WICHITA STATE UNIVERSITY

Program Review

Self-Study Template

Revised 11-15-2021

Academic unit: *Chemistry and Biochemistry* College: Fairmount College of Liberal Arts and Sciences.

Date of last review 2018 Date of last accreditation report (if relevant) June 30, 2021 (ACS Periodic Report)

List all degrees described in this report (add lines as necessary)

Degree:	BS Chemistry	CIP* code:	40.0501
Degree:	BS Biochemistry	CIP code:	26.0202
Degree:	MS Chemistry	CIP code:	40.0501
Degree:	PhD Chemistry	CIP code:	40.0501

*To look up, go to: Classification of Instructional Programs Website, http://nces.ed.gov/ipeds/cipcode/Default.aspx?y=55

Certificate (s):

Faculty of the academic unit (add lines as necessary)

(If interdisciplinary, please list your core teaching faculty and department name if external to academic unit)

NAME (List department –if external to unit)	SIGNATURE	TENURE OR NON-TENURE TRACK
Dr. Kevin Alliston (Teaching Professor)		Non Tenure Track
Dr. James G. Bann (Associate Professor)		Tenure Track
Dr. Moriah R. Beck (Associate Professor)		Tenure Track
Dr. Dennis H. Burns (Professor)		Tenure Track
Dr. Douglas S. English (Associate Professor)		Tenure Track
Dr. Maojun Gong (Associate Professor)		Tenure Track
Dr. William C. Groutas (University Distinguished Professor)		Tenure Track
Dr. Katie Mitchell-Koch (Associate Professor)	on sabbatical	Tenure Track
Dr. Alexandre A. Shvartsburg (Associate Professor)		Tenure Track
Dr. Jian Wang (Assistant Professor)		Tenure Track
Dr. Kandatege Wimalasena (Professor)		Tenure Track

Dr. Haifan Wu (Assistant Professor)		Tenure Track

Submitted by: Douglas S. English, Associate Professor and Chair _____ Date _____
(Name and title) (Date)

Please note that the signatures indicate that each faculty has read the self-study template and agreed (by consensus) to its contents.

Part 1: Departmental Purpose, Relationship to the University Mission and Strategic Plan engagement

Please list the program purpose statement. Explain in 1-2 concise paragraphs the role of the program and tie them to the University mission (printed below) and strategic plan.

The mission of Wichita State University is to be an essential ***educational, cultural and economic driver*** *for Kansas and the greater public good.*

A. Program Purpose Statement - formerly Mission

A. The mission of the undergraduate program in Chemistry and Biochemistry is to provide students with a broad understanding of all disciplines in chemistry, to train them in the specific skills required for chemical research and to prepare them for careers in the chemical and biochemical-related industry, for advanced study in their field, or for pursuit of professional degrees.

B. The mission of the Masters of Science program in Chemistry and Biochemistry is to provide students with advanced understanding of chemistry and biochemistry, to develop their technical research and analytical skills, and to prepare them for careers in the chemical or biochemical-related industry, and for further study at the doctoral level.

C. The mission of the PhD program in Chemistry or Biochemistry is to provide students with an in-depth expertise in a specific area of chemistry or biochemistry, to develop the ability to conceive of and carry out an independent research program, and to prepare students for senior-level careers in industry or academic careers at research institutions.

D. The cultural mission of the Department of Chemistry and Biochemistry is to provide the university and surrounding region with diverse chemical scientific discussion through community engagement.

B. The role of the Program(s) and relationship to the University mission:

The Baccalaureate degree programs in the Department of Chemistry and Biochemistry are designed to provide students with a solid background in all areas of chemistry, including organic, analytical, inorganic, physical, and biochemistry. Through traditional coursework, extensive laboratory experience, and independent study research projects, students are provided with the conceptual knowledge base, introduced

to the principles of the scientific method, and given the opportunity to apply these while developing critical thinking and problem solving skills. An undergraduate degree in chemistry or biochemistry will prepare the student for immediate employment in industry, government, or primary or secondary education; careers in chemical-oriented business or law; or graduate study in chemistry, biochemistry, or medical professional schools (including medicine, dentistry, optometry, veterinary).

The Masters of Science program is a strong research-based program designed to provide students with advanced instruction in a variety of chemical disciplines, develop students' technical expertise with chemical instrumentation, and further engage them in state-of-the-art original research. Through a core curriculum of advanced courses and a faculty-mentored research project culminating in a thesis, students are prepared for positions in the chemical and pharmaceutical industry, teaching at the high-school and junior college level, and further study at the doctoral level in chemistry or a related field.

The PhD program in Chemistry and Biochemistry is designed to provide students with advanced instruction over a broad range of chemical disciplines as well as in-depth instruction in a specific area. The expectation is that the student will become an expert in a specific field of study and will develop the skills required to be an independent researcher, including genesis and development of an idea, formulation of a research strategy, collection and analysis of data, drawing appropriate conclusions, and presentation of results. The degree culminates in the writing and defense of a dissertation based on an original research project. Recipients of the PhD are prepared for employment in senior positions in industry and government, teaching at four-year colleges, and postdoctoral positions leading ultimately to teaching positions at research universities.

C. *Has the purpose of the Program(s) changed since last review?* ☐ *Yes* ☒ *No*

If yes, describe in 1-2 concise paragraphs. If no, is there a need to change?

D. *How does the Program support the university strategic plan?*

Describe in 1-2 concise paragraphs.

The department promotes student success by striving to provide lecture and lab experiences that optimize student career outcomes. Emphasis is put on quality course materials and responsive instruction from faculty and graduate teaching assistants. The department offers in house tutoring and student support services through open TA hours in McKinley 223 (this service will move to the centralized tutoring area planned for Clinton Hall). We also provide professional development opportunities for our students through our colloquium series which includes topics on professional opportunities along with visits from returning graduates. All undergraduate students are required to complete at least two credit hours of independent research under the supervision of a faculty member. Students are also encouraged to start research early and it is not uncommon for our undergraduate researchers to spend multiple semesters doing hands-on independent, original research the results in publications and/or presentations at professional meetings.

We provide opportunities for students to make connections with local and regional industry through our alumni employed at those locations, for instance Morton Salt, Pfizer Chemical, BG Products and others. Within the department we promote a diverse and inclusive environment and efforts include recruiting and hiring a diverse faculty along with providing interesting speakers at the department colloquium (required for

all graduates students as Chem 701 and open to the public). Recent talk titles included topics that emphasize diversity such as, *"Reimagining career advancement and publishing in science"* by Prachee Avasthi, (Dartmouth) and *"Without inclusion, diversity initiatives may not be enough in science"* by Chandler Purrity of UCSD.

E. *Provide an overall description of your program (s) including any changes made since the last review?*

The Department of Chemistry and Biochemistry (formerly, as of 2021, the Department of Chemistry) undergraduate program offers a number of degrees tailored to prepare students for different career or higher education options. The BS in Chemistry is certified by the American Chemical Society and is geared to students intending to seek employment in chemical or related industry or those planning to pursue advanced degrees in their field. A biochemistry option is available with this degree, which is attractive to those students intending to pursue advanced degrees in biochemistry. The department was renamed in 2021 to more accurately convey the importance placed on biochemistry and to help attract students to the BS in Biochemistry. The BS in Chemistry-Premedicine is designed for students intending to pursue advanced degrees in health-related fields, such as medicine, pharmacy, or dentistry. The BS in Chemistry and Biochemistry/Business is a joint venture with the Barton School which is designed for students seeking careers in the pharmaceutical or chemical industries. The Field Major in Biochemistry, shared with the Department of Biological Sciences, also prepares students for graduate study in biochemistry and biomedical fields. The department also offers a BA degree in chemistry.

The objectives for all the undergraduate degrees are to develop a solid foundation in the principles of chemistry including all major subdivisions of the field, to become familiar with the synthetic and analytical techniques of chemistry, and to gain an understanding of the scientific method and application of the principles learned in classes to chemical research. Measurable outcomes include (i) assessment exams taken following completion of most undergraduate courses and (ii) a written report on the independent research project. Just prior to the previous program review we revamped the BS Chemistry Premedicine degree to incorporate more courses from biological sciences and health professions in order to better prepare students for medical school. We are currently working on revisions to our ACS accredited Biochemistry degree to improve its attractiveness and to make it simpler to complete in four years. At this writing we have removed the calculus III requirement and are considering reducing the upper division lab requirements which would give students the ability to tailor the degree more toward their specific research interests and provide a smoother route to four-year degree completion.

The MS program in Chemistry and Biochemistry is a strong, research-based program aimed at producing graduates who will be employed in the chemical or pharmaceutical industry or teaching positions at the high-school or junior college level, or who will pursue advanced degrees in chemistry or a related field. Success in achieving this goal can be measured by the percentage of graduates who have been able to obtain such positions. Based on the data given in Part 4, the program has achieved this goal, with 100% of the graduates having gone on to such positions related to their MS. The objectives of this degree are to build on the

the principles and techniques of chemical research. The measurable outcome is the written thesis based on an original research project and the oral defense thereof.

The PhD program in Chemistry and Biochemistry is intended to graduate students who will establish careers as independent researchers in the chemical industry and in academic positions at four-year colleges and research universities. Success in achieving this goal can be measured by the percentage of graduates who have been able to obtain such positions. Based on the data given in Part 4, the program has achieved this goal, with 100% of the graduates having gone on to such positions related to their PhD.The objectives of this degree are to acquire expertise in a specific area of Chemistry and Biochemistry, establish proficiency in the techniques of chemical research, and develop the ability to conceive of, express, and carry out an independent research project. The measurable outcomes are (i) cumulative exams taken in the 2nd and 3rd years, (ii) preparation and defense of an original research proposal in the 5th semester, and (iii) the written dissertation based on an original research project and the oral defense thereof.

Some significant changes since the last review include the department name change, re-organization of the Talaty Endowed Research Professorship as a rotating position, and addition of new faculty, development of low-cost in-house lab manuals, establishment of a DEI committee and development of two new honors lab courses.

Part 2: Faculty Quality and Productivity as a Factor of Program Quality

The quality of the program/certificate as assessed by the strengths, productivity, and qualifications of the faculty in terms of scholarly/creative activity and service. (Refer to instructions in the WSU Program Review Instructions for more information on completing this section. Tables 4 (Instructional FTE), 6 (Program Majors) and 7 (Degree Production) from OPA can be used to help with this section.)

Complete the table below for the faculty who support the program (all faculty who signed or should have signed the coversheet).

Scholarly Productivity	Number Journal Articles		Number Presentations		Performances			Number of Exhibits		No. Books	No. Book Chaps	No. Grants Awarded or Submitted	$ Grant Value**
	Ref	Non-Ref	Ref	Non-Ref	*	**	***	Juried	****				
2017-2018	29		56							1		29	11.0 M
2018-2019	16		53									21	7.0 M
2019-2020	15		44									21	5.8 M
2020-2021	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

*Winning by competitive audition. **Professional attainment (e g , commercial recording). ***Principal role in a performance. ****Commissioned or included in a collection. ++ This total is for $ awarded.

A. *Briefly explain the standards in place in your college/department for the evaluation of your faculty research/scholarship/creative activity.* ***If an interdisciplinary program, please report on the program where faculty research has been recorded and provide narrative related to productivity.***

program, please report on the program where faculty research has been recorded and provide narrative related to productivity.

Research productivity in chemistry is best assessed by an analysis of the papers published in peer-reviewed academic journals and patents submitted or accepted. The goal set for faculty members in our department, and a reasonable expectation for an institution such as WSU, is a minimum of one paper per year. Faculty members and students are also encouraged to present research findings at regional, national, and international meetings. Such activity not only allows for personal interactions with others in the field, but also brings recognition to the department and the university. The other metric by which to assess a research program is that of external funding.

B. *Provide a brief assessment of the quality of the faculty/staff using the data from the table above. Include details related to productivity of the faculty including scholarship/research and creative activity and services. (i.e., some departments may have a few faculty producing the majority of the scholarship, service, efforts to recruit/retain faculty, departmental succession plans, etc.)*

Over the period from 2018-2021 the department's faculty maintained an average rate of 1.6 peer-reviewed articles per faculty per year. This rate was slightly lower than the last review cycle which was 1.9 articles per faculty member per year. This slight decline is most likely due to the pandemic. While the numbers were slightly down, publications continue to appear in highly regarded high-impact journals, such as *Proceedings of the National Academy* and *Journal of the American Chemical Society, Journal of Medicinal Chemistry*, and *PLOS.*

WSU always brings a large contingent of graduate and undergraduate students to present at the Midwest Regional Meeting of the American Chemical Society. In 2019 the meeting was hosted by WSU and researchers from all groups in the department gave presentations. In addition, presentations were made at prestigious meetings such as the national meetings of the American Chemical Society, including some invited talks, the American Society of Mass Spectrometry, Biophysical Society, Pittcon, Telluride Confernces, and Gordon Research Conferences. Department faculty members were also invited speakers at regional universities such as the University of Nebraska, Pittsburg State, Oklahoma State University, as well as at other universities around the country and world, such as University of Nevada, Notre Dame, University of Lyon, and Ecole Normale Supérieure, Paris.

All faculty members in the Department of Chemistry have actively pursued external funding during the period of review. External funding in chemistry has become increasingly difficult to achieve. Still, faculty in the WSU Department of Chemistry have maintained a high level of success in securing external funding from federal and state sources (NIH, NSF, COBRE, KINBRE, etc.).

Part 3: Academic Program(s) and Emphases

Analyze the quality of the program as assessed by its curriculum and impact on students for each program (if more than one). Attach updated program assessment plan(s) as an appendix (refer to instructions in the WSU Program Review document for more information).

A. Undergraduate programs:

1. Please review Table 8 provided by the Office of Planning and Analysis. Is the program ACT below 20 (triggered by KBOR defined Minima)? ☐ Yes ☒ No

   If yes, please explain the average ACT scores for your students.

B. Graduate programs:

1. Please review Table 9 provided by the Office of Planning and Analysis. Is the program GPA below the university average? ☐ Yes ☒ No

Our department seven year average from (2014 to 2020) was 3.5.

C. Accreditation status: If accreditation is previously noted, please add:

Accrediting Body: American Chemical Society

Next Review Date: 2027

Commendations and concerns from the last review:

The summary of the results from our last review during the summer of 2021 is reproduced here:

Final Decision Executive Summary:
Wichita State University's 2021 Periodic Report was reviewed by members of the ACS Committee on Professional Training during their January 2022 Executive Session. Upon evaluation of the report, the reviewers agree that the program meets all ACS approval requirements and recommend is continue approval. The program reports multiple positive changes that have resulted in a strong sustainable program. More faculty are taking sabbaticals and have been winning prestigious awards. The new pedagogical resources have been implemented and more funding has been allocated to those working with the chemistry program. An increase in capital equipment in the past six years provides the resources to give students top-rate exposure to instrumentation. Efforts to promote DEI are also being noted and the program is encouraged to continue their efforts to diversify faculty. Your next periodic report is due June 30, 2027.
Final Program Strengths:
The program is proactively and strategically seeking improvement in the preparation and training of their majors. These efforts are reflected in terms of infrastructure, curricular development, faculty hires, undergraduate research, and faculty development.
Final Should:
There are several areas that the program can make improvements: 1) make efforts to improve gender and ethnic diversity of their faculty, 2) revise the introductory analytical chemistry lab that relies heavily in using titrations, 3) improve the tracking of undergraduates after they finish their degree.
Final Exemplars:
The instrument holdings are exemplar and the financial support for undergraduate research is excellent.

D. Assessment of Learning Outcomes

1. Complete the table below with program level data. Identify the principal learning outcomes (i.e., with what skills does your Program expect students to graduate) and provide aggregate data on how students are meeting those outcomes

You may add an appendix to provide more explanation/details. (If specialty accreditation has been conferred within 18 months of this process, programs can append the information from the accreditation document to this self-study and cite, with page number, the appropriate information. If specialty accreditation has not been affirmed within 18 months, please complete the table or submit an updated version of your accreditation information. If not accredited, please complete the table below.)

Table 2 Learning Outcome Assessment

Learning Outcomes (most programs will have multiple outcomes)	Assessment Type (e.g., portfolios, exams)	Assessment Tool (e.g. rubrics, grading scale)	Target/Criteria (desired program level achievement)	Results	Analysis
Demonstrate the ability to apply principles of organic, inorganic, physical (thermo and quantum), analytical (and instrumental), and biochemistry	American Chemical Society exams in each field are administered at the conclusion of the appropriate course	Comparison to national norms.	85% of students will demonstrate satisfactory performance on exam by performing within one standard deviation of the national norm or above.	AY 17-18 Analytical 77% Instrumental 88% Organic 87% Thermo 100% Quantum 93% Inorganic 100% Biochem 661 64% Biochem 663 94% AY 18-19 Analytical 73% Instrumental 100% Organic 94% Thermo 100% Quantum 100% Inorganic 67% Biochem 661 65% Biochem 663 100%	While we are missing the target of 80% in the highly enrolled courses that have non-majors, i.e. analytical, instrumental and organic we meet the 80% goal in courses where our majors make up over 90% of the students, i.e. thermo, quantum, inorganic and biochemistry.

				AY 19-20 (No ACS for SP 2020) Analytical 74% Organic 100% Thermo 91% Biochem 661 66%	
Demonstrate the ability to apply techniques and concepts of chemistry in a research project	Research report submitted at the conclusion of the mandatory independent study research course				Quantitative analysis has not been carried out to date, but in the future reports will be analyzed according to AACU Inquiry and Analysis rubric evaluated by the research mentor.

Definitions:
Learning Outcome: Learning that should result from instruction.
Assessment Type: Type of assessment used to identify, collect, and prepare data to evaluate the achievement of learning outcomes (e.g., a writing project evaluated by a rubric).
Assessment Tool: Instrument used to evaluate the achievement of learning outcomes.
Criterion/Target: Percentage of students expected to achieve the desired outcome for demonstrating program effectiveness (e.g., 90% of the students will demonstrate satisfactory performance on a writing project).
Result: Actual achievement on each learning outcome measurement (e.g., 95%).
Analysis: Determines the extent to which learning outcomes are being achieved and leads to decisions and actions to improve the program. The analysis and evaluation should align with specific learning outcome and consider whether the measurement and/or criteria/target remain a valid indicator of the learning outcome as well as whether the learning outcomes need to be revised

2. Provide an analysis and evaluation of the data by learner outcome with proposed actions based on the results listed in Table 2. Data should relate to the goals and objectives of the program as listed in Part 1.

Analytical and biochem scores are consistently low. Both courses have a substantial enrollment from non-majors with about 40% of nonmajors in 523 and 15-20% in Chem 661. It is tempting to assign the lower pass rate on the ACS exams to the non-majors enrolled in these courses and who may have less aptitude or interest in the material. However, the high passing rate for the ACS exam in Chem 532 which only has about a 15-20% enrollment from majors has a very high ACS passing rate.

Part of the low passing rate in Chem 523 and 661 relative to 532 could come from the high completion rate in 523 (81% over the three academic years in the table) and 661 (87%) compared to Chem 532 (75% over the same period). The higher drop rate for 532 may contribute to a higher ACS exam pass rate since students who withdraw are usually those performing poorly in the class and likely to do poorly on the final exam.

An examination of the grade distributions in 523 and 661 show a much higher average grade than observed in 532. For instance the rate of A grades in 523 and 661 are 24% and 31%, respectively. For Chem 532 over the same period only 10.4% of students receive A's. This suggest that while the students in 523 and 661 are meeting the instructor's expectations

Update and review ACS exams for 523 and 661. Review syllabus and time spent on different materials.

, In table 2 these are the only two courses with substantial numbers of students outside their major. Same professor has taught analytical for past three years – need to (blame on It's likely that these scores are low due to mismatch between course coverage and ACS exam coverage.

E. Assessment of Student Satisfaction

Table 3 Student Learning Outcomes Comparison . Tabulated Data for Academic Years 2017-2019 on Students' Performance based on American Chemical Society (ACS) Standardized Exams for the Chemistry Courses Indicated

	2017			2018			2019		
Course	Ave.[a]	%*	Norm	Ave.[a]	%*	Norm	Ave.[a]	%*	Norm
103	45	100	29±8			29±8	43	100	29±8
211	34	70	40±12	33	70	40±12	32	67	40±12
212	33	82	36±11	37	86	36±11	33	83	36±11
523	24	77	26±7	23	73	26±7	24	74	26±7
524	24	88	24±7	22	88	24±7	26	100	24±7
532	38	84	37±11	38	89	37±11	54	100	37±11
545	29	100	26±7	29	100	26±7	25	91	26±7
546	29	80	29±8	29	93	29±8	30	100	29±8
615	36	88	32±9	35	100	32±9	28	67	32±9
661	17	66	22±9	18	64	22±6	19	66	22±6
663	32	91	33±9	38	94	33±9	40	100	33±9

[a]Average score on the ACS standardized exam – *% of students meeting the benchmark of the national norm on the ACS standardized exam

3. Use Table 3 and OPA Table 10 to provide analysis and evaluation using student majors' satisfaction (e.g., exit surveys from the Office of Planning and Analysis), capstone results, licensing or certification examination results (if applicable), employer surveys or other such data that indicate student satisfaction with the program and whether students are learning the curriculum (for learner outcomes, data should relate to the outcomes of the program as listed in 3d) to illustrate student satisfaction with the program and perceptions of program value.

Need to do better in Chem 211. – Mention chairs slides.

From the Application for Degree Exit Survey, the Chemistry and Biochemistry Department's student satisfaction is aligned with the college results and exceeds that of the university average in all but 2019. This high level of satisfaction comes from several factors. From departmental exit interviews students comment on three main items. First they frequently cite their experience in Chem 690 – Independent Research. This course is required for all of our majors and is used to fulfill the University's applied learning requirement, although it has been a long standing requirement within the department. Indeed many students who enroll in Chem 690 often continue their research in subsequent semesters. They enjoy being part of a research group effort and working side by side with graduate students. The second highly-cited area of satisfaction is the student's exposure to chemical instrumentation. Student's frequently mention their upper division lab courses (525, 547, 616 and 664) as sources of satisfaction due to chance to use advanced instrumentations. The third item that is frequently cited is small class size in upper division courses and the close interaction with professors. During advising for our majors efforts are made to emphasize the importance of the upper division courses and to steer our majors toward Chem 690 by helping them understand the application/selection process. It is fairly rare to have a chemistry or biochemistry major who finds themselves seeking a research experienced in their last semester, usually no more than one or two per AY. To better convey the importance of the research experience we make efforts beyond one on one advising. These include acitively advertising and inviting our majors to attend our weekly research colloquium. During 2021, Jim Bann our UG Coordinator, hosted an UG Research Showcase that we hope to continue. Dr. English, Department Chair, visits the Chemistry 211 lecture sections during the first week of classes and gives a short presentation about the department and our degrees in which he spends some time talking about our UG research opportunities.

In general satisfaction among majors appears to be relatively high with a mean response of 4.3 - 4.6 out of 5 over the 2014-2020 period. Table 3 however does reveals some areas that should be addressed especially with respect to service credit hours in our general chemistry sequence. Of specific concern is the low performance on the ACS exam for Chem 211 that shows that only about 70% of Chem 211 students are meeting the national average. While that number doesn't in itself seem particularly low, in comparisoin wot the other courses in Table 3 it stands out. More revealing is that Chem 211 has been flagged as a high DWF course with 23% of students failing or withdrawing. We discuss below in seciont xxxx but it is relevant here as well. Efforts to address these two issues that are under consideration include, 1) reassignment of specific

instructors, development of a pre-semester "boot camp" for our majors and select engineering students, offering a remedial course such as Chem 110.

F. General Education

1. Does your program support the university General Education program? ☒ Yes ☐ No

   If yes, please complete the table below by listing the general education courses and noting which of the general education outcomes are addressed in the class. If no, skip this question.

Table 4 General Education Outcomes

Course	Results	Assessment Type	General Education Outcomes			
			Have acquired knowledge in the arts, humanities, and natural and social sciences	Think critically and independently	Write and speak effectively	Employ analytical reasoning and problem-solving techniques
Math 242: Calculus I				*x*		*x*
Chem 103	*2017-18: 82% passed* 2018-19: 77% passed 2019-20: 72% passed*			X		X
Chem 211	*2017-18: 79% passed 2018-19: 82% passed 2019-20: 84% passed*			X		X
Chem 212	*2017-18: 88% passed 2018-19: 86% passed 2019-20: 80% passed*			X		X
Chem 514	*2017-18: 71% passed 2018-19: 64% passed 2019-20: 96% passed*			X		X
Chem 523	*2017-18: 82% passed 2018-19: 83% passed 2019-20: 83% passed*			X		X
Chem 531	*2017-18: 71% passed 2018-19: 78% passed 2019-20: 75% passed*			X		X
Chem 545	*2017-18: 100% passed 2018-19: 71% passed 2019-20: 100% passed*			X		X
Chem 661	*2017-18: 90% passed 2018-19: 81% passed 2019-20: 94% passed*			X		x

*Includes students who scored D- or better. Data taken from APS. Note: Not all programs evaluate every goal/skill. Programs may choose to use assessment rubrics for this purpose. Sample forms available at: http://www.aacu.org/value/rubrics/

2. Use Table 4 to further explain which goals of the *WSU General Education Program* are assessed in undergraduate programs (optional for graduate programs) and the results.

Students who take and pass the courses in Table 4 are taught key components of the Gen. Ed. Program. Chemistry courses make extensive use of conceptual and mathematical models that relate measurable quantities to atomic and molecular-level phenomena that cannot be directly observed. The models are based on theories derived from combinations of fundamental scientific principles and quantitative measurements and empirical observations. The models usually make use of some relevant approximations or assumptions that simplify the system. This is a theme found throughout chemistry from modelling how electrons behave in atoms to understanding chemical reaction dynamics and energetics. The understanding and use of these quantitative frameworks require students to grapple with analytical reasoning that connects the visible (observables) to the invisible (molecules). Naturally this requires critical thinking and application of systematic and rational reasoning. A large focus of the lower division undergraduate curriculum also deal with fundamental skills associated with problem solving that include evaluating given information and formulating approaches for reaching solutions to problems and then checking those solutions against informed expectations.

G. Concurrent Enrollment

1. Does the program offer concurrent enrollment courses? ☐ Yes ☒ No

If yes, provide the assessment of such courses over the last three years (disaggregated by each year) that assures grading standards (e.g., papers, portfolios, quizzes, labs, etc.) course management, instructional delivery, and content meet or exceed those in regular on-campus sections.

If no, skip to next question.

H. Credit Hours Definition

1. Does the Program assign credit hours to courses according to Wichita State University Policy 2.18?
   ☒ Yes ☐ No

If no, provide explanation.

I. Overall Assessment

Define the overall quality of the academic program based on the above information and other information you may collect, including outstanding student work (e.g., outstanding scholarship,

inductions into honor organizations, publications, special awards, academic scholarships, student recruitment and retention).

The Department of Chemistry and Biochemistry at Wichita State University is a vibrant, research-active department whose primary missions are to enhance and sustain a highly competitive undergraduate and graduate training program in all areas of chemistry and to make significant scholarly contributions to the body of chemical knowledge. All faculty members hold a PhD and have received further postdoctoral training before joining the WSU faculty. All tenure-track faculty maintain active research programs, all are involved in teaching undergraduate and graduate courses, and all serve on MS thesis and PhD dissertation committees. By its nature, research in Chemistry and Biochemistry involves student researchers – therefore nearly all publications by a faculty member include one or more student (undergraduate or graduate) or postdoctoral authors. The high level of research activity among the faculty of the Department of Chemistry and Biochemistry is important for all three degree programs. An education in chemistry requires engagement in original laboratory research. At the graduate level, this is obvious, since the major portion of the graduate degree (MS or PhD) is the research project, which is carried out in close collaboration with the student's major advisor – students in these programs embark on their final research project no later than their second semester in the program. This is, however, no less true at the undergraduate level – even at institutions without high-level research programs, faculty are encouraged to engage in research so as to expose their students to this aspect of chemistry. At WSU, participation in undergraduate research is a requirement for all BS programs in Chemistry and Biochemistry except the Chemistry and Biochemistry/business degree, and the availability of research programs operating at the highest levels makes this a more fruitful endeavor. Furthermore, given the rapidly changing nature of Chemistry and Biochemistry, the fact that faculty are operating at the frontiers of chemical research allows them to bring that knowledge back into the classroom – even at the most introductory levels, instruction is informed by the current state of the discipline.

The Department of Chemistry and Biochemistry produces a large number of credit hours, primarily due to the service aspects of the Introductory Chemistry, General Chemistry, Organic Chemistry, and Biochemistry classes, which are required for many students majoring in other fields or aspiring to professional education in the health professions. Over the past three years, total SCH production has held steady with a 4.7% decrease during the pandemic followed by large increase of 14.5% for the current academic year returning SCH numbers to 2018 levels. The majority of those credit hours, 63%, are for service to other disciplines. The 100-299 level courses had a decrease of 13% from pre-pandemic levels but increased by over 20% during the current academic year, returning to levels last seen in 2018. At the 500-699 level SCH has held steady and are similar to 2018 levels but about 14% below 2016-17 numbers. SCH produced by tenure-eligible faculty has remained relatively constant (70%) over the three years with the remaining SCH delivered by our NTT Professor, Kevin Alliston, and several adjuncts.

Degree production at the graduate level has remained fairly constant over the past eight years fluctuating between 5-12 PhD and MS degrees per year. Bachelor's degree production has decreased over the last three years but over the past three years our student headcount has increased by 5%. Retention, appears to be high – 30 freshman Chemistry and Biochemistry majors in 2017 yielded 35 sophomores in 2018, 34 juniors in 2019.

Faculty research production has held steady as described in section 2B. Chemistry and Biochemistry faculty members have won awards reflecting distinction in all aspects of their activities. These include: WSU's only ever PECASE award, NSF-CAREER award, INGRAMS Icons of Education Award, Partners for Progress & Prosperity Award from the American Chemical Society. Students in the department regularly receive awards from internal and external sources including the American Chemical Society.

Since the last review one professor (Rillema) transitioned to emeritus status, two new tenure track hires were made (Wu and Wang), one adjunct was promoted to NTT professor (Alliston) and we gained one full professor through an administrative hire (Pugh). This led to a net increase in faculty which brings us near our target of 15 tenure-track faculty. Initiatives from the Dean's office, namely workload and UG/Grad coordinator policies, have resulted in some teaching releases. Consequently, we continue to rely on adjunct, temporary, and non-tenure-eligible faculty to facilitate teaching of lower-level classes. We are fortunate to have been able to obtain highly qualified individuals to teach these classes, ensuring that the quality of instruction for our students has been maintained at a high level. We hope, however, to continue to add faculty members in the next couple of years with anticipated retirements.

Part 4: Student Need and Employer Demand

Analyze the student need and employer demand for the program/certificate. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).

Complete the table below.

Table 5 Employment of Majors 2020-2021

Program Name	Avg. Salary	Employment In state (%)	Employment in the field (%)	Employment related to the field (%)	Employment outside the field (%)	Pursuing graduate or professional education (N)	Projected growth from BLS**
Bachelors in Chemistry or Biochemistry	$32k	68%*	>30%	>30%	10-20%	>33%	6% (Chemists)** 12% (Chemistry Professors – higher rate than average)

* https://ksdegreestats.org/program_search.jsp and U.S. Bureau of Labor Statistics Website: http://www.bls.gov/oco/ are good resources to view job outlook data and salary information (if the Program has information available from professional associations or alumni surveys, enter that data).

Employment Outcome for Chemistry Bachelor of Science spring 2015 to spring 2021

	Industry	Graduate School	Professional School	Teaching (K-12)	Self-Employed	Government	Other	Seeking Employment	Unknown	Total
B.S. Pre-med and Field Major	9	9	12	1	0	3	2	2	15	52

ACS Chemistry and Biochemistry	17	10	2	0	1	1	1	1	12	44
	26	19	14	1	1	4	3	3	27	96

Students obtaining PhD degrees in chemistry from WSU have been very successful in obtaining postdoctoral positions or employment in chemistry or related fields. Graduates from the PhD program in the past three years went on to the following positions:

2020 Athri Dewmina Thennakoon Mudiyanselage – Postdoc fellow at Northwestern Univ, Evanston, IL
2020 Naveen Maddukuri – Eurofins PSS Insourcing Solutions, Chicago, IL
2020 Bhusi Seelam - Olon Ricerca Biosciences (Ohio)
2020 Gene Zaid – Hyatt Life Sciences, Sterling, KS
2020 Vinay Kumar Kadarla – Eurofins Lancaster Laboratories, Lansdale, PA
2020 Sharifah Albraiki – Asst. Prof. at Jacksonville State University, LA
2019 Maruthi Alsuri –Clinical Data Manager at Parexel Int.
2018 Chandana Kasireddy – Bioinformatics Scientist, QIAGEN, Raleigh/Chapel Hill/Durham, NC
2018 Venugopal Reddy Komreddy - Olon Ricerca Biosciences (Ohio)
2018 Sireesha Mamillapalli – Asst. Prof. Biochemistry & Physiology, Geisinger Commonwealth School of Medicine, Scranton, PA
2017 Jayangika Niroshani Dahanayake – Sr. Lecturer, University of Kelaniya, Colombo, Sri Lanka
2017 Anushka Chathuranga Galasiti Kankanamalage – Scientist in Medical Chemistry, Neurocrine Biosciences, San Diego, CA
2017 Ravi Vattepu – Researcher, Antibody & Protein Engineering, Cambridge, MA
2017 Senaratnelage Nilmini Kumari Senaratne -
2017 Vishnu Damalanka – Sr. Scientist, Organix, Inc., Burlington, MA

Master's Program Graduates:

2021 Kenita Dahal – SOFIE (Formerly IBA Molecular) Kansas City, MO
2020 Thanh Vu Dang Dinh – Octapharma Plasma, Wichita, KS
2018 Matthew Baird – Research & Development Chemist, BG Products, Inc, Wichita, KS
2018 Jonathan Ellis – Student, University of Wisconsin, Madison, WI
2018 Shan Shi – Analyst, Charles River Labortories, Montreal/Quebec, Canada
2018 Andrew Bowman, Postdoctoral Fellow, AbbVie Pharmaceutical, Chicago, IL

List any triggered programs with reason (majors/faculty/graduates).

1.
2.
3.

A. Provide a brief assessment of student need and demand using the data from Tables 11-15 from the Office of Planning and Analysis and from the table above. Include the most common types of positions, in terms of employment graduates can expect to find. Programs that are triggered for graduates or majors should get particular attention.

Our undergraduate majors pursue three main paths forward after graduation, employment at the bachelor's level, admission to graduate school or admission to professional schools, mainly medical and pharmD programs. Not surprisingly, the data in the employment outcome table above shows that students wishing to pursue graduate school over professional school are more likely to pursue one of the ACS degrees whereas students seeking to go into medicine will enroll in our BS Pre-medicine degree program.

The percentage of under-represented minorities in our undergraduate program, mirrors that of the university. At the graduate level we have a level of participation from URM students. The chair of the department's DEI committee (Professor Katie Mitchell-Koch) is also a member of the graduate affairs committee and will add extra attention to applications from URM students. When URM applicants apply we will make attractive offers to recruit them into our program. While our domestic URM numbers are low in the graduate program, the graduate population is extremely diverse consisting of students from the United States (including one Native American student and several Asian American students), Asia, the Middle East, and Africa. The gender distribution in the graduate program is slightly less than half female (16 of 34).

B. Briefly describe how the department and faculty have engaged in undergraduate strategic enrollment management including recruitment and retention activities and provide an assessment of successes, challenges, and deficiencies with those activities.

Our department has appointed three faculty who take the lead on college and university sponsored undergraduate recruitment and retention activities, Dr. Bann, Dr. Beck and Dr. Mitchell-Koch. These faculty provide tours to all campus visitors who express a desire to visit the department. They staff a table at each occurrence of Black and Yellow days and follow that up with activities in the department.

The department is active in Science Olympiad Invitational and regional competitions each year. In McKinley each spring we host the state science Olympiad and host four to six events. These events are attended by approximately 300 statewide competitors. The department has been engaged in this activity for 20 years and we estimate about 20 students have returned to earn degrees in our department. Staff and faculty from our department regularly judge regional and state science fairs.

Expand Your Horizons is an on-campus activity that originated in our department through efforts by Professor Beck. This event has external support from local sources like Boeing. Each spring about 40 middle-school aged girls spend a Saturday on campus participating and learning through hands-on activities in chemistry, biochemistry and biology.

The department has an active student chapter of the American Chemical Society, (faculty mentors are Professors English and Beck) that engages in outreach activities to local elementary schools (Robinson, Meade, Cessna and others) and participate in EYH and Science Olympiad.

Another mechanism for engaging regional students is through the Watkins visiting scholars program. This is a program sponsored by FCLAS that provides summer stipends for high school and community college instructors to spend the summer doing research in our department. We typically have about two Watkins scholars in our department during the summer. These scholars will sometimes bring some of their students to see the department and the research they are engaged in.

For student retention we strive to provide efficient advising this includes efforts to get our majors involved in laboratory research projects early on. This often leads to its own rewards in the form of publications, patents, presentations and awards for ours students. In fact our students have received the Rosalee and Alvin Sarachek Award for Scholarly Excellence 5 of the last 9 years. This is the top award for seniors in the natural sciences at WSU. Our students' success at competing for this awards speaks to the high level of scholarship and research that they achieve. Within the department we acknowledge these accomplishments through an annual awards reception each spring and last fall we launched what is planned to be an annual event – The Undergraduate Research Showcase. This featured UGs from around the college who gave talks and posters about their research. At last year's event we had as keynote speaker Tatiana Mishanina of UCSD who gave a talk about her research: *"Transcribing DNA code into RNA messages: Insights into RNA polymerase from structural and biochemical experiments."* Professor Mishanina graduated from WSU in 2008 with a BS in Chemistry.

C. Briefly describe how the department and faculty have engaged in graduate strategic enrollment management including recruitment and retention activities and provide an assessment of successes, challenges, and deficiencies with those activities.

The department's Graduate Recruitment Committee prepares a list of potential speakers each yeaer that is sent out to the chairs of regional chemistry departments offering to provide a speaker for their seminar series at no cost to them. While this activity ceased during the pandemic, it generally yielded 2 or 3 invited talks each year. It is difficult to assess the success of this program, but there are usually a few students in our grad program from regional institutions who would have seen one of these talks at their school or at a regional meeting. Currently we have graduate students who received their BS degrees at Neumann and Fort Hays where we directly recruit.

D. Also address students enrollment, degree production and employment outcomes for diverse students.

As discussed above our undergraduate and graduate programs are made up of a highly diverse pool of students. In the undergraduate program our URM participation is above the college average. Most concerning is a significant decrease in URM majors from the freshman/sophomore level to junior/senior. This is a trend we seek to change and have started on some possible solutions. We are currently working to lower our general chemistry DWF rates by early intervention and advising through a planned "boot camp" to be rolled out in August of 2022 in collaboration with the COE. Additionally, we are making some minor changes to our curricula for our two ACS degrees that could have significant impact. One of these changes is

removing the Calculus III requirement. Calc III is not required by the ACS and comes at a crucial time in a student's career – usually around their 3rd to 5th semester. This, along with lowering the requirements for our upper division labs, is likely to make matriculation easier for all of our students with the biggest impact on the most vulnerable.

In the graduate program we tend to get a very diverse pool of international and domestic students. Of particular note is the near equity gender balance. A long-cited problem in STEM education is the "leaky pipeline," especially for women in science – i.e. many start out at the freshman level but few ultimately appear academic faculty ranks. While this is continues to be a problem within the department we have been successful in increasing the number of female faculty to 3 (compared to zero in 2010). The growth in our faculty diversity undoubtedly helps to create a more welcoming environment for all groups. During the past six years we have four female PhD graduates who have gone on to take tenure-track academic jobs. We hope to continue this trend by continuing to provide mentoring and opportunities. A recent improvement within in our graduate program was the development of a comprehensive Graduate Student Handbook that details the requirements and timeline for both degrees.

Part 5: Program Service

*Analyze the service the Program/certificate provides to the **discipline, other programs at the University, and beyond**. Complete for each program if appropriate. **Data tables 1, 2, 3 and 5a, b and c provided by the Office of Planning Analysis (covering SCH by FY and fall census day, instructional faculty; instructional FTE employed; program majors; and degree production) can be used to partially address this section.** (Refer to instructions in the WSU Program Review document for more information on completing this section).*

A. *Provide a brief assessment of the service the Program provides using SCH by majors and non-majors.*

Approximately 67% of our produced SCH is delivered to non-majors. At the general chemistry level (Chem 103, 211 and 212) about 94% of SCH (*ca.* 5500 to 6000) is delivered to non-majors.

B. *Provide a brief assessment of the service the Program/certificate provides to other university programs.*

As the "central science" at least a year of chemistry is taken by nearly all natural science majors and most engineering majors are required to take at least one semester.

C. *Provide a brief assessment of the service the Program/Certificate provides to the institution and beyond.*

Chemistry is an essential department for any university. It provides critical education to a host of majors. Chemical research provides collaborative opportunities across campus. Faculty in our department collaborate with engineers, biologists, health-professionals and physicists. Our graduates go on to fill critical job demands within the state of Kansas and beyond. Recent BS graduates from our program have gone on to

work at Meridian Analytics, BG Products, Pfizer, Genzada, Deciphera Pharmaceuticals and Morton Salt, all in Kansas. In addition to providing economic impact through workers in needed positions we also provide service in the form of scientific dialogue through EYH, Science Olympiad, ACS Student Chapter, Watkins speakers and peer-review services.

Part 6: Impact of Previous Self-Study Recommendations

At the conclusion of the last program self-study performed, the committee provided recommendations for improvement for the department. Please list those recommendations and note your progress to date on implementation.

Committee Recommendation from last review?

☐ Forward Facing Goals Accepted ☐ Forward Facing Goals Resubmitted (Date _____)

Internal Follow-up Recommendation:

☐ 2-year Follow-Up ☐ NA

KBOR Recommendation:

☐ Enhanced ☐ Maintained ☐ Monitored for improvement Discontinued

Complete the table.

Table 6 Changes made based on Previous Recommendations

Recommendation	Activity	Outcome
• Include cultural component in mission statement (educational & economic drivers addressed, cultural not really discussed)	We have added a cultural component to our mission statement in Part 1.	We have strived to provide compelling educational, scientific discussions on popular issues that include interesting topics for the public at Watkins seminars and through our colloquium. We will continue to advertise our activities through the proper channels (KMUW, Strat Comm) to inform the public about events in our department.
• Employ other assessment tools besides ACS exams at the UG level (note made that in the future research reports will be evaluated using AACU rubrics)	We have not moved forward on this recommendation beyond some initial discussions regarding areas where ACS exam results are not aligning with instructor expectations. See Part 3D. We expect to make progress on this goal in the coming AY*.	
• Include service provided beyond the university for item number 5 (Service the program provides…etc.)	These sections have been completed.	We regularly engage with local industry. Our faculty also provide an immense amount of peer-review services for both journals and funding agencies.

* Part of the delay on this issues is due to an unplanned change in the department chair and office staff.

Part 7: Program Forward-Facing Goals from Last Review

Report on the Program's/certificate's goal (s) from the last review. List the goal(s), data that may have been collected to support the goal, and the outcome. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).

Complete the table.

Table 7 Results of Goals from Last Review

(For Last 4 FYs)	Goal(s)	Assessment Data Analyzed	Outcome	Status (Continue, Replace, Complete)
	Continue to improve program assessment. Our assessment of student learning with regards to content, using ACS examinations, is working well. We continue to explore the best ways to assess other aspects of student learning.	ACS exam data.	Strong overall with some notable deficiencies as discussed in Part 3D. Have not yet developed a systematic evaluation of the written research reports.	Continue
	Continue to improve tracking of undergraduate alumni. Our alumni survey produced limited return, although it was in line with expectations from such a survey. We will make another attempt at reaching out to alumni through our next departmental newsletter.	Social media.	We have been able to improve our tracking of undergrads. We currently have contact information for about half of our majors who graduated since 2015. We expect this number to improve with ongoing efforts.	Continue

	Work towards returning the staffing level of the department to 14 or 15 faculty members. Our current search for the Erach Talaty Distinguished Professor is in progress – if successful it will bring us to 12 faculty members. One faculty member is retiring after AY19 and will need to be replaced.		Some progress has been made in this area. We are currently at 13 tenure track faculty (though two of these have major administrative roles, Pugh and Eichhorn).	Continue – due to likely retirements.
	Develop honors curriculum. We have been in consultation with the Cohen Honors College regarding the development of an honors science track including honors General Chemistry. We hope to begin this in the fall with the establishment of an honors lab section for Chem 211.	Student feedback	We have developed two general chemistry honors lab. Gen Chem I (offered once) and Gen Chem II (offered twice).	Continue – after running these two labs we are now ready to formalize the Gen Chem II honors lab in the catalog and expect to complete the roll out of the Gen Chem I honors lab during the next AY.

Part 8: Forward-facing Goals

Identify goal(s) for the Program to accomplish in time for the next review. Goals must be **Specific, Measurable, Attainable, Realistic and Time-bound (SMART)** and should be tied to the university and college strategic plans.

Complete the table.

Table 8 Forward Facing Goals for Program Review Period

Program/Certificate Goal	Specific	Measurable	Attainable	Realistic	Time-bound
Ex. To improve student learning outcomes (exam scores) by supporting Supplemental Instruction from four sections to seven by fall 2020.	*Yes – Exam Scores*	*Yes – How many sections.*	*Yes – budget approved. Discussed with OSS.*	*Yes – Within the scope of responsibility.*	*Yes – Fall 2020*
Improve student retention for large service courses in General Chemistry – specifically Chem 211.	Yes-explore mechanisms for improving student comprehension.	Yes- DFW rates and student feedback.	Yes – it's hard to say whether we can improve DFW, but even so the aim will be to improve the course deliverables. This could be considered a "stretch goal."	Yes – stretch goal, and in need of attention.	Yes – will seek to make and evaluate changes over the next three academic years.

Provide any additional narrative covering areas not yet addressed.