Chemistry MS: 2018-2019

Definition of Unit

Providing Department:
Chemistry MS

Department/Unit Contact:
Jeff Boles

Mission/Vision Statement:

The mission of the graduate program in chemistry may be summarized as follows:
1. To provide an ongoing program of study that prepares graduates to successfully pursue scientific careers in industry or to continue their education in a doctoral program or professional school.
2. To provide students with opportunities to reinforce their background and expand their knowledge in areas integrated with their undergraduate coursework, with course offerings in the five major branches of chemistry.
3. To provide an ongoing, stimulating and intellectual atmosphere conducive to the learning process of both students and faculty through low student-to-faculty ratios.
4. To provide the facilities and professional mentorship enabling students to propose, conduct, evaluate, and report in a systemic way on original research and thereby add to the knowledge of humanity.
5. To provide opportunities for students to refine both oral and written communication skills.

The graduate curriculum is designed to acquaint students with the current ideas in the five major areas of chemistry (organic, inorganic, physical, analytical, and biochemistry). The thesis project affords the student practical experience in the methods used to obtain new knowledge and to develop the skills necessary to understand and relate this knowledge. Special topics courses allow individual professors to present specialized material in their area of expertise. The faculty maintains a wide variety of research programs, giving each student an opportunity to conduct, evaluate, and report on original research.

Learning Outcomes 1-6: Effective Use of Scientific Method

Define Goal:

Students will emerge from the M.S. Chemistry graduate program being able to use the scientific method effectively to solve chemical research problems. Particularly, this includes (but is not limited to the following sub-outcomes).

Intended Outcomes / Objectives:

Students will be able to:

- employ critical thinking skills to analyze a chemical problem, (Assessment Item 12 on M.S. Survey of Graduates, M.S. Survey of Faculty). Surveyed annually and compiled every 5 years.
- collect background information through the effective use of the scientific literature, (Assessment Item 13 on M.S. Survey of Graduates, M. S. Survey of Faculty). Surveyed annually and compiled every 5 years.
- prepare a hypothesis, design and execute experiments to test the hypothesis, keeping complete experimental records, (Assessment Item 14 on M.S. Survey of Graduates, M. S. Survey of Faculty). Surveyed annually and compiled every 5 years.
- apply appropriate statistical analysis to collected research data, (Assessment Item 15 on M.S. Survey of Graduates, M. S. Survey of Faculty). Surveyed every 5 years.
- apply critical thinking skills to further refine the hypothesis based on experimental evidence (Assessment Item 12 on M.S. Survey of Graduates, M.S. Survey of Faculty). Surveyed annually and compiled every 5 years.
- effectively communicate scientific knowledge and ideas through both oral and written communication skills.

DRILL DOWN----------
RELATED ITEM LEVEL 1

Assessment: LOs 1-6: Effective Use of Scientific Method

Frequency of Assessment:
Annual

Rationale:

Graduate Advisory Committees of the graduate students assess student progress at the time of the proposal presentation, the thesis seminar, and the oral defense of the written thesis. See below (and attached) for information concerning a direct measure of assessment.

Chemistry M.S. Survey of Graduates: Specific items on this survey (Attached) along with the students Graduate Advisory Committee will assess students' progress on each of the sub-outcomes.

Chemistry M.S. Survey of Faculty: Specific items on this survey (Attached) will assess students' progress on sub-outcomes.

Seminar Evaluation Form: Both faculty and students attending student seminars fill out an evaluation form (Attached) on the student speaker. This is helpful to both the student giving the seminar as well as the student grading the seminar. These are kept by the Seminar Program Coordinator, who also provides feedback to students, and to the M.S. Program Coordinator.

A student with an advanced degree in chemistry must have sufficient critical thinking and problem solving skills in order to succeed. **Graduate Advisory Committees** of the graduate students at the time of proposal presentations, literature seminar, thesis seminar, and oral defense of the written thesis will make evaluations of student progress. Progress and novel ideas for improvement are discussed within these committees, at faculty retreats and occasionally at faculty meetings. The results of the Chemistry M.S. Survey of Graduates and the Chemistry M.S. Survey of Faculty are also discussed at faculty meetings and retreats since they contain valuable information as a direct measure of assessment.

External program reviews (every 5 years) also contributes to improvements in the assessment tools utilized by the department. The results of these reviews are maintained in the Chemistry Chair’s office.

RELATED ITEM LEVEL 2

Results: LOs 1-6: Effective Use of the Scientific Method

Results:

Results of Graduate Advisory Committees rubric.

Results of MS Survey of Graduates

Results of MS Survey of Faculty

Results of Seminar Program Evaluation Form

Attachments:

Program Goal 1: Increase Level of Research and Scholarly Activity

Define Goal:

Engage graduate students in **cutting-edge research activities**.

Intended Outcomes / Objectives:

To continuously **increase the level of research and scholarly activity** among the faculty by **5% (every 2 years)** in order to engage graduate students in **cutting-edge research activities**.

To **increase** external **funding by 5% per year** to **improve quality of instrumentation** necessary for education and research.

DRILL DOWN----------
RELATED ITEM LEVEL 1

Assessment: Program Goal 1 - Research and Scholarly Activity

Frequency of Assessment:
Annual

Rationale:

Chemistry Department Annual Report - Information in the Chemistry Department Annual **Report provides annual tabulation of the results** of each program goal (Indirect, but containing information from Direct Measure Assessment)

Assessment of the **number of refereed scholarly publications** will be those listed in the Directory of Graduate Research (DGR). **Historical Note:** For the years prior to 2001, our departmental faculty had an average of 17 per year. A 5% increase per edition beginning with Outcome 1. **Beginning in 2013**, the DGR no longer published the peer-reviewed publications of each faculty member, thus, assessment changed to the utilization of SciFinder Scholar as a direct measure assessment tool.

The Directory of Graduate Research historically provided a national means for comparing productivity in research publication to that of the faculty in TTU Chemistry. Although this data is no longer available, extraction of publications of each faculty member can be accomplished utilizing **SciFinder Scholar**.

Information in the Delaware Study will be utilized to determine and tabulate the **total amount of external funds activated each year** by the department, the **actual teaching load assigned** by the chair and the number of degrees awarded.

The University must file certain reports each year that indicate levels of funding support acquired from outside sources. The Delaware Report is thus very useful for acquiring this data.

We will continue to monitor the graduation rate of the M.S. Chemistry program on the yearly cycle defined to begin with Summer commencement through following Spring commencement. The Chemistry Department Annual Report is used to not only track such data, but is also **disseminated to the faculty and discussed at faculty meetings and retreats**, as are the other assessment tools. The graduate program is assessed by external peer-review every 5 years.

RELATED ITEM LEVEL 2

Results: Program Goal 1 - Research and Scholarly Activity

Results:

As assessed by the Directory of Graduate Research (through 2013), the following table tabulates the **publication productivity** in the department of chemistry. We more than exceeded our target several years. Since there is inherent variability in such data, we have included in Table 1 the total publications for the period 2001-2014 compared to the target expected and we are near our target as of this writing. This goal will continually be assessed on a two-year cycle, although SciFinder Scholar will be used as the direct assessment tool. Two-Year cycle is defined, for example, as papers published during calendar year 2017 and 2018 and reported as 2017-2018.

Refereed Publications Listed in the Directory of Graduate Research (DGR)

Years Tabulated	# of Publications	Target (5% increase)
1991-2001	17 (average)	
2001-2002	21	18
2003-2004	21	19
2005-2006	30	20
2007-2008	17	21
2009-2010	11	22

2011-2012	13	23
2013-2014	20	24
2015-2016	41	25
2017-2018	41	27
2018-2019		
2001-2018	**232**	**175**

The following table tabulates acquired funding by the department of Chemistry faculty since 2005. To provide an historical perspective: the four-year total research funding level in the department 1998-2002 was an average of $121K per year. Our target is a research funding level that increases by 5% per year over the previous average. We have **dramatically exceeded this goal (nearly tripled)** as seen in the table below (Ref. Delaware Reports 2005-2006 through 2009-2010 and the Chemistry Annual Report).

External Funding Awarded to Departmental Faculty

Academic Year	**Total New Awards**	**Target Level**
2006-2007	$1,037,689	$126K
2007-2008	$36,300	$132K
2008-2009	$283,013	$139K
2009-2010	$103,000	$146K
2010-2011	$122,253	$153K
2011-2012	$236,957	$161K
2012-2013	$94,309	$169K
2013-2014	$568,600	$177K
2014-2015	$725,046	$185K
2015-2016	$1,437,827	$194K
2016-2017	$545,294	$203K
2018-2019	$434,356	$223K
Total last 12 years	**$ 6,694,769**	**$2,341,000**

Attachments:

Program Goal 2: Decrease Teaching Load of Graduate Faculty

Define Goal:

Decrease the traditional classroom **teaching load of Graduate Faculty.**

Intended Outcomes / Objectives:

To **decrease** the traditional classroom **teaching load of Graduate Faculty to 9 contact hours or less** by providing appropriate credit for student research involvement, grant writing, special service work, and other chair-assigned activities.

DRILL DOWN----------
RELATED ITEM LEVEL 1

Assessment: Program Goal 2: Decrease Teaching Load of Graduate Faculty

Frequency of Assessment:
Annual

Rationale:

Information in the Delaware Study will be utilized to determine and tabulate the **actual teaching load assigned** by the chair.

Faculty are consulted by the chair regarding teaching loads and release time needs in order for them to be more productive in research. The chair works with the Dean of Arts & Sciences and analyzes Delaware Reports to **assure** that both the **requirements of the American Chemical Society are met** (regarding teaching loads) and that resources are available to reach that goal

RELATED ITEM LEVEL 2

Results: Program Goal 2: Decrease Teaching Load of Graduate Faculty

Results:

The average load of the research active faculty is now 9.2 contact hours, however, the average load when all permanent faculty are considered is 10.5.

Attachments:

Program Goal 3: Maintain a Satisfactory Graduation Rate

Define Goal:

The Chemistry M.S. Program will **maintain a satisfactory graduation rate.**

Intended Outcomes / Objectives:

The Chemistry M.S. Program will **maintain a level of at least 5 graduates per year**.

DRILL DOWN----------
RELATED ITEM LEVEL 1

Assessment: Program Goal 3: Maintain a Satisfactory Graduation Rate

Frequency of Assessment:
Every other year (biannual)

Rationale:

Information in the Delaware Study will be utilized to determine and tabulate the total amount of external funds activated each year by the department, the actual teaching load assigned by the chair and the number of degrees awarded.

RELATED ITEM LEVEL 2

Results: Program Goal 3: Maintain a Satisfactory Graduation Rate

Results:

Year	Number of Graduates
2007-2008	4
2008-2009	6
2009-2010	6
2010-2011	6
2011-2012	5
2012-2013	6
2013-2014	4
2014-2015	6

2015-2016	7
2016-2017	10
2017-2018	5
2018-2019	4

Attachments: