

Institutional Effectiveness

2018-2019

Program: Chemistry BS

College and Department: College of Arts & Sciences – Department of Chemistry

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Mission: The primary mission of the Department of Chemistry is the chemical education of students at ~~Eastern Tennessee State University~~ Eastern Tennessee State University. The goals is to provide students the facilities, opportunity, and inducement to conduct, evaluate, and report on original research under the supervision of a faculty mentor and thereby add to the knowledge of mankind while participating in team-based approaches to learning that are likely to be encountered in a graduate's career.

Undergraduate Program: BS Chemistry Program Description

Concentrations (abbreviations):

CHMA – ACS certified Chemistry Major

CHMP – Pure Chemistry Major

CHMN – Applied Chemistry Major

CHMN – Biochemistry Major

Senior chemistry majors in all three concentrations will be able to demonstrate a high level of critical thinking

SLO 1: Demonstrate knowledge and critical thinking

1. ETS Chemistry Field Exam

Student Performance on the national ETS Chemistry Field Exam in the four branches of chemistry (referred to as subscores 1 through 4) for Outcome 1. Student performance, Assessment Indicator #2 (Critical Thinking and Reasoning Ability) for Outcome 2. Senior performance on the ETS Chemistry Field Exam -Assessment indicator #1 (Biochemistry knowledge assessment) for Learning Outcome 3.

- x This mastery level by TTU students on the ETS Field Exam, which should exceed the national average for CHMA majors as demonstrated on the ETS Chemistry Field Exam, is discussed at faculty meetings (cohort = CHMP, CHMB, CHMN).
- x This mastery level by TTU students for critical thinking and reasoning ability on the ETS Field Exam that should meet or exceed the national average for chemistry majors as demonstrated on the ETS Chemistry Field Exam is discussed with faculty at faculty meetings (cohort = CHMP, CHMB, CHMN)
- x This mastery level by TTU CHMB students on the ETS Field Exam, which should exceed the national average as demonstrated on the Biochemistry knowledge assessment of the ETS Chemistry Field Exam, is taken into consideration during faculty planning for our one-year intensive biochemistry course (cohort = CHMB)

SLO 2: Successful graduates

1. Annual Report

The annual report is largely a data repository but also includes content related to the evolving history of the department. Matriculation to graduate and professional schools as well as the number of students conducting research during the academic year and/or presenting research at regional and national scientific meetings are collected and tabulated in the annual report.

2. Senior Surveys

Graduating Senior Surveys provides a variety of data about the program and is discussed at faculty meetings and faculty retreats in order that the faculty have the opportunity to assess/reflect on student outcome goals. cohort =CHMP, CHMB, CHMN

SLO 3: Integrate chemical knowledge and team work

1. Annual Report

The annual report

2. ACS National Meetings Program

SLO 4: Knowledge of general chemistry

1. General Chemistry Exam

The National ACS General Chemistry exam,

SLO 1: *Demonstrate knowledge and critical thinking*

Mean scores for ETS Chemistry Exam by Sub-test

	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
# of students	7	11	2	21	5	21
1. Physical Chemistry	43	45	25	42	41	53
2. Organic Chemistry	44	45	33	48	46	55
3. Inorganic Chemistry	49	50	31	46	44	57
4. Analytical Chemistry	50	46	35	45	44	57
National Score	49	49	49	49	50	50
TOTAL	146	146	129	146	143	157

Mean scores for ETS Chemistry Exam Critical Thinking and Reasoning

	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019
# of students	7	18	-	22	5	21
Critical Thinking and Reasoning	40	41	-	38	35	52

While the ETS Chemistry Biochemistry Assessment indicator does not reflect an actual Biochemistry

SLO 2:

TTU General Chemistry Assessment

Year	Average Score
2017	51
2018	54
2019	53

Final exam results for CHEM 1110 & 1120 are shown below. The exams are the same for each semester, but different for each course. The exams were constructed largely based on questions written for the standard hour exams over the previous four-year period for which the individual item statistics were favorable in terms of discrimination index (separating the higher achieving students from those who are not) and overall difficulty.

Tabulation of Final Exam averages in CHEM 1110 & 1120

	CHEM 1110	CHEM 1120
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light scattering detector (ELSD) for a liquid chromatograph and a new FT-

importance of planning for graduate and professional schools. In 2008, the department initiated the Student Research Development Grant program, an in-house program that provides opportunities for students to write research grants, submit them for review, carry out their proposed research and disseminate their research. In the last four years, ~\$50,000 has been awarded to successful students (2015-2019).

SLO 3: Integrate chemical knowledge and team work

As also described in the Chemistry Department Annual Report, we have made excellent progress towards Student Learning Goal 4 by continuing to take an active role in promoting involvement of every qualified undergraduate major in an undergraduate research project with a faculty member. Beginning in 2007, we initiated a Fall research mini-symposia followed by a cook-out social for the purpose of making undergraduates more aware of research opportunities in the department. Multiple faculty give 10-15 minute presentations about project opportunities in their labs. This resulted in an immediate increase in the number of students both carrying out research in faculty labs, but also in the number of students presenting the results of their research at scientific meetings (see assessment results). We continue to keep students informed about summer research activities in government, industrial and academic research laboratories. Faculty encourage their students to apply for coop and internship experiences, and apply for Chapter 606 funds for undergraduate research projects, in addition to the Student Research Development Grants (SRDG) mentioned in Learning Outcome VI. In 2008, the year the SRDG was initiated, \$2,800 was awarded; in 2009, \$5,600 was awarded and in 2010, \$10,543 was awarded. In Fall 2011, an additional \$4,185 was awarded during the first of four submission dates during the 2011-2012 academic year. Funds awarded during 2012-2013 exceeded \$11,000 as they did during 2013-2014 and 2014-2015, 2015-2016 and 2016-2017. The funds awarded in this program are generated through the sale of department-authored laboratory manuals. We also take advantage of the Jackson/Swindell Undergraduate Research Award program and have funded at summer stipends to assist additional students remain on campus throughout the summer to carry out undergraduate research. During 2017-2018, two students applied for and received this grant. During 2018-2019, the SRDG awarded \$15,467.00 with an average award of \$1,933.00. One Swindell-Jackson award was granted and for the first time, a Kline award was granted in support of research.

SLO 4: Knowledge of general chemistry

For continued success in Learning Outcome 5, the department feels that our students should be able to outperform the established national norms (50.2% average score) on the National ACS General Chemistry Exam on a consistent basis. In 2017 we switched to an in-house professionally equivalent exam and will use that for five years for assessment. In order to firmly establish this goal as a trend, the department has continued its prior actions of utilizing on-line homework for assessment, adding additional guided-inquiry experiments in the lab component of the course and utilizing the MeasureNet data acquisition system coupled to PC's in the lab to further enrich student experience. In 2014-2015 we moved to the "Atoms First" teaching pedagogy for General Chemistry which also included an online homework component. We continued using the atoms first approach during 2017-2018 and will do so during 2018-2019, as well. Scores on the ACS exam have been consistently above or at the national average (see Table under Results for trends). In 2007, the department initiated a new course, CHEM

background in chemistry have the opportunity to take this course before they take the CHEM 1110/1120 sequence. Students are also allowed to transfer into this course if they are trying but failing CHEM 1110. Retention of these students was initially very high following completion of CHEM 1000. The first cohort of 16 students graduated in Spring 2011 (100%) and all were retained in STEM majors, although two of those ended up with Nursing degrees. The assessment and development of CHEM 1000 also continues.

CHEM 1110-1120 Specific Modifications for Continuing Improvement (as recorded end of 2018-2019 academic year)

The results of the final exams are analyzed and broken down in terms of broad topics and individual questions. From these results, the faculty are encouraged to strategically alter their approaches to enhance outcomes for content areas, targeted to the topics identified as having the lowest success rates according to the analysis and high impact content throughout the chemistry degree curricula at TTU. This protocol will be enhanced by research projects being undertaken by graduate students designed to identify commonalities between low-performing items/groups on the final exams to allow faculty to make more targeted changes with a broader impact. Additionally, student learning outcomes (SLOs) have been developed and will be tied to assessment outcomes making progress easier to track and provide more clarity to the skills expected of students in the course.

After a lengthy evaluation process that involved piloting new software in the CHEM 1110 lectures during the Spring 2019 semester and class tests with the CHEM 1120 Honors recitation, a new homework system will be implemented based on faculty observations and survey results provided by students. The ALEKS system is unlike a traditional homework system in that it directs student studying toward topics for which they have not demonstrated mastery, and guides students through supporting topics to provide the best possible chance for success in attempting more challenging problems. The faculty felt this was the strongest software solution on the market, and it specifically seemed to help conscientious students who are willing to put forth effort but need more structured study plans than what the faculty can reasonably provide.

CHEM 1120 curriculum. Delivering the content through a modeling exercise also exposes students to a branch of chemistry they may not have been aware of previously, which could be more attractive to a broader audience, therefore increasing interest in the subject, which could lead to more motivated students and stronger outcomes.

Appendices

1. Curriculum Map
2. Graduating Senior Survey

Appendix 1: Curriculum Map

Chemistry BS

Course	Title	Student Outcomes			
		SLO1	SLO2	SLO3	SLO4
		Factual knowledge	Critical thinking	Research	

4320	Spectro Ident-Organic Compounds	X	X	X	X	
4410	Forensic Chemistry	X	X	X	X	
4520	Instrumental Analysis	X	X	X	X	
4610	General Biochemistry I	X	X			
4620	General Biochemistry II	X	X			
4650	General Biochemistry Lab	X	X		X	

Appendix 2: Graduating Senior Survey

TENNESSEE TECHNOLOGICAL UNIVERSITY

DEPARTMENT OF CHEMISTRY

GRADUATING SENIOR SURVEY

Major: _____ Emphasis: _____ Advisor: _____

Years at TTU: _____ Years in the Department: _____ Original major at TTU: _____

	of the following items.				
	Poor	Fair	Good	Excellent	Not Applicable
Quality of courses in preparing me for employment/graduate school	1	2	3	4	5
Quality of instruction in: General Chemistry	1	2	3	4	5
Organic Chemistry	1	2	3	4	5
Analytical Chemistry	1	2	3	4	5
Inorganic Chemistry	1	2	3	4	5
Physical Chemistry	1	2	3	4	5
Biochemistry	1	2	3	4	5
Fairness in grading my courses	1	2	3	4	5
Availability of required courses	1	2	3	4	5
Opportunity for formal student evaluation of instruction in chemistry courses	1	2	3	4	5
Quality of general education courses	1	2	3	4	5
Organization and clarity of curriculum requirements	1	2	3	4	5
Opportunities for professional and personal interactions with chemistry faculty	1	2	3	4	5
Opportunities for students to participate in faculty research	1	2	3	4	5
Availability of advisor	1	2	3	4	5
Willingness of advisor to assist	1	2	3	4	5
Quality of curricular advising in chemistry	1	2	3	4	5
Quality of career advising in chemistry	1	2	3	4	5
Quality of classroom facilities	1	2	3	4	5
Quality of laboratory facilities	1	2	3	4	5
Quality of TTU library chemistry holdings	1	2	3	4	5
Quality of computer support	1	2	3	4	5
Availability of professional activities or clubs in the department	1	2	3	4	5
Assistance given by departmental secretary	1	2	3	4	5
Assistance given by stockroom manager	1	2	3	4	5
Quality of my initial contact with the department	1	2	3	4	5
Opportunity for student participation in departmental decisions	1	2	3	4	5
Overall quality of the department	1	2	3	4	5
Overall satisfaction with degree program	1	2	3	4	5

