	Chemistry, General	400501	

Table 2. Other peer institutions and available undergraduate chemistry degree programs.

Institution	Type of UG Degree	Degree Title in CHE Academic Programs Searchable Database	Concentrations
Appalachian State University	BS	Chemistry	Certified Chemist Environmental Fermentation Forensic Science Individually designed Marketing and Business Pre-professional and Paramedical Secondary Education
	BA	Chemistry	
Belmont University		Chemistry	Advanced Pre-Health Applied Pharmaceutical
	BS	Biochemistry & Molecular Biology	
Elon University	AB	Chemistry	
	BS	Chemistry	ASC approved
	AB	Chemistry/Chemical Engineering	
	BS	Biochemistry	
James Madison University	BS	Chemistry	ACS certified Biochemistry ACS certified Chemistry ACS certified Chemical Education ACS certified Materials Chemistry Chemistry/Business General Chemistry
Mercer	BS	Chemistry	ACS certified General
SUNY Geneseo	BS	Biochemistry	
	BA	Chemistry	
	BS	Chemistry	ACS certified
The College of New Jersey	BS	Chemistry	Condensed Matter Forensic
UNC-Asheville	BS	Chemistry	ACS certified General ACS certified Biochemistry
University of Mary Washington		Chemistry	General ACS certified General
UNC Wilmington	BA	Chemistry	
	BS	Chemistry	ACS certified General ACS certified Biochemistry
Western Carolina University	BS	Chemistry	General Biomedical and Technology ACS approved

Enrollment

Admissions criteria specific to the program

The chemistry programs have no admissions requirements beyond the general university requirements.

Enrollment

No change in enrollment is expected as a result of this report/modification; however, the admission numbers for Chemistry have increased since 2010 and the program is expected to remain healthy, especially with the recruitment and retention efforts of programs such as EagleSTEM and ChemSTEM.

Table 3. Fall enrollment data for Chemistry Program

Concentration	Fall 2010	Fall 2011	Fall 2012	Fall 2013	Average
BS Chemistry, ACS General	7	16	19	17	15
BS Chemistry, ACS Biochemistry	20	30	34	29	28
BS Chemistry, ACS Engineering-Physics	0	2	3	11	5*
BS Chemistry, ACS Forensic Chemistry	17	25	18	21	20
BS Chemistry, ACS Chemistry-Business	1	5	4	5	4
BS Chemistry, Biochemistry	0	2	2	8	4*
BS Chemistry, Multidisciplinary Chemistry	16	17	13	11	14
BS Chemistry, Old programs/undeclared	47	20	40	29	34
Total Program Enrollment	108	117	133	131	122

* 3-year average

Table 4. Graduation data for Chemistry Program

Concentration	10-11	11-12	12-13	13-14
BS Chemistry, ACS General	4	5	4	1
BS Chemistry, ACS Biochemistry	2	6	2	3
BS Chemistry, ACS Engineering-Physics		1		
BS Chemistry, ACS Forensic Chemistry		2		1
BS Chemistry, ACS Chemistry-Business		1	1	2
BS Chemistry, Biochemistry				2
BS Chemistry, Multidisciplinary Chemistry	6	11	9	8
BS Chemistry, Old programs/undeclared			1	
Total Program Completion	12	26	17	17

Table 5. Credit hour production for Chemistry Program collectively

	2010-2011	2011-2012	2012-2013	2013-2014
Credits Attempted	3,041	3,551	4,061	3,831
Credits Earned	2,767	3,163	3,543	3,305
Registration Count	1,339	1,544	1,677	1,640

Discussion of Data

Because the current report is an effort to report on existing options, data provided are actual enrollment information and represent the last 4 years.

Estimated New Enrollment

There is no expected change in the enrollment pattern due the current proposal.

Curriculum

Program of Study

BS in Chemistry (ACS Options) 2014-2015 Catalog

Course	Title	Hrs
General Education Courses		
ACAD101	Principles of the Learning Academy	1
<i>Critical Skills</i>		
Writing and Critical Thinking: WRIT101 & CRTW201	Composition; Critical Reading, Thinking , & Writing	6
Quantitative Skills	Met in major by MATH201	0
Oral Communication	Choose from approved options	3
Logic/Language/Semiotics	Met in major by MATH102	0
Foreign Language Requirement	Language at 102 level	3-4
Technology	Met in major by CSCI151	0
<i>Skills for a Common Experience and Thinking Across Disciplines</i>		
HMXP102	The Human Experience: Who Am I?	3
Global Perspectives	Choose from approved options	3
Historical Perspectives	Choose from approved options	3
<i>Developing Critical Skills and Applying them to Disciplines</i>		
Natural Science	Met in major	0
Social Sciences	Choose from approved options; must include 2 designators	6-9*
Humanities and Arts	Choose from approved options; must include 2 designators	6-9*
	* 15 total hours across categories	
Intensive Writing	Choose from approved options or met through other requirement	0-3
Constitution	Choose from approved options or met through other requirement	0-3
	Subtotal	37-44

Requirements in Major: Complete Core and one of five Degree Concentrations (ACS-Chemistry, ACS-Approved Biochemistry, ACS Engineering-Physics, ACS Forensic Chemistry, or ACS Chemistry-Business)

Required Core Program for ASC Programs

BIOL 203-204	Principles of Biology	4
MATH 201-202	Calculus I & II	8
PHYS 211-212	Physics with Calculus I & II	8
CHEM 105, 106/108	General Chemistry I & II/Lab	8
CHEM 301, 302/ 304	Organic Chemistry I & II/Lab	8
CHEM 305	Chemical Hygiene and Safety	1
CHEM 312	Introductory Chemometrics	1
CHEM 313-314	Quantitative Analysis	4
CHEM 407, 409, 408, 410	Physical Chemistry I & II	8
CHEM 491, 492, 493, 494	Department Seminars	0
CHEM 495	Senior Seminar in Chemistry	1
CHEM 523, 525	Biochemistry I	4
CHEM 530, 531	Inorganic Chemistry and Lab	5

CSCI 151	Overview of Computer Science	3
Subtotal		62

ACS Chemistry Degree Concentration (Students completing this degree concentration will be ACS-certified chemistry graduates.)		
CHEM 551-552 Or 500-level CHEM course with 3 laboratory credits hours	Research	6
Subtotal		6

ACS Biochemistry Degree Concentration (Students completing this degree concentration will be ASBMB Accredited biochemistry graduates and ACS-certified chemistry graduates.)		
Three Courses from: BIOL310, 315, 317, or 555	Microbiology, Cell Biology, Genetics, Molecular Biology	11-12
CHEM524	Biochemistry II	3
CHEM 551-552	Research	6
Subtotal		20-21

ACS Engineering-Physics Degree Concentration (Students completing this degree concentration will be ACS-certified chemistry graduates.)		
MATH 301, 305	Calculus III, Differential Equations	7
PHYS 321	Materials Science	3
CHEM 551-552 Or 500-level CHEM course with 3 laboratory credits hours	Research	6
Subtotal		16

ACS Forensic Degree Concentration (Students completing this degree concentration will be ACS-certified chemistry graduates.)		
CHEM 502-503	Instrumental Analysis	4
CHEM 505-506	Forensic Analytical Chemistry	4
CHEM 551-552 Or 500-level CHEM course with 3 laboratory credits hours	Research	6
Subtotal		14

ACS Chemistry-Business Degree Concentration (Students completing this degree concentration will be ACS-certified chemistry graduates.)		
ACCT 280-281	Accounting I & II	6
ECON 215-216	Microeconomics and Macroeconomics (<i>meets 6 hours of general education</i>)	6
Complete two of the following: FINC 311, MGMT 321, or MKTG 380	Principles of Finance; Management and Leadership; Principles of Marketing	6
CHEM 551-552 Or 500-level CHEM course with 3 laboratory credits hours	Research	6
Subtotal		24

Other Requirements		
Foreign Language Requirement	101 level if appropriate	0-4
General Electives		0-24
ASC Degree Total		124-133

**BS in Chemistry (Multidisciplinary Option)
 2014-2015 Catalog**

Course	Title	Hrs
General Education Courses		
ACAD101	Principles of the Learning Academy	1
<i>Critical Skills</i>		
Writing and Critical Thinking: WRIT101 & CRTW201	Composition; Critical Reading, Thinking , & Writing	6
Quantitative Skills	Met in major by MATH201	0
Oral Communication	Choose from approved options	3
Logic/Language/Semiotics	Met in major by MATH102	0
Foreign Language Requirement	Language at 102 level	3-4
Technology	May be met in major by CSCI151	0-3
<i>Skills for a Common Experience and Thinking Across Disciplines</i>		
HMXP102	The Human Experience: Who Am I?	3
Global Perspectives	Choose from approved options	3
Historical Perspectives	Choose from approved options	3
<i>Developing Critical Skills and Applying them to Disciplines</i>		
Natural Science	Met in major	0
Social Sciences	Choose from approved options; must include 2 designators	6-9*
Humanities and Arts	Choose from approved options; must include 2 designators	6-9*
	* 15 total hours across categories	
Intensive Writing	Choose from approved options or met through other requirement	0-3
Constitution	Choose from approved options or met through other requirement	0-3
Subtotal		37-47

Requirements in Major: Multidisciplinary Chemistry		
<i>Required Core Program for ASC Programs</i>		
BIOL 203-204	Principles of Biology	4
MATH 201-202	Calculus I & II	8
PHYS 211-212 or PHYS 201-202	Physics with Calculus I & II OR General Physics I & II	8
CHEM 105, 106/108	General Chemistry I & II/Lab	8
CHEM 301, 302/ 304	Organic Chemistry I & II/Lab	8
CHEM 305	Chemical Hygiene and Safety	1
CHEM 312	Introductory Chemometrics	1
CHEM 313-314	Quantitative Analysis	4
CHEM 407, 409, 408, 410	Physical Chemistry I & II	8
CHEM 491, 492, 493, 494	Department Seminars	0
CHEM 495	Senior Seminar in Chemistry	1
CHEM >299	Chemistry Elective	3
BIOL, CHEM, CSCI, GEOL, QMTH, PHYS, MATH >299)	Mathematics or science electives	9
Subtotal		63

Other Requirements		
Foreign Language Requirement	101 level if appropriate	0-4
General Electives		10-24
Multidisciplinary Degree Total		124

**BS in Chemistry (Biochemistry Option)
 2014-2015 Catalog**

Course	Title	Hrs
General Education Courses		
ACAD101	Principles of the Learning Academy	1
<i>Critical Skills</i>		
Writing and Critical Thinking: WRIT101 & CRTW201	Composition; Critical Reading, Thinking , & Writing	6
Quantitative Skills	Met in major by MATH201	0
Oral Communication	Choose from approved options	3
Logic/Language/Semiotics	Met in major by MATH102	0
Foreign Language Requirement	Language at 102 level	3-4
Technology	May be met in major by CSCI151	0-3
<i>Skills for a Common Experience and Thinking Across Disciplines</i>		
HMXP102	The Human Experience: Who Am I?	3
Global Perspectives	Choose from approved options	3
Historical Perspectives	Choose from approved options	3
<i>Developing Critical Skills and Applying them to Disciplines</i>		
Natural Science	Met in major	0
Social Sciences	Choose from approved options; must include 2 designators	6-9*
Humanities and Arts	Choose from approved options; must include 2 designators	6-9*
	* 15 total hours across categories	
Intensive Writing	Choose from approved options or met through other requirement	0-3
Constitution	Choose from approved options or met through other requirement	0-3
Subtotal		37-47

Requirements in Major: Multidisciplinary Chemistry		
<i>Required Core Program for ASC Programs</i>		
BIOL 203-204	Principles of Biology	4
MATH 201-202	Calculus I & II	8
BIOL 310 or 315	Microbiology, Cell Biology	4
PHYS 211-212	Physics with Calculus I & II	8
CHEM 105, 106/108	General Chemistry I & II/Lab	8
CHEM 301, 302/304	Organic Chemistry I & II/Lab	8
CHEM 305	Chemical Hygiene and Safety	1
CHEM 312	Introductory Chemometrics	1
CHEM 313-314	Quantitative Analysis	4

CHEM 407, 409, 408, 410	Physical Chemistry I & II	8
CHEM 491, 492, 493, 494	Department Seminars	0
CHEM 495	Senior Seminar in Chemistry	1
CHEM 523, 525	Biochemistry I	4
CHEM 524 or 528	Biochemistry II, Advanced Topics in Biochemistry	3
BIOL, CHEM, CSCI, GEOL, QMTH, PHYS, MATH >299)	Mathematics or science electives	3
Subtotal		65

Other Requirements		
Foreign Language Requirement	101 level if appropriate	0-4
General Electives		8-22
Biochemistry Degree Total		124

Program Assessment

Table 6 provides a matrix of goals and outcomes associated to specific program/student measures. Data is collected annually and analyzed on a four-year cycle.

Table 6. Chemistry Assessment

Program Goal or Student Learning Outcome	Assessment Measures
<p><i>Program Goal:</i> Students gain hands-on experience using relevant and modern laboratory instruments and research tools to prepare themselves for professional chemistry positions in industry, graduate school, and governmental scientific research centers. In laboratory work involving all five areas of chemistry (for ACS degree concentrations) or involving at least three areas of chemistry (for other degree concentrations), students demonstrate competent scientific professional skills in understanding and using modern sophisticated instrumentation, in designing and conducting chemistry experiments, in quantitatively analyzing experimental data, in properly recording experimental results, and in interpreting chemistry experimental results.</p>	Availability of and degree of student engagement with modern instrumentation. Incorporation into curriculum of modern instrumentation recommended by the ACS CPT. External reviews by the ACS CPT.
	Actual recent graduate matriculation into fully-funded chemical science PhD programs; into medical/dental/pharmacy/other health professional programs; into industrial professional chemistry positions; into other graduate programs; and into chemistry teaching positions.
	Student participation in research, internships, national/regional scientific conferences, and research publications.
	Student laboratory performance. Student individual performance in competency-based scientific data analysis and experimental design evaluations.
<p><i>Student Learning Outcome 1:</i> During their Winthrop learning experience, students will demonstrate intellectual and professional development in chemistry; develop a firm scientific foundation; and demonstrate technical competence in problem solving, critical thinking, and analytical reasoning involving all five areas of chemistry (for ACS concentrations) or involving at least three areas of chemistry (for other degree concentrations).</p>	This assessment method focuses upon student outcomes; these provide the most credible, objective evidence of student achievement of Learning Outcome.
	Actual recent graduate matriculation into fully-funded chemical science PhD programs; into medical/dental/pharmacy/other health professional programs; into industrial professional chemistry positions; into other graduate programs; and into chemistry teaching positions.
	This assessment method evaluates the rigor and the content of student learning in chemistry; this is a particularly critical element for evaluating student

Program Goal or Student Learning Outcome	Assessment Measures
	<p>learning since Winthrop offers a Professional Chemistry Certification.</p> <p>External review and assessment by the American Chemical Society (ACS) Committee on Professional Training (CPT) of coverage, depth, and rigor in Winthrop chemistry courses for all five areas of chemistry. The ACS CPT requires approved chemistry programs such as Winthrop to routinely submit course syllabi, quiz, test, and final exam problems for Winthrop Chemistry Foundation Courses in each of the five areas of chemistry and for four or more Winthrop In-Depth Chemistry Courses. These critical thinking and analytical reasoning problem-solving exercises are then reviewed by chemistry professionals appointed by the ACS to assess coverage, rigor, and depth to determine whether these meet ACS standards for an undergraduate professional education in chemistry. Evidence of periodic national and regional competitiveness of Winthrop chemistry majors.</p> <p>Student performance on national undergraduate chemistry examinations developed and validated by the American Chemical Society Division of Chemical Education Examinations Institute.</p> <p>Student pursuit of intellectual development in critical thinking and problem-solving through non-mandatory advanced active-learning activities to include: completion of ACS degree concentrations in chemistry; co-authorship of peer-reviewed research publications; research presentations at national and regional scientific conferences; participation in chemistry research; completion of 500-level chemistry courses; completion of chemistry industrial internships; and active engagement in nationally chartered Winthrop student SAACS and NOBCCHE chemistry chapters.</p> <p>Inputs from Winthrop chemistry faculty; chemistry student feedback on learning experiences; senior exit surveys; chemistry alumni feedback on learning experiences.</p>
<p><i>Student Learning Outcome 2:</i> Chemistry students demonstrate personal and social responsibility by adhering to proper chemical hygiene and safety procedures in laboratory experiments involving toxic substances and by properly disposing of hazardous chemical wastes. Chemistry students achieve excellence, demonstrate a sense of responsibility to the broader community, and contribute to the greater good by actively participating in research or internships to improve the quality of modern human life.</p>	<p>Continued compliance with American Chemical Society Chemistry Hygiene and Safety Guidelines, and continued availability of resources to achieve best practices for chemical hygiene and safety. If students are to leave Winthrop with an ethical sense of their personal responsibility and commitment to chemical hygiene laboratory safety, they must work in an environment that adheres to best practices.</p> <p>Students receive chemical hygiene and safety training at the beginning of the summer, fall, and spring semesters. Students complete the CHEM305 Chemical</p>

Program Goal or Student Learning Outcome	Assessment Measures
	<p>Hygiene and Safety Course. In Fall 2012, we required all students completing safety training to complete an online safety quiz. Students were required to pass with a 70%.</p> <p>Chemistry department will track student accidents, injuries, and near-misses from working in the laboratory</p> <p>Response to chemistry senior seminar exit survey question "You are leaving Winthrop with a chemistry degree. Comment on the degree to which you feel that you have developed a substantive awareness of chemical hazards and a professional understanding of chemical hazards and modern laboratory chemical hygiene / safety requirements for the safe handling, use, and disposal of chemicals; for the safe operation of chemistry equipment; and for the safe conduct of laboratory experiments. Recommend changes that would improve learning and increase focus in this area."</p> <p>Students are actively engaged in research and internships that contribute to the greater good.</p>
<p><i>Student Learning Outcome 3:</i> Chemistry students demonstrate an understanding of the interconnected nature of the world and the time in which they live by conducting and interpreting molecular modeling computations, by mathematically analyzing complex multivariate instrument-generated data, and by effectively using modern software to control analytical instrumentation, to establish/alter experiments, and to collect data. Students are able to use modern chemical literature search/retrieval methods to obtain information on a given chemistry topic and to recognize chemistry's role as the central science inextricably linked to so many other fields.</p>	<p>Assessment of student individual performance in independent literature searches using the CHEM495 written review article rubric as an instrument. To successfully complete the literature search, students will have to search a variety of databases and evaluate materials from different disciplines of chemistry in order to extract relevant information and apply it to their chosen topic.</p> <p>Student performance on relevant summaries from external speakers presenting their research to the department as part of the chemistry seminar course series (CHEM491-494). These seminars span all disciplines of chemistry and students must analyze and summarize the work presented, thereby demonstrating an understanding of the research and its application to the world.</p> <p>Student individual performance in competency-based scientific data analysis and experimental design evaluations including: the manipulation of recombinant microorganisms and the products they generate (CHEM525 final lab report) and the quantitative analysis of commercially available products (CHEM314 multivitamin titration report). These experiments demonstrate the role of chemistry in the everyday world and in order to earn a passing grade on the reports, students must discuss these relationships.</p>
<p><i>Student Learning Outcome 4:</i> Students encounter numerous learning opportunities to strengthen verbal and written technical communication skills. Students are able to effectively communicate experimental plans and scientific results through written works and</p>	<p>Student completion of WRIT465, Preparation of Oral and Written Reports and WRIT566, Writing for the Sciences and Technology, with a grade of C or higher. These courses are designed to specifically bolster the communication abilities of students.</p>

Program Goal or Student Learning Outcome	Assessment Measures
through oral presentations.	Assessment of student performance in oral presentations on scientific topics including: CHEM108 group presentation on enzyme kinetics and CHEM495 individual oral presentations. The effectiveness of the presentations as communication tools is inextricable from the science discussed as presenting data in intelligible formats is as important as discussing those same data.
	The CHEM525 final laboratory report is a 15 to 20 page assignment delivered in the form of a peer-reviewed scientific article and must include Abstract, Introduction, Materials and Methods, Results, Discussion, Conclusion, and Literature cited sections. Students must construct figures suitable for publication in scientific journal. The report is the summary of the entire semester's work of work and requires repeated draft construction and evaluation.

New Courses

No new courses are being created in relationship to this proposal.

Faculty

Table 7. Faculty by Rank

Faculty Member	Highest Degree	University	Research Areas
Professor 1 (and chair)	Ph.D., Analytical Chemistry	University of North Carolina-Chapel Hill	Analytical Chemistry, Environmental Chemistry, Chemical and Environmental Data Analysis
Professor 2	Ph.D., Biochemistry	University of South Carolina	Biochemistry, Cancer Biochemistry, Molecular Biology, Enzymology
Professor 3	Ph.D.	Wake Forest University	Analytical Chemistry, Instrument Development for Atomic and Molecular Spectroscopy, Atomic and Molecular Spectrometry for Clinical and Environmental Analysis, Technology in the Undergraduate Curriculum
Professor 4	Ph.D., Inorganic Chemistry	Washington University	Physical Inorganic and Biophysical/Bioinorganic Chemistry, Fluorescences Spectroscopy, Nanoscience
Associate Professor 1	Ph.D., Microbiology and Cell Science	University of Florida	Structural Biology, Biochemistry, Biophysics
Associate Professor 2	Ph.D., Organic Chemistry	University of California, San Diego	Organic synthesis and methodology

Faculty Member	Highest Degree	University	Research Areas
Associate Professor 3	Ph.D., Organic Chemistry	Duke University	Organic synthesis, organic methodology, chemistry pedagogy
Associate Professor 4	Ph.D., Chemistry	Cornell University	
Associate Professor 5	Ph.D., Chemistry	University of South Carolina	Medicinal Chemistry and Drug Design
Assistant Professor 1	Ph.D., Analytical Chemistry	University of South Carolina	General Chemistry Education, Chemical Hygiene and Safety
Assistant Professor 2	Ph.D., Chemistry	Dartmouth College	Biochemistry, Biophysical Chemistry, Bioinorganic Chemistry
Visiting Assistant Professor 1	Ph.D., Chemistry	University of Notre Dame	
Adjunct Instructor 1	Ph.D., Chemistry	University of North Carolina at Chapel Hill	
Adjunct Instructor 2	M.S. Chemistry	University of Colorado-Denver	General Chemistry Lecture and Laboratory, Analytical Chemistry
Adjunct Instructor 3	B.S. Chemistry with extensive industry/lab experience	Virginia Military Institute	Pharma Intermediate Marketing
Adjunct Instructor 4	Ph.D., Biochemistry	University of South Carolina	

New faculty

This proposal does not require the hiring of additional faculty.

Proposed changes in assignments of existing faculty

This proposal does not require assignment changes for existing faculty.

Institutional plan for faculty development as it relates to proposed program

This proposal does not require special professional development of faculty.

Institutional definition of full-time equivalents (FTE)

One faculty FTE is defined as a single faculty member teaching more than six hours in the program in a given semester. Otherwise, one faculty FTE is defined as the accumulation of 24 semester hours of teaching in an academic year.

Headcount and FTE

This proposal will not affect FTE in the department.

Physical Plant

Adequacy of existing physical plant and additional requirements

This proposal does not require changes in the physical plant.

Equipment

This proposal does not require additional equipment.

Library Resources

This proposal does not require additional library resources.

Accreditation

Winthrop's Chemistry program overall is approved by the American Chemical Society. In addition, all of Winthrop's five ACS Chemistry Degree Concentrations meet guidelines established by the American Chemical Society's Committee on Professional Training (CPT) for an undergraduate professional education in chemistry. All graduates who complete an ACS degree concentration are issued a chemistry professional certificate by the ACS. Winthrop's ACS Biochemistry degree concentration was the nation's first program accredited by the American Society of Biochemistry and Molecular Biology (ASBMB) in 2013 and, as of July 2014, the only ASBMB-accredited program in the Carolinas.

The Chemistry Department submits annual reports to the American Chemical Society; every six years, the department also submits a very comprehensive periodic report to the ACS. In 2013, Winthrop received ACS feedback on its recent periodic report submission. The CPT noted that *"The chemistry program has continued to progress since receiving initial approval in 2004. The Department's self-evaluation activities and use of results to direct program improvement are excellent. The Committee praised the faculty's outstanding record of obtaining grants. The Committee praised the faculty's attention to pedagogy in general chemistry, particularly the use of principles from medicinal chemistry and mechanisms of drug action. The excellent improvement in the number of chemistry majors who continue on to graduate school was also commended. The undergraduate research program is strong and well designed as a major pedagogical tool. The Committee characterized the quality of the student research reports as outstanding."*

In 2013, Winthrop received feedback from ASBMB as part of its program accreditation. The committee specifically noted that: *"We saw enormous strengths in your program...we found your application very strong overall. The areas that were particularly noteworthy were:*

- *Institutional and department/program commitment to diversity*
- *Excellent core faculty: vibrant and productive*
- *Centrality of undergraduate research"*

ASBMB also recommended the addition of advanced biology courses; this recommendation has already been implemented with a major curriculum change approved by Winthrop's Faculty Conference in Spring 2014.

Estimated costs

No additional costs are required in relationship to this proposal. Table 8 shows a projected budget report for the 2014-2015 academic year based on expenses and enrollments in 2013-2014. No new costs or requirements are associated with this proposal, so this budget is provided as evidence of our current capacity to support the chemistry program.

Narrative for Line items

Program Administration: This represents 50% of the chair's salary. Salaries include the 2% cost of living increase for the 2014-2015 academic year and base salary increases due to promotions in rank affective August 2014.

Faculty Salaries: This includes all chemistry-related instructional salaries funded by University sources and 50% of the chair's salary. Salaries include the 2% cost of living increase for the 2014-2015 academic year and base salary increases due to promotions in rank affective August 2014.

Clerical/Support Personnel: This includes department-related administrative support and lab support. This is all non-instructional salary supported through University sources. Salaries include the 2% cost of living increase for the 2014-2015 academic year.

Supplies and Materials: This represents 80% of the costs in the general operating budget for the department. The department also includes courses in Physics and Geology, and it is estimated that 20% of the resources are associated with the delivery of non-chemistry coursework.

Equipment: This includes all equipment and related service that was billed to the departmental operating budget. There are additional service contracts and large equipment purchases that are made through college and university level budgets that are not captured here.

Tuition Funding: This figure was estimated by taking the number of chemistry credit hours attempted in 2013-2014 (3831 credits) multiplied by the 2014-2015 in-state undergraduate per credit cost (\$576).

Program-Specific Fees: This represents 80% of the lab fees credited to the department in 2013-2014. The department also includes courses in Physics and Geology, and it is estimated that 20% of the fees are associated with non-chemistry coursework.

Table 8. Cost to institution and source of funding.

Estimated Costs for 2014-2015	
Program Administration	\$51,535
Faculty Salaries	\$854,472
Graduate Assistants	\$0
Clerical/Support Personnel	\$139,309
Supplies and Materials	\$63,686
Library Resources	\$0
Equipment	\$37,270
Facilities	\$0
Total	\$1,146,272
Sources of Funding	
Tuition Funding	\$2,206,656
Program Specific Fees	\$54,990
State Funding	\$0
Reallocation of Existing Funds	\$0
Federal Funding	\$0
Other Funding	\$0
Total	\$2,261,646

Assurances of Institutional Approvals

Since this is an update for the CHE Inventory of Programs, the various concentrations were approved over several years and reflect the current offerings in the BS in Chemistry degree program.

Update approved by the Provost – July 1, 2014

Update approved by the Acting President – Sept 10, 2014