UNIVERSITY OF WYOMING

College of Arts and Sciences
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8 September 2016

MEMO

TO: Kate Miller
Provost/VPAA

FROM: Paula M. Lutz
Dean, Arts and Sciences

RE: Program Review for Chemistry B.S. (ACS)—Dean's recommendation

The B.S. in Chemistry (ACS) (BS-2 in their shorthand) has produced 27 graduates in the past five year. This represents the most rigorous undergraduate degree for the department. It is focused on students interested in careers in chemistry, with the 'next step' as chemistry professionals or medical or graduate students in the physical sciences. [Indeed, the majority of these UW ACS B.S. students are placed in medical, pharm-D, or graduate school following graduation.]

Comparison of this degree and the 'regular' chemistry B.S. (BS-1) shows that the ACS degree required three additional chemistry courses and one additional credit of undergraduate research. This higher profile degree allows UW to compete for the very best students. Having the ACS-approved curriculum means that ACS monitors the quality and reports periodically (every 5 years). [The department is currently working to answer two critiques from the 2015 review.] This is as close to accreditation as we come in our science disciplines, and that comparison to national standards is important.

Are both B.S. degrees necessary (BS-1 and BS-2 ACS)? I agree with the department that they are. The two degrees cover the needs of a wider range of students and fit well with the current emphasis on strong STEM education and the Science Initiative goals. The ACS B.S. degree supports high quality chemistry instruction for the campus as well. Fifteen to twenty undergraduate TA's are recruited each year from this high achieving group. These students help with the labor-intensive instruction in labs and are absolutely necessary to the department's teaching mission.

The dean's recommendation is to maintain the ACS B.S. degree in Chemistry.

Academic Program Review
Report Template
University of Wyoming
Office of Academic Affairs
March 2016

(adapted from SDSU)

Deans and Directors who administer an authorized major or course of study approved by action of the Board of Trustees will be responsible for conducting program reviews. Four key elements should be addressed in each academic program review: (1) Program Demand, (2) Program Quality, (3) Mission Centrality, and (4) Cost.

For each program that is reviewed, a recommendation will be made by the Academic Dean to the Vice President of Academic Affairs.

Instructions: *Please provide the following information:*

Title of Program/Specialization: Chemistry/BS-2 (ACS approved)
Indicate whether undergraduate or graduate program/specialization: undergraduate
Department and College: Chemistry and Arts & Sciences
Department Head Name and contact information: Professor David T. Anderson, (307) 766-2775, danderso@uwyo.edu

Part 1 – Program Review

Instructions: *Please answer each of the following questions. Items listed under each question have been provided to help guide your response. If an item is not applicable, simply indicate "N/A".*

1. **Program Demand*:**
   (*Note: If degrees granted exceeds cutoff, delay review until next round.*)
   a. Number of graduates over 5-year period: 27
   b. Enrollment in major/specialization over 5-year period: 116

   * Cutoffs for "Low Demand" Designation -- *Degrees Granted*
   - Bachelor's Programs: Average – 5 per year; 5-year total: 25
   - Master's Programs: Average – 3 per year; 5-year total: 15
   - Ph.D. Programs: Average – 1 per year; 5-year total: 5

   (See APPENDIX A for the types of programs that will be excluded from review.)

2. **Program Quality: Is the program of high quality?**
   a. Program accreditation
      i. For programs currently accredited include:
         1. Name of accrediting body/organization: American Chemical Society
         2. Date most recently accredited: December 30, 2015
         3. Next reaccreditation date: 2019

4. List recommendations from most recent visit and progress to date:

   The Committee made the following recommendations that require action by the department. **Research** The Committee described the student research reports as uneven in quality. Some reports were insufficient in length, lacking abstracts, experimental data, and appropriate references to the primary literature. The grading of the research reports appeared to be inconsistent with the Committee's perceived quality. While all reports received A's, only two were described as excellent while the other three were characterized as poor. The Committee encourages the faculty to consider developing guidelines for student use when writing reports and require more than initial drafts to be prepared with faculty review at each stage. A brief discussion of the changes you have implemented and samples of student-prepared research reports must be included with the department's next periodic report. The enclosed supplement describes CPT's expectations for student research reports. **Student skills** According to the periodic report form, student skills are developed in CHEM 4000 and in research. The Committee found no evidence that students are given open-ended laboratory experiments that exercise decision making skills or are using the primary chemical literature to design their experiments. The Committee asks that the faculty either incorporate more of these activities into the curriculum and report on your progress or thoroughly document how the department fosters the development of student skills in these areas at the time of the department's next periodic review.

   Progress to date:
   1. Systematized research report formats for all undergraduate research. Need to collect student reports starting fall 2016.
   2. Starting to incorporate open-ended experiments in laboratories such as inorganic chemistry lab and physical chemistry lab.

ii. For programs seeking accreditation include:
   1. Name of accrediting body/organization
   2. Timeline for seeking accreditation

iii. For all other programs include:
   1. Date of most recent Academic Program Review (APR)
   2. List of recommendations from the most recent APR and progress to date.

(Note: For first-time reviews, include N/A in response.)

b. Credentials of faculty

i. Include a list of all faculty by name, highest degree and discipline of highest degree.

1. David T. Anderson	PhD	Chemistry
2. Navamoney Arulsamy	PhD	Chemistry
3. Franco Basile	PhD	Chemistry

4. Carla Beckett	MS	Chemistry
5. Edward Clennan	PhD	Chemistry
6. Robert Corcoran	PhD	Chemistry
7. Debashis Dutta	PhD	Chemical Engineering
8. Patricia Goodson	PhD	Chemistry
9. Caleb Hill	PhD	Chemistry
10. John Hoberg	PhD	Chemistry
11. Elliott Hulley	PhD	Chemistry
12. Jan Kubelka	PhD	Chemistry
13. Teresa Lehmann	PhD	Chemistry
14. Brian Leonard	PhD	Chemistry
15. Bruce Parkinson	PhD	Chemistry
16. Dean Roddick	PhD	Chemistry
17. Michael Sommer	PhD	Chemistry
18. Jing Zhou	PhD	Chemistry

ii. Also, include a breakdown by gender and ethnicity.

Male 14
Female 4
White 14
Hispanic 2
Indian 2

iii. Grants awarded to academic personnel: Previous 5 years

Name	Years	Agency	Amount
David T. Anderson	2014-2017	NSF	$367,029
David T. Anderson	2009-2014	NSF	$431,583
Navamoney Arulsamy	2014-2015	WSGC	$14,750
Navamoney Arulsamy	2015-2016	UW OR	$2500
Franco Basile	2014-2017	NSF	$414,025
Franco Basile	2016-2019	NSF	$350,000
Carla Beckett	APL		
Edward Clennan	2012-2016	NSF	$491,210
Edward Clennan	2014-2016	NSF	$19,600
Robert Corcoran	2016-2017	NIEHS	$16,000
Debashis Dutta	2014-2017	NIH	$334,497
Debashis Dutta	2014-2015	ITHS	$14,150
Debashis Dutta	2010-2015	NSF	$489,342
Patricia Goodson	APL		
John Hoberg	2014-2017	NSF REU	$331,062
John Hoberg	2015-2016	UW, A&S	$2870
Elliott Hulley	2016-2019	PNNL	$3098
Jan Kubelka	2014-2017	NSF	$264,489
Jan Kubelka	2014-2017	NSF	$350,000
Teresa Lehmann	2013-2015	TIORCO	$371,614
Teresa Lehmann	2014-2017	NIH	$297,660

Brian Leonard	2014-2015	UW SER	$30,000
Brian Leonard	2013-2015	ACS-PRF	$100,000
Bruce Parkinson	2015-2018	DOE	$422,410
Bruce Parkinson	2015-2018	NSF	$300,000
Bruce Parkinson	2014-2017	DOE-BES	$600,000
Bruce Parkinson	2008-2014	DOE-BES	$570,000
Dean Roddick	2012-2015	NSF	$431,000
Dean Roddick	2015-2018	NSF	$528,226
Michael Sommer	APL		
Jing Zhou	2012-2017	NSF	$506,000
Jing Zhou	2016-2018	SER	$214,984

iv. Grants submitted by academic personnel: Previous 5 years

Name	2015	2014	2013
1. David T. Anderson	0	1	2
2. Navamoney Arulsamy	2	3	1
3. Franco Basile	11	3	1
4. Carla Beckett	APL		
5. Edward Clennan	2	3	2
6. Robert Corcoran	1	0	0
7. Debashis Dutta	7	7	4
8. Patricia Goodson	APL		
9. Caleb Hill	----	----	----
10. John Hoberg	2	1	6
11. Elliott Hulley	3	1	----
12. Jan Kubelka	3	3	3
13. Teresa Lehmann	1	3	5
14. Brian Leonard	4	8	9
15. Bruce Parkinson	1	3	2
16. Dean Roddick	1	0	0
17. Michael Sommer	APL		
18. Jing Zhou	7	5	2

v. Publications/presentations by academic personnel

Name	2015	2014	2013	2012	2011
1. David T. Anderson	4	2	5	4	2
2. Navamoney Arulsamy	6	4	1	3	7
3. Franco Basile	1	1	1	1	5
4. Carla Beckett	APL				
5. Edward Clennan	2	2	1	0	5
6. Robert Corcoran	0	0	0	0	1
7. Debashis Dutta	5	5	4	6	3
8. Patricia Goodson	APL				
9. Caleb Hill	3	1	4	0	2
10. John Hoberg	1	0	0	0	2

11. Elliott Hulley	4	4	2	0	1
12. Jan Kubelka	4	8	11	5	7
13. Teresa Lehmann	2	2	4	3	2
14. Brian Leonard	4	3	3	0	3
15. Bruce Parkinson	3	3	2	3	4
16. Dean Roddick	2	2	2	2	4
17. Michael Sommer	APL				
18. Jing Zhou	3	0	1	2	0

vi. National/international awards
Humboldt Research Award

vii. Other

c. Program reputation

i. If program is ranked, include rank and by what organization.

US News and World Report, #131, Ranked in 2014

ii. Include a brief description of any other indicators of program reputation such as demand (e.g. waiting lists or over enrollment) for admission into program, employer data/feedback, etc.

Important to remain ACS-approved and offer the most rigorous chemistry BS degree.

d. Curriculum of major or specialization

i. Include a list of courses by prefix, number, title required in the major or specialization (do not include general education course unless required as part of the major requirements.)

The BS-2 (ACS-approved) degree takes significantly more effort to get than the regular BS-1 degree; 9 additional credits in chemistry coursework, 1 additional credit of undergraduate research, and 18 credits of directed electives. The BS-2 (ACS-approved) degree is more prestigious and has the virtue of international name recognition (the ACS is the largest chemistry professional society in the world!). Please see our webpage: http://www.uwyo.edu/chemistry/undergraduate/

Semester	Course	Credit hrs
Freshman Fall	CHEM 1020 General Chemistry 1	4
Freshman Spring	CHEM 1030 General Chemistry 2	4
Soph. Fall	CHEM 2420 Organic Chemistry 1	4
Soph. Spring	CHEM 2440 Organic Chemistry 2	4
Soph. Spring	CHEM 2230 Quantitative Analysis	4
Junior Fall	CHEM 4100 Inorganic Laboratory	2
Junior Fall	CHEM 4110 Inorganic Chem.	3

Junior Fall	CHEM 4400 Biological Chemistry	3
Junior Fall	CHEM 4930 Undergrad. research	1
Junior Spring	CHEM 4930 Undergrad. research	1
Senior Fall	CHEM 4000 Career Skills	1
Senior Fall	CHEM 4230 Instrum. Methods	4
Senior Fall	CHEM 4507 Phys. Chem 1	3
Senior Fall	CHEM 4525 Phys. Chem Lab 1	1
Senior Fall	CHEM 4930 Undergrad. research	1
Senior Spring	CHEM 4508 Phys. Chem. 2	3
Senior Spring	CHEM 4530 Phys. Chem. Lab 2	1

e. Distance delivery of program/major

Note if the program is offered online and/or at one of the off-campus attendance centers (e.g., UW-Casper)

Not offered online or at off-campus attendance centers.

f. Quality of Assessment Plan/data

Include a brief description of the program assessment plan and how the data are used to inform decisions related to program quality and student learning.

The American Chemical Society-Committee on Professional Training (ACS-CPT) has made a list of skills that accredited programs must deliver to their students. We have a curriculum map to link our courses to specific learning outcomes and skills. We reorganized our assessment team and are working to provide improved assessment tools on our general chemistry curriculum. Specifically, we are testing the benefits of active learning pedagogies. We will use this information to shape how we teach chemistry.

g. Strategic Plan

Include a brief description of any plans for the program or specialization that appear in the college/department strategic plan (i.e., facilities upgrades, curriculum changes, on-line or off-campus delivery, enrichment learning opportunities, etc.)

Chemistry currently offers BA, BS-1 and BS-2 (ACS approved) undergraduate degrees. The BA degree is intended for students who need some background in science (chemistry), but who will mostly be doing other things in their career. Many of our BAs go on to dental school (2016 Spitaleri finalist, Catherine Cloetta), education at the high school level (2016 Spitaleri finalist Mackenzie Brogan), or careers in health science related fields. Both the BS-1 and BS-2 (ACS-approved) degrees are intended for students who want to pursue graduate school or careers in chemistry straight out of college. The regular BS-1 degree is fine for going to graduate school (maybe not top 10, but schools like Montana State, Utah State, or CSU) or getting a job in industry. This degree is also popular with students who want a

dual/concurrent major in another department (Chemical Engineering, Molecular Biology). However, the BS-2 (ACS-approved) degree requires significantly more effort and is more prestigious. Potential graduate schools or employers instantly know that the ACS-approved degree is more rigorous. The BS-2 (ACS approved) degree therefore matches well with our undergraduate teaching mission to attract top WY high school students and offer them the option of a rigorous chemistry degree developed for chemistry professionals. This degree is well aligned with the Science Initiative and the new ENZI laboratory building to provide a chemistry program with modern teaching laboratories, research experiences, and pedagogies to best prepare undergraduate students for careers in chemistry. The BS-2 (ACS-approved) degree promotes excellence in chemistry education for undergraduate students and the approval process provides a direct mechanism to evaluate our chemistry program. The high quality and accreditation of the chemistry program at UW relies on us maintaining ACS-approved status. We constantly strive to increase the number of graduates for this degree through recruiting, advising, and cultivating an undergraduate chemistry culture.

3. **Mission Centrality: Does the program advance the mission of UW including institutional strategy?**
    a. Describe how the program supports the mission, vision and strategic goals of UW.

    Having an ACS-approved program that offers a BS-2 (ACS approved) degree allows for a broad based and rigorous chemistry education that is well aligned with UW's commitment to strong STEM education and training. If we were to eliminate the BS-1 degree, we would lose many majors because of the additional requirements of the BS-2 (ACS-approved) degree. Offering both BS-1 and BS-2 degrees is somewhat standard at research active universities and instantly gives our program the highest standards and world-wide prestige. The chemistry department works hard to maintain the BS-2 degree status and this is a source of pride for the department.

    b. Describe how the program contributes to other programs across campus (i.e., general education courses, minor or support courses, interdisciplinary program, etc.)

    Many of the students in the BS-2 (ACS approved) degree are our top performing undergraduate students. Chemistry hires 15-25 undergraduate TAs each semester to help teach our general chemistry discussions and laboratories. Many of these TA positions are filled by ACS-approved degree candidates who contribute immensely to the training process. This major also benefits our graduate and undergraduate research programs by providing academic credit for participation in ongoing research projects and creating a rich chemistry research culture. Many of our ACS-approved degree candidates shoot for undergraduate research scholarships. This degree also indirectly supports the ACS student chapter at UW. Belonging to the ACS student chapter provides students with outreach opportunities, the full benefits of ACS membership, and opportunities to attend national meetings and present their work.

Having an ACS-approved program helps give our graduates the most opportunities for career development and advancement.

c. Include placement data for graduates and indicate if graduates are working in the field or not.

Name	graduation date	placement
1. Alissa Schunter	2010	Grad school (PhD) Notre Dame
2. John Alhusen	2010	Grad school (PhD) U. of Utah
3. Jordan Calmes	2010	Pharmacy PhD program, UW
4. Maria Lambousis	2010	Grad school (PhD) UT-Austin
5. Carla Holman	2010	Joined energy company in 2012
6. Lindsey Monger	2010	Chemistry Graduate Program, Germany
7. Chris Averill	2011	Grad school (Penn State): currently Senior Consultant (Renewable Energy) at Booz Allen Hamilton in Washington DC
8. Brandon Scott	2011	PhD from UW
9. Mattson Mathey	2011	Medical School (U of Washington)
10. Kevin Grauberger	2011	
11. Jenna Milliken	2011	Scientist, Millipore Sigma, Laramie, WY
12. Nathaniel Kaan	2011	Medical School (U of Washington)
13. Nick McDougall	2011	MS (Chem Eng) from South Dakota School of Mines and Technology. Now Engineer at Las Alamos National Lab
14. Melissa Phillips	2012	Grad school (PhD) UC-Boulder
15. Jason Henrichs	2012	
16. David Mikesell	2012	
17. Jennifer De Long	2012	
18. Carrie McCarthy	2012	Grad school (PhD) U of Southern Calif
19. James Thorne	2012	Grad school Boston College
20. Alex Literati	2012	Industry job (Western Research Inst)
21. Ashlin Porter	2013	Grad school (PhD) Purdue
22. Greg Waetzig	2013	Grad school (PhD) Texas A&M
23. Kari Baber	2013	
24. Elizabeth Cleverdon	2013	Grad School (PhD) Syracuse
25. Sakun Duwal	2013	Grad School (PhD) not sure where
26. Katherine Boswell	2013	Lab Study Analyst at Hyde Engineering
27. Erik Peterson	2014	Chemistry Graduate Program at UW
28. Christopher Nordyke	2014	Chemistry Graduate Program at UW

d. Describe the uniqueness or duplication of this program across the UW.

Only the Chemistry Department in A&S offers undergraduate degrees in chemistry.

e. Other:

4. **Cost: Is the program financially viable?**
    a. Ratio of student credit hours per FTE: 650.2

    b. Direct instructional expenditures (FY 2015): $3,604,250
        i. Per student FTE: $9,663
        ii. Per total degrees awarded: $124,284
        iii. Non-personnel expenditures per total academic FTE: $8,667

    c. Course enrollment
        i. Number of classes falling under University minimums: 5
        ii. Lower-division courses falling under University minimums: 0

    d. Research expenditures per tenured/tenure-track FTE (and other academic personnel, where appropriate): $149,248

Part II - Recommendations

Instructions: *After the review is completed, the Dean in consultation with the Department Head will select one of the following recommendations. In the justification, address each of the items associated with the recommendation.*

1) Retain Due to Critical Need

a) A college may recommend that a degree program be retained due to its ability to fulfill a critical workforce need or shortage area for the state.

b) Justification for retaining due to critical need must include:
    i) Explanation of why the program is important to the University/State/region
    ii) Description of specific steps (already taken and/or planned) to increase enrollment and graduate production;
    iii) Preliminary outcomes of steps taken.

2) **Retain with Further Review Required**

a) A college may request that a program be retained for further review for those degree programs that serve a specific function central to the mission of the college or university.

b) Justification for retain due to further review must include:
   i) Explanation for how the program is central to the university's mission and the benefit to the system;
   ii) Description of specific steps (already taken and/or planned) to increase enrollment and graduate production;
   iii) Preliminary outcomes of steps taken.

3) **Consolidate with Another Program within College**
   a) A college may request that a program be consolidated with a similar program on campus that achieves similar degree requirements.

   b) Justification to consolidate with another program on campus must include:
      i) Explanation for how the degree requirements for the two programs warrant consolidation;
      ii) Evidence that the consolidation will meet graduate production thresholds, or specific steps to increase enrollment to meet production thresholds;
      iii) Preliminary outcomes of steps taken.

4) **Consolidate with Program(s) between Colleges/campuses (e.g., UW/C)**
   a) Two or more colleges may request that similar degree programs be consolidated to maintain equivalent degree programs.

   b) Justification for retaining due to cross-college consolidation must include:
      i) Explanation for how the consolidated programs will collaborate (e.g., sharing of required courses, shared faculty, etc.) to maintain graduate production thresholds;

      ii) Evidence that multi-college collaboration will meet graduate production thresholds, or specific steps to increase enrollment if merging programs fails to meet production thresholds;
      iii) Preliminary outcomes of collaboration between colleges.

5) **Terminate**
   a) A college may request that a program be terminated due to limited graduate production, lack of student interest, shifts in a given field of study, or continued declines in major enrollments.
   b) If the exigency for termination results from the program productivity review process then a brief justification to terminate a program should be included. Such a justification must include:
      i) Explanation for the decline in graduate production in the degree program;
      ii) Intended timeframe for submitting a program termination request to the Board of Trustees for their consideration;
      iii) Expected timeline to meet teach-out requirements established through the regional accrediting body.

APPENDIX A

"Low Productivity" Programs Excluded from Review Process

1) **Major Program Modifications**
   a) Degree programs that have undergone recent program modifications that adversely impact graduate production for a college.
   b) Modifications traditionally include programs that have undergone recent name changes during the reporting window that result in two equivalent degree programs.

2) **Program/Major Specializations**
   a) Degree programs that have one or more specializations which reduce the total number of graduates.
   b) The exclusion may apply only for those specializations where the combination results in graduate production that meets the establish threshold for the degree.

3) **Terminated Programs**
   a) Degree programs that have been inactivated during the reporting period, but still depict graduates that fall below the established thresholds.
   b) Terminated programs will remain on the Program Productivity Report until inactive programs have completely cycled through the established reporting period.

4) **New Programs**
   a) Degree programs that have been activated within the past 7 years resulting in limited graduate production due to program implementation.
   b) Institutional review may be requested prior to the 7^{th} year if graduate production is not scaling to the required thresholds for the degree level.

Academic Program Review: **Chemistry BS – Amer. Chem. Soc. Approved**

Section 8 – Cost

a) Ratio of student credit hours per FTE (AY 2014/15): **650.2**

b) Direct instructional expenditures (FY 2015): **$3,604,250**

i) Per student FTE: **$9,663**

ii) Per total degrees awarded: **$124,284**

iii) Non-personnel expenditures / total academic FTE: **$8,667**

c) Course enrollment (AY 2014/15)

i) Classes falling under university minimums: **5**

ii) Lower-division courses falling under university minimums: **0**

e) Research expenditure per tenure-track FTE (FY 2015): **$149,248**