2018 Periodic Report
to the
ACS Committee on Professional Training

Please consult the ACS Guidelines (http://www.acs.org/cpt) before completing this report. The information contained in this report should pertain only to your undergraduate program. To facilitate committee review, all responses must be provided on this form. Extra pages for the tables are available under the Templates tab on CPRS.

Name of Institution: Utah State University

City, State, and Zip Code: Logan, UT 84322

Report Prepared by (e.g., Dr. Mary Smith or Juan Ruiz): Dr. Alvan Hengge
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Current Chemistry Department Chair
Name: Alvan Hengge
Title: Professor
E-mail: alvan.hengge@usu.edu

Name of Department: Chemistry and Biochemistry

Section 1

1.1 Degrees Offered in Chemistry (check those offered)

- Bachelor's ☒
- Master's ☒
- Ph.D. ☒

1.2 Number of Calendar Weeks per Term (not counting final exams)

Semester	15
Quarter	
4-1-4	
Other	

1.3 Provide the number of students in the current (most recently completed) academic year:

Entire Campus	17,604
Undergraduates	15,959
Chemistry Seniors	56
Sum of enrollments in all undergraduate chemistry courses	3,744

1.4 Provide the number of bachelor's-degree graduates during the past six years who went on to:

Graduate School in the Chemical Sciences	37
Medical and other Professional Schools	31
Private Sector	15
Teaching	3
Other/Unknown	106

Section 2: Institutional Environment

2.1 Is the institution accredited by a regional accrediting association? Yes ☒ No ☐

Name of Accrediting Association NWCCU

2.2 Is the chemistry department organized as an independent administrative unit? Yes ☒ No ☐

a. If no, how is the department or program administered and to whom does the department administrator report?

b. If no, who controls budgetary, personnel, and teaching decisions for the chemistry program, and how are chemistry faculty involved?

2.3 Check the Minimum Salary for each Rank of Chemistry Faculty (Nine Months)

Minimum Salary	Professor	Associate Professor	Assistant Professor	Long-term, non-tenure track
Below $51K	☐	☐	☐	☒
$51 - $60K	☐	☐	☐	☐
$61 - $70K	☐	☐	☒	☐
$71 - $80K	☐	☒	☐	☐
$81 - $90K	☒	☐	☐	☐
Over $90K	☐	☐	☐	☐

2.4 Chemistry Expenditures (rough estimates – 2 significant figures):

If your expenditures are over $60,000 per year, excluding internal and external grants, salaries, and library budget, check here ☒ and go to Item 2.5.

	Current	Annual Average Over the Past Five Years
Operating Expenditures Exclusive of Salaries		
Instrument Maintenance and Repair		
Student and Faculty Travel		
Internal Grants		
External Grants		

2.5 Describe whether the level of institutional support allows the department to meet its teaching, infrastructure, and faculty development needs.

Faculty development is well supported, financially and in the form of training workshops, particularly for new faculty. The infrastructure for undergraduate teaching is adequate, and a percentage of lab fees is used for the purchase and replacement of teaching lab instrumentation. Significant enrollment growth in recent years has resulted in increasing demand for general and organic chemistry service courses and labs. Institutional teaching assistant support is sufficient, but barely.

Section 3: Faculty and Staff

3.1 Number of Chemistry Faculty in the Spring 2018 Academic Term **(If you have no faculty in a particular category, record a "0").** Please be sure the Total Faculty column sums to the number in the Permanent Total row.

Faculty	Total Faculty	With Ph.D.	Female	Black/AA*	Native American	Asian	Hispanic/ Latinx	Other**
Permanent total	21	21	3	0	0	4	0	0
Full-time	21	21	3	0	0	4	0	0
Tenured	15	15	2	0	0	1	0	0
Pre-tenured	6	6	1	0	0	3	0	0
Long-term, non-tenure track	2	2	0	0	0	0	0	0
Part-time	0	0	0	0	0	0	0	0
Tenured	0	0	0	0	0	0	0	0
Pre-tenured	0	0	0	0	0	0	0	0
Long-term, non-tenure track	0	0	0	0	0	0	0	0
Temporary total	0	0	0	0	0	0	0	0
Full-time	0	0	0	0	0	0	0	0
Part-time	0	0	0	0	0	0	0	0

* AA = African American. **Other includes other ethnicities/diversities beyond Caucasian.

3.2 Number of Instructional Staff (Do not include faculty listed in Item 3.1 or Teaching Assistants. **If you have no instructional staff in a particular category, record a "0".**)

Instructional Staff	Total Staff	With Ph.D.	Female	Black/AA	Native American	Asian	Hispanic/ Latinx	Other
Long-term*	0	0	0	0	0	0	0	0
Full-time	0	0	0	0	0	0	0	0
Part-time	0	0	0	0	0	0	0	0
Temporary	0	0	0	0	0	0	0	0
Full-time	0	0	0	0	0	0	0	0
Part-time	1	0	1	0	0	0	0	0

* Employed for three years or more or expectation of employment for at least three years

3.3 The ACS is concerned about the potential overreliance on temporary faculty and temporary instructional staff. If the total number of individuals listed as temporary in Items 3.1 and 3.2 above is more than one-third of the number of permanent faculty and long-term instructional staff, describe the courses the temporary appointments teach and indicate whether those courses are required for certification in the curriculum.

3.4 Diversity in the faculty provides valuable perspectives, resources, and knowledge within an academic setting. Examples of diversity include gender identity, people of color, sexual orientation/LGBTQ, religion, ethnicity, multi-racial identity, country of origin, disability status, first-generation college students and military service.

a. Please describe any attributes of the diversity of your faculty and instructional staff that are not captured in Items 3.1 and 3.2.

b. Please describe any activities the program has engaged in to enhance and promote diversity among faculty and instructional staff in the last five years. You may include strategies used to (1) reach out to applicants from diverse backgrounds, (2) execute the search process, (3) recruit the applicant(s), (4) create an inclusive environment, and (5) retain the recruit(s).

Our most recent faculty hire was an accomplished female applicant for whom we sought and received permission to hire as an associate professor, rather than at the assistant level, as the position was advertised, in the interest of improving female representation on the faculty. Another lecturer has been hired to begin fall 2018, also a female. She was recruited from a recent applicant pool from a search in which she finished a close second to the person who was hired. When funds for an additional hire became available, we received permission to hire her without conducting a new search, in the interest of furthering female representation on the faculty.

3.5 a. Number of Support Staff:

Administrative	4
Stockroom	1
Instrument Technicians	2
Other	

b. Comment on the adequacy of support staff:

Overall the staff level is adequate.

3.6 Describe the professional development opportunities (including sabbaticals) that are available to chemistry faculty and instructional staff.

Faculty may apply for sabbaticals every seven years, for either one or two semesters. The Department assists with travel costs for faculty to attend research or teaching-focused conferences. For faculty with primary duties in teaching including lecturers, and for staff, the Department covers the full cost for one conference annually. The university's Academic and Instuctional Services office provides ongoing workshops and seminars for all faculty.

3.7 Report the number of chemistry faculty and instructional staff who have taken a sabbatical or professional leave in the last six years.

Requested 3

Granted 3

3.8 Teaching Contact Hours for 2017-2018 Academic Year (Classroom and Lab)
Please provide the minimum and maximum numbers that occurred during this academic year. **The ranges reported here should match the numbers reported in Table 3.1.**

a. Contact Hours/week per semester for Chemistry Faculty (exclusive of research):
Range from 3 to 12 ; Average 5

b. Contact Hours/week per semester for Instructional Staff:
Range from 3 to 3 ; Average 3

c. If you need to explain how contact hours are counted or if there is a special situation, for example, for online instruction please explain:

d. Are maximum and/or minimum teaching loads established as an institutional policy?
Yes ☐ No ☒

If yes, explain briefly:

3.9 a. Do you use student teaching assistants? Yes ☒ No ☐

If yes, answer items b. and c.

b. Describe the formal instruction and assistance in laboratory and/or classroom teaching provided to teaching assistants.
TAs either supervise laboratory sections, or recitation sections associated with a lecture course. All complete a daylong 3-week TA Training Workshop conducted by the Graduate School. The workshop includes training covering teaching and grading best practices, FERPA, sexual harassment prevention policies, and accommodation of students with disabilities. All TAs receive laboratory safety training by the University's Environmental Safety and Hygiene Office.

c. How are teaching assistants supervised in the laboratory?
Before the start of each semester, and then weekly, all laboratory TAs meet with the faculty coordinator of their laboratory courses.

Table 3.1 – Teaching Contact Hours

Provide the **actual contact hours** per week for each individual involved in undergraduate instruction for the 2017-2018 academic year. List one faculty member per row and enter as many faculty per page as possible. List non-tenure-track faculty, temporary faculty, and instructional staff and **identify them with the key below**. Do not include graduate teaching assistants. If the average number of contact hours for your department is less than 12 contact hours per week, complete Table 3.1 only for those individuals with 12 or greater contact hours per week. Please use whole and half numbers only. Additional copies of this table are available under the Template tab on CPRS.

	Fall Semester/1st Quarter 2017				Spring Semester/2nd Quarter 2018			
Faculty Member (list according to rank)	**Course Number and Title**	**1***	**2***	**3***	**Course Number and Title**	**1***	**2***	**3***
Curie, Marie (Professor)	CHEM112 – Gen Chem I CHEM 257 – O. Chem I CHEM 258 – O.Chem Lab (2 sections)	3 3 0	0 3 5	14	CHEM259 – Analytical Chemistry CHEM260 – O. Chem II CHEM268 – O.Chem Lab	3 3	3 3 2.5	14.5

*1 Number of class hours scheduled per week.

*2 Number of contact hours of lab per week.

*3 Total of columns 1 and 2 for a grand total for each individual.

\# Non-tenure track faculty

@ Temporary faculty and instructional staff

\+ Long-term instructional staff

Table 3.1 – Teaching Contact Hours (continued)

	Third Quarter 2018 (Do not report Summer hours.)			
Faculty Member (list according to rank)	**Course Number and Title**	**1***	**2***	**3***

*1 Number of class hours scheduled per week.

*2 Number of contact hours of lab per week.

*3 Total of columns 1 and 2 for a grand total for each faculty member.

Non-tenure track faculty

@ Temporary faculty and instructional staff

+ Long-term instructional staff

Section 4: Infrastructure

4.1 Comment on the adequacy and condition of your department's instruments and lab apparatus to meet your program's teaching and research needs. Describe the arrangements for repair, replacement, and maintenance of instruments.

Instrumentation is adequate for teaching and research. Older equipment is maintained in good condition by a full-time instrumentation specialist. Replacement of equipment or new instrumentation for teaching labs is funded in part from lab fees. Research equipment is funded from the department, grants (several recent successful NSF-MRI awards) and an equipment matching grant program from the VPR. Major purchases in the past five years include a 500 MHz NMR, an LC-MS, spectropolarimeter, analytical ultracentrifuge, liquid scintillation counter, and gel imager.

4.2 Do you rely on off-site instrumentation to meet your department's research needs? Yes ☒ No ☐

If yes, please describe the arrangement:

Two inorganic chemists send small molecule crystallography samples to a facility at the University of Utah on a fee per structure basis. Several faculty members have collaborators at other universities or at national labs who provide expertise and particular instrumentation, such as high-resolution mass spectrometry of biological materials.

4.3 Comment on the adequacy of the facilities and space available for the undergraduate chemistry program.

The undergraduate chemistry lab space is excellent. General and organic labs constructed in 2000. Upper division labs are run in an older building constructed in the 1970's that has updated hoods and ventilation systems, and safety features. Lecture rooms throughout campus are adequate and are equipped with modern instructional instrumentation and internet access.

4.4 a. Indicate the number of chemistry journals to which students have immediate institutional access on your campus.

13 or fewer ☐ 14 or more ☒

b. Do your students and faculty have access to journals that are not available on campus through interlibrary loan? Yes ☒ No ☐

c. What types of access do undergraduate students and faculty have to chemical information databases on your campus? (Check all that apply.)

Online through ChemSpider	☒
Online through SciFinder	☒
Online through STN	☐
Online through Web of Science	☐
Other access	☒
Specify	Scopus, Science Direct

4.5 What is the maximum number of students in a laboratory section who are directly supervised per faculty member, instructional staff member, or teaching assistant? 24

Table 4.1 – Instrumentation and Specialized Laboratory Apparatus

If you have more than one particular instrument, please list up to two. **Only report functioning instrumentation that is used by undergraduate students.** If your department has more than one of a particular instrument type, please list the two newest.

Instrument/Apparatus	Used by Undergraduates		Year Acquired	Manufacturer and Model
	In Chemistry Course Work	In Research		
NMR spectrometer(s)	☒	☒	2006	JEOL ECX-300
	☒	☒	2014	Bruker Avance Ascend-500
Optical Molecular Spectroscopy	☐	☐		
IR spectrometer(s)	☒	☐	2017	Thermo Nicolet iS5(2)
	☒	☐	2017	Perkin elmer Spectrum 100
UV-Vis spectrometer(s)	☒	☐	2011	ThermoFisher Spec 200 (8)
	☒	☐	2006	Ocean Optics USB 4000 (2)
Other: Circular Dichroism Spectrophotometer	☐	☒	2017	Jasco J1500
Optical Atomic Spectroscopy	☐	☐		
Atomic absorption/emission	☒	☐	1994	Buck Scientific PFP-7
	☒	☐	1994	Buck Scientific 200A
Other:	☐	☐		
Mass Spectrometry	☐	☐		
Mass spectrometer(s)	☒	☒	2005	Micromass M@LDI-R
	☐	☒	2015	Shimadzu LCMS 2020
GC-Mass spectrometer(s)	☒	☒	2000	Shimadzu QP-5000 GC-MS
	☐	☐		
Other:	☐	☐		
Chromatography and separations	☐	☐		
Gas chromatograph(s)	☒	☐	1995	SRI 8610b (2)
	☐	☒	2004	HP5921A
Liquid chromatograph(s)	☒	☒	2009	BioRad Logic LP (6)
	☐	☒	2015	Shimadzu LCMS 2020
Gel electrophoresis	☒	☐	2008	BioRad MiniProt Tetra (6)
	☒	☐	2008	BioRad Minigel (6)
Other:	☐	☐		
Electrochemistry	☐	☐		
Electrochemical Instrumentation	☐	☒	2012	Basi E2P-001000
	☐	☐		
Other:	☐	☐		
Other	☐	☐		
Radiochemistry (including counting equipment and sources)	☐	☒	2015	HIDEX 300 Scint. Counter
	☐	☐		
Thermal analysis equipment	☐	☒	2013	TA Instruments NanoITC
	☐	☐		
Schlenklines and dry box apparatus	☒	☒	1989	Vac Atmospheres
	☐	☐		
Imaging microscopy	☐	☒	2009	Olympus IX81
	☐	☐		
Other:	☐	☐		
Additional Instruments (over $10,000 in cost):				
Analytical Ultracentrifuge	☐	☒	2015	Beckman ProteomLab XL1
Digital Imager	☒	☒	2014	BioRad ChemiDoc MP

4.6 Safety

a. Are the following laboratory facilities **adequate** for your instructional program and are they routinely **inspected and/or tested**:

Safety Showers	Adequate	☒ Yes ☐ No	Inspected and/or Tested	☒ Yes ☐ No
Eye Washes	Adequate	☒ Yes ☐ No	Inspected and/or Tested	☒ Yes ☐ No
Fire Extinguishers	Adequate	☒ Yes ☐ No	Inspected and/or Tested	☒ Yes ☐ No
Hoods	Adequate	☒ Yes ☐ No	Inspected and/or Tested	☒ Yes ☐ No
Ventilation	Adequate	☒ Yes ☐ No	Inspected and/or Tested	☒ Yes ☐ No

b. If you do not have any of the above items, or if it is not adequate, inspected and/or tested, please explain.

4.7 a.

	Yes	No
Does the department/university have established safety rules?	☒	☐
Does the department/university have emergency reporting procedures?	☒	☐
Does your department have a written chemical hygiene plan?	☒	☐
Are there adequate facilities and arrangements for disposal of chemical waste?	☒	☐
Are safety information and reference materials (e.g., MSDS, SDS, SOPs) readily available to all students and faculty?	☒	☐
Is appropriate personal protective equipment available and used by all students and faculty?	☒	☐

b. If no is checked for any of the above, please explain.

c. Does the chemistry department or program have a safety committee? Yes ☒ No ☐

If yes, how often does it meet? each semester

If no, does the chemistry department have a safety officer? Yes ☐ No ☐

If you answered no to both checkboxes above, who in the department is responsible for promoting a culture of safety? ______

Section 5: Curriculum

5.1 a. Are all foundation courses taught annually? Yes ☒ No ☐

b. If no is checked above, indicate the foundation courses that are **not** taught annually.

c. If all of the courses required for student certification are not taught annually, describe how students can complete the requirements for a certified chemistry degree within four years.

d. Are at least four semester-long (or six quarter-long) in-depth courses taught annually, exclusive of research? Yes ☒ No ☐

5.2 Refer to section 5.8 of the ACS Guidelines for the definition of degree tracks and **list only those degree tracks that lead to an ACS-certified bachelor's degree** in chemistry or related field.

Track 1 Professional Chemistry Emphasis
Track 2 Biochemistry Emphasis
Track 3 Environmental Chemistry Emphasis
Track 4
Track 5

Complete Tables 5.1 – 5.4 only for those courses in degree tracks that may lead to an ACS-certified bachelor's degree.

Table 5.1 – Introductory Course Work

List all introductory chemistry course work students may use to prepare for the foundation course work listed in Table 5.2. Do not include courses listed in Table 5.2 and 5.3 or courses that are not used for ACS certification purposes. Enter only one course per row.

Dept. & Course Number	Course Title	Total Hours[1]		Textbook and Author	Credit Hours	Tracks[2]				
		Class	Lab			1	2	3	4	5
Chem 1210	Principles of Chemistry 1	62		Chemistry, the Central Science,13th ed.Brown et al.	4	R	R	R	_	_
Chem 1215	Chemical Principles Laboratory 1		42	Chemistry 1215-Chemical Principles Lab I Catalyst-Prentice Hall Custom Laboratory Program for Chem.	1	R	R	R	_	_
Chem 1220	Principles of Chemistry 2	62		Chemistry, the Central Science,13th ed.Brown et al.	1	R	R	R	_	_
Chem 1225	Chemical Principles Laboratory 2		42	Chemistry 1225-Chemical Principles Lab II Catalyst-Prentice Hall Custom Laboratory Program for Chem.	1	R	R	R	_	_
Biol 1610	Biology 1	47		Campbell Biology, 11th ed. Reese et al.	3	_	R	_	_	_
Biol 1615	Biol 1 Laboratory		42	No Text: Experiments provided by instructor via Canvas	1	_	R	_	_	_

1. Total Hours refers to the total contact hours per term. Do not record credit hours or contact hours per week in this column.
2. Using the drop-down menu, indicate whether a course is required (R) or one of two or more alternatives (A) that students may choose for each degree track.

5. 3 Please report the number of hours in each course listed above in Table 5.1 that reflect remote or virtual laboratory experiences. If none are taught in this matter, please record 0.

0

Table 5.2 – Foundation Course Work

List below all course work students may use to satisfy the FOUNDATION requirements in the sequence(s) suggested for ACS certification. Do not include courses listed in Tables 5.1 and 5.3 or courses that are not used for ACS certification purposes. Refer to Section 5.3 of the ACS Guidelines for the definition of a foundation course. Enter only one course per row.

Dept. & Course Number	Course Title	Total Hours[1]		Textbook and Author	CH[2]	Subdisciplinary % Breakdown[3]					Tracks[4]				
		Class	Lab			A	B	I	O	P	1	2	3	4	5
Chem 2310	Organic Chemistry 1	62		Organic Chemistry, 6th ed. Bruice	4				100		R	R	R		
Chem 2315	Organic Chemistry Lab 1		36	No Text: Experiments provided by instructor via Canvas	1				100		R	R	R		
Chem 3000	Quantitative Analysis	47		Quantitative Chemical Analysis, 8thed. Harris	3	100					R	R	R		
Chem 3005	Quantitative Analysis Lab		36	No Text:Experiments provided by instructor via Canvas	1				100		R	R	R		
Chem 3510	Intermediate Inorganic Chemistry	32		Inorganic Chemistry, 6thed. Shriver et al.	2			100			R	R	R		
Chem 3520	Inorganic Chemistry Lab		42	No Text: Experiments provided by instructor via Canvas	1			100			R	R	R		
Chem 3060	Physical Chemistry 1	47		Physical Chemistry 6th ed. Levine	3					100	R	R	R		
Chem 3080	Physical Chemistry Lab 1		36	Experiments in Physical Chemistry 8^{th} ed. Garland et al	1					100	R	R	R		
Chem 3700	Introductory Biochemistry	47		Biochemistry: A Short Course, 2nd ed. Tymoczko et al.	3		100				A		A		
Chem 5700	General Biochemistry 1	47		Lehninger Principles of Biochemistry, 5^{th} ed. Nelson	1		100				A	R	A		

1. Total hours refers to the total contact hours per term including the final. Do not record credit hours or contact hours per week in this column.
2. Indicate the credit hours (CH) for each course listed.
3. State the approximate percentage of each subdiscipline found in each course (analytical chemistry (A), biochemistry (B), inorganic chemistry (I), organic chemistry (O), and physical chemistry (P)). The percentage coverage must add up to 100% for each course. For example, Biophysics I might be 40% biochemistry and 60% physical or Organic Chemistry I might be 100% organic.
4. Using the drop-down menu, indicate whether a course is required (R) or one of two or more alternatives (A) that students may choose to meet the foundation requirements for each degree track.

Table 5.2 – Foundation Course Work (continued)

Dept. & Course Number	Course Title	Total Hours[1]		Textbook and Author	CH[2]	Subdisciplinary % Breakdown[3]					Tracks[4]				
		Class	Lab			A	B	I	O	P	1	2	3	4	5
											_	_	_	_	_
											_	_	_	_	_
											_	_	_	_	_
											_	_	_	_	_
											_	_	_	_	_
											_	_	_	_	_
											_	_	_	_	_
											_	_	_	_	_

1. Total hours refers to the total contact hours per term including the final. Do not record credit hours or contact hours per week in this column.
2. Indicate the credit hours (CH) for each course listed.
3. State the approximate percentage of each subdiscipline found in each course (analytical chemistry (A), biochemistry (B), inorganic chemistry (I), organic chemistry (O), and physical chemistry (P)). The percentage coverage must add up to 100% for each course. For example, Biophysics I might be 40% biochemistry and 60% physical or Organic Chemistry I might be 100% organic.
4. Using the drop-down menu, indicate whether a course is required (R) or one of two or more alternatives (A) that students may choose to meet the foundation requirements for each degree track.

5.4 If any courses are listed as alternative courses in Table 5.2, please explain how students satisfy the foundation requirements for certification for each degree track. List the names and course numbers. If a course is listed here, ensure it is also entered in Table 5.2.

Table 5.3 – In-Depth Course Work

List the in-depth course work used for ACS certification. Do not include courses listed previously in Tables 5.1 and 5.2. Refer to Section 5.4 of the ACS Guidelines for the definition of an in-depth course. Enter only one course per row.

Dept. & Course Number	Course Title	Total Hours[1]		Textbook and Author	Foundation Prerequisite Course #	CH[2]	Tracks[4]				
		Class	Lab				1	2	3	4	5
Chem 2320	Organic Chemistry 2	62		Organic Chemistry, 6th ed. Bruice	Chem 2310	4	R	R	R	_	_
Chem 2325	Organic Chemistry Lab 2		39	No Text:Experiments provided by instructor via Canvas	Chem 2315	1	R	R	R	_	_
Chem 3070	Physical Chemistry 2	47		Physical Chemistry 6th ed. Levine	CHEM 3060	3	R	R	R	_	_
Chem 3090	Physical Chemistry Lab 2		36	Experiments in Physical Chemistry 8th ed. Garland et al	Chem 3080	1	R	R	R	_	_
Chem 5710	General Biochemistry 2	47		Lehninger Principles of Biochemistry, 5thed. Nelson	Chem 5700	3	E	R	E	_	_
Chem 5720	General Biochemistry Lab		105	No Text:Experiments provided by instructor via Canvas	Coreq: CHEM 5710	3	E	R	_	_	_
Chem 5640	Instrumental Analysis	47		Principles of Instrumental Chemistry, 6th ed. Skoog et al	Chem 3000 Chem 3080	3	R	R	R	_	_
Chem 5650	Instrumental Analysis Lab		84	No Text:Experiments provided by instructor via Canvas and handouts	Chem 3005 Chem 3080	2	R	R	R	_	_
Chem 5520	Advanced Inorganic Chemistry	32		Inorganic Chemistry, 3d ed. Housecraft	Chem 3070 Chem 3510	2	R	_	_	_	_
Chem 5530	Advanced Synthesis Lab		108	No Text:Experiments provided by instructor via Canvas	Chem 2325 Chem 3070	2	R	_	_	_	_
Chem 5670	Intermediate Environmental Chemistry	47		Environmental Chemistry, 9th ed. Manahan	Chem 3000 Chem 3005		E	_	R	_	_

1. Total hours refers to the total contact hours per term including the final. Do not record credit hours or contact hours per week in this column.
2. Indicate the credit hours (CH) for each course listed.
3. Indicate whether a course is required (R) or elective (E) for each track using the drop-down menu.

Table 5.3 – In-Depth Course Work (continued)

Dept. & Course Number	Course Title	Total Hours[1]		Textbook and Author	Foundation Prerequisite Course #	CH[2]	Tracks[3]				
		Class	Lab				1	2	3	4	5
Chem 5680	Environmental Chemistry Lab		98	Laboratory Experiments in Environmental Chemistry, 9th ed. Boehnke et al.	Chem 3000 Chem 3005	2	E	_	R	_	_
Chem 4990	Undergraduate Seminar	30		No Text: related materials provided by instructor via Canvas	NA	2	R	R	R	_	_
Chem 4800	Research Problems		Var	ACS Guidelines for Preparing a Research Report	NA	3	E	E	E	_	_
Chem 6010	Quantum Chemistry	47		Quantum Chemistry, Levine	Chem 3070 Math 2250	3	E	_	_	_	_
Chem 6020	Molecular Spectroscopy	47		Molecular Spectroscopy, 1st ed. McHale	Chem 6010	3	E	_	_	_	_
Chem 6300	Advanced Modern Organic Chemistry	47		Perspectives on Structure and Mechanism in Organic Chemistry, 2nd ed. Carroll	Chem 2320 Chem 3070	3	E	_	_	_	_
Chem 6500	Reactivity and Mechanisms in Inorganic Chemistry	47		No Text: related materials provided by instructor via Canvas	Chem 5520	3	E	_	_	_	_
Chem 6510	Chemical Applications of Group Theory	17		No Text: related materials provided by instructor via Canvas	Chem 3070	1	E	_	_	_	_
Chem 6600	Modern Chemical Analysis	47		NA	Chem 5640	3	E	_	_	_	_
Chem 5100	Computational Chemistry	47		Essentials of Computational Chemistry, 2nd ed. Cramer	Chem 3070	4	E	_	_	_	_
Biol 3060	Genetics	62		Genetics-A Conceptual Approach, 6th ed. Pierce	Biol 1610	4	_	E	_	_	_
Biol 3300	Microbiology	62		Brock Biology of Microorganisms, 15th ed. Madigan et al.	Biol 1610 Chem 2310	3	_	E	_	_	_

1. Total hours refers to the total contact hours per term including the final. Do not record credit hours or contact hours per week in this column.
2. Indicate the credit hours (CH) for each course listed.
3. Indicate whether a course is required (R) or elective (E) for each track using the drop-down menu.

Table 5.4 – Physics and Mathematics Courses

List the physics and mathematics course work required for ACS certification. Refer to Section 5.7 of the ACS Guidelines. Enter only one course per row.

Dept. & Course Number	Course Title	Total Hours[1]		Department	Credit Hours	Tracks[2]				
		Class	Lab			1	2	3	4	5
Math 1210	Calculus 1	62		Mathematics and Statisctics	4	R	R	R	_	_
Math 1220	Calculus2	62		Mathematics and Statisctics	4	R	R	R	_	_
Math 2210	Multivariable Calculus	47		Mathematics and Statisctics	3	R	R	R	_	_
Math 2250	Linear Algebra/Differential Equations	62		Mathematics and Statisctics	4	A	A	A	_	_
Stat 3000	Statistics for Scientists	47		Mathematics and Statisctics	3	A	A	A	_	_
Phys 2210	General Physics-Science & Engineering 1	62		Physics	4	R	R	R	_	_
Phys 2215	Physics for Scientist & Engineers lab 1		45	Physics	1	R	R	R	_	_
Phys 2220	General Physics-Science & Engineering 2	62		Physics	4	R	R	R	_	_
Phys 2225	Physics for Scientist & Engineers Lab 2		45	Physics	1	R	R	R	_	_
						_	_	_	_	_
						_	_	_	_	_

1. Total hours refers to the total contact hours per term including the final. Do not record credit hours or contact hours per week in this column.
2. Indicate whether a course is required (R) or elective (E) for each track using the drop-down menu.

5.5 How do ACS-certified graduates **in each degree track** meet the in-depth course requirements? List the names, course numbers, and indicate if required or elective. If a course is listed here, ensure it is also entered in Table 5.3. Where a student may choose among two or more courses, clarify the options, and how many courses are required for certification.

Tracks 1, 2 and 3 all require Organic Chemistry (CHEM 2320), Organic Chem Lab 2 (CHEM 2325), Physical Chem 2 (CHEM 3070), Physical Chem Lab 2 (CHEM 3090), Instrumental Analysis (CHEM 5640), and Instrumental Analysis Lab (CHEM 5650).

Track 1 Professional Chemistry Emphasis: Advanced Inorganic Chemistry (CHEM 5520)-Required, Advanced Synthesis Laboratory (CHEM 5530)-Required.

6 credits of electives must be completed from the following coures: Quantum Chemistry (CHEM 6010)-E, Molecular Spectroscopy,(CHEM 6020)-E, Advanced Modern Organic Chemistry (CHEM 6300)-E, Reactivity and Mechanisms in Inorganic Chemistry (CHEM 6500)-E, Chemical Applications of Group Theory (CHEM 6510)-E, Modern Chemical Analysis (CHEM 6600)-E.

Track 2 Biochemistry Emphasis:

CHEM 5710 Gen Biochemistry 2-required, CHEM 5720 Gen Biochemistry Lab-Required

Choice from one of these two BIOL courses:

Principles of Genetics(BIOL 3060)-E or General Microbiology (BIOL 3300)-E

Track 3 Environmental Chemistry Emphasis:

Intermediate Environmental Chemistry (CHEM 5670)-Required

Environmental Chemistry Lab (CHEM 5680)-Required

3 credits of electives must be chosen from one of the following courses: Environmental Toxicology (ADVS 5400)-E, Water Quality and Pollution (WATS 4530)-E, Environmental Quality Analysis (CEE 5610)-E, Aquatic Chemistry (CEE 5620)-E, Analysis and Fate of Environmental Contaminants (CEE 5730)-E, Atmospheric and Air Pollution Chemistry (CEE 6850)-E, Principles of Environmental Soil Chemistry (PSC 5050)-E.

5.6 How do ACS-certified graduates **in each degree track** meet the laboratory requirement of 400 hours? Include the subdisciplinary area (ABIOP) covered by each course, the course name, the course number, the number of lab hours devoted to each area, and indicate whether courses are required or elective. Please record the total sum of lab hours for the courses listed in each track. Do not include lab hours from general or introductory lab courses. If a course is listed here, ensure it is also entered in Table 5.2 or 5.3.

Example: Organic Chemistry II (CH 232), Organic 45 hours, Required

Track 1, Professional Chemistry Emphasis (ALL listed are required):

Organic Chemistry Lab I (CHEM 2315), Organic; 36 hours. Organic Chemistry Lab II (CHEM 2325), Organic; 39 hours. Quantitative Analysis Lab (CHEM 3005), Analytical; 36 hours. Inorganic Chemistry Lab (CHEM 3520), Inorganic; 42 hours. Physical Chemistry Lab I (CHEM 3080), Physical; 36 hours. Physical Chemistry lab II (CHEM 3090), Physical; 36 hours. Instrumental Analysis Lab (CHEM 5650), Analytical; 84 hours. Advanced Synthesis Lab (CHEM 5530), Inorganic, Organic, and Analytical; 108 hours. TOTAL: 417 hours

Track 2, Biochemistry Emphasis (ALL listed are required):

Organic Chemistry Lab I (CHEM 2315), Organic; 36 hours. Organic Chemistry Lab II (CHEM 2325), Organic; 39 hours. Quantitative Analysis Lab (CHEM 3005), Analytical; 36 hours. Inorganic Chemistry Lab (CHEM 3520), Inorganic; 42 hours. Physical Chemistry Lab I (CHEM 3080), Physical; 36 hours. Physical Chemistry lab II (CHEM 3090), Physical; 36 hours. Instrumental Analysis Lab (CHEM 5650), Analytical; 84 hours. General Biochemistry Lab (CHEM 5720), Biochemistry and Analytical; 98 hours. TOTAL: 407 hours

Track 3, Environmental Chemistry Emphasis (ALL listed are required):

Organic Chemistry Lab I (CHEM 2315), Organic; 36 hours. Organic Chemistry Lab II (CHEM 2325), Organic; 39 hours. Quantitative Analysis Lab (CHEM 3005), Analytical; 36 hours. Inorganic Chemistry Lab (CHEM 3520), Inorganic; 42 hours. Physical Chemistry Lab I (CHEM 3080), Physical; 36 hours. Physical Chemistry lab II (CHEM 3090), Physical; 36 hours. Instrumental Analysis Lab (CHEM 5650), Analytical; 84 hours. Environmental Chemistry Lab (CHEM 5680), Analytical, Organic, Inorganic, & Biochemistry; 98 hours. TOTAL: 407 hours

5.7a How is the requirement for coverage of at least two of synthetic polymers, biological macromolecules, supramolecular aggregates and/or meso or nanoscale systems, described in Section 5.1 of the Guidelines, satisfied within course work required for certification:

____ one or more stand-alone courses that are required for certification

x distributed coverage among courses required for certification

5.7b i. If the coverage of biological macromolecules is used to meet up to half of the requirement, list the course numbers and titles of these classes.

CHEM 5700, General Biochemistry; CHEM 3700, Introductory Biochemistry; CHEM 3710, Intro Biochemistry Lab; CHEM 2320, Organic Chemistry II; CHEM 5720, Biochemistry laboratory

ii. Identify additional areas that are covered, report the approximate number of hours spent in lecture and lab on each topic, and the courses in which these topics are covered in.

Material Classification	Approximate Number of Hours in Lecture	Course Numbers	Approximate Number of Hours in Lab	Course Numbers	Not Covered
Synthetic polymers	1	3070			☐
Supra-molecular aggregates	3.5	5530, 5520	13	5530	☐
Meso- or nanoscale materials	2.5	3510,5520	10.5	3520	☐

iii. Provide specific examples of how these systems are covered and how the student learning is assessed.

a. Preparation/synthesis

5530: The definition, synthetic strategies, and applications of polymeric materials are discussed. Students preapare two MOF-based polymers. 3510 and 3520: Synthesis and characterization methods are covered. Quizzes and exams assess learning. Three lab sessions are used to synthesize and characterize nanoscale materials using XRD and SEM.

b. Characterization

5530:SEM is used to study morphology of student-synthesized MOF materials. EDS and ICP-MS are used to quantify metal, C, and O content. XRD determined crystallinity and IR for structural and bonding information. 5520: MOF characterization is covered using literature examples, inlcuding SEM, X-ray powder diffraction, EDX and EXAFS.

c. Physical Properties

3070: Glass-transition temperature Tg and melting temperature Tm are covered. 5530: Bonding information on carbonyl groups before and after incorporating into MOFs. 5520: Capture and decomposition of chemical warfare agents by Zirconium MOFs is covered. Another example discussed the catalytic H2O2 decomposition reactivity of a UiO-type MOF.

5.7c Provide the course syllabi and exams for any course(s) cited in Items 5.7b.

5.8 Describe the computational chemistry facilities and software (e.g., Gaussian) that students use in their course work and research.

A computer lab contains 12 PCs and a separate set of 24 laptops are used by several classes. 2315, 2325, 3710 and 5720 use Discovery Viewer Pro and Discovery Studio 2017. 5100, and undergraduate research students under the mentorship of computational chemists use Gaussian 09 and Gaussian 16, Mathematica, and Matlab, as well as software written locally such as adaptive natural density partitioning (AdNDP). Desktop computers and a computer cluster are available for quantum chemical calculations. Such students may program in Fortran, C++, or Python.

5.9 How do students gain hands-on experience using chemical instrumentation?

Hands-on experience in these lab courses: 2315/2325: balances, Mel-temps, Vernier mini-GCs, ATR FTIR. 3080 and 3090: NMR, IR, Raman, UV-Vis. 5530: FT-IR, 500 MHz NMR, SEM, XRD, ICP-MS, UV-Vis and fluorescence spectrophotometers, potentiostat for cyclic voltammetry. 3005: flame emission spectroscopy, GC, titrations using pH meters, and electrogravimetry. 5650: more hands-on usage with much of the already named equipment, plus HPLC; MALDI MS; GC-MS; FTIR; 2D NMR. 3710 and 5720: PCR, gel electrophoresis, centrifuges, sonicators, FPLC, UV-Vis.

5.10 a. Are any classes required for student certification taught wholly online? Yes ☐ No ☒

b. If you are having problems or concerns with the arrangements for these courses, please describe them.

Section 6: Undergraduate Research

6.1 Undergraduate Research

a. Do you use undergraduate research to fulfill certification requirements for lab hours?

Yes ☐ No ☒

b. Do you use undergraduate research to fulfill certification requirements for in-depth course work?

Yes ☐ No ☒

If yes to either question above, is a comprehensive written report required? Yes ☐ No ☐

If no, go to Item 6.3.

6.2 Do you have a standard rubric used to evaluate research reports? Yes ☐ No ☐

If yes, please upload the rubric used for evaluation.

6.3 Submit a sample of the comprehensive student research reports or theses representative of multiple disciplines and faculty, with the grade the student received indicated on each report. Also indicate on each report the number of terms (semesters or quarters) and actual student hours per term of research covered by the report.

Number submitted ______ (3-5 reports, 5 maximum)

6.4 Report on the participation in undergraduate research during the last six years.

a. Number of undergraduate majors (all degrees offered by your program) who participated in a research experience 115

b. Number of chemistry faculty who were regularly involved in research with undergraduates 18

6.5 If undergraduate research done outside of your institution is used to satisfy certification requirements, are students required to submit a comprehensive written research report that a faculty member at your institution evaluates and approves?

Yes ☐ No ☐ Not applicable ☒

6.6 How are students who are involved in research projects provided with experiment-specific safety education and training?

All students must compete a general laboratory safety course by the university Environmental Health and Safety office. Every research lab maintains a current Chemical Hygiene plan and set of Standard Operating Procedures for particular equipment and procedures in that laboratory. When a student joins a lab for research they are provided these documents and asked to sign verifying they have read and understood them. All undergraduates are provided a graduate student or postdoc as their mentor for carrying out their research and for safety procedures.

Section 7: Student Skills

Provide instructional courses and/or laboratories required for the certified degree, ***exclusive of research experiences***, where each skill listed below is developed and assessed.

1. Report the course and/or lab where this skill is first introduced
2. If applicable, provide up to two other courses and/or labs where development of this skill is emphasized.
3. Give up to three specific examples of assignments and assessments.

7.1 **Problem solving** (defined as developing testable hypotheses, designing and executing experiments, understanding the fundamental uncertainties in experimental measurements, and drawing appropriate conclusions)

5650: Teams of 3 students conduct a 2-3 week project of their own design centered around a team-chosen question/hypothesis that must significantly utilize instrumentation. Library/literature searches are used in developing experimental protocols. 5530: Students use experimental observations and spectroscopic data to troubleshoot low yield and impurities of reactions using chemical principles and propose solutions to solve problems.
5720: Students perform a self-designed protein purification project. They develop a proposal to express and purify a "mystery" protein and are given 3 weeks to execute the experiments.

7.2 **Reading/searching of primary literature**

4990: As part of required poster and oral seminar presentations, students do a literature search of their topic. A written report documenting the literature searches is required. 5650: See entry under Problem Solving above describing use of literature in student projects. 3710 and 5720: Students are introduced to the Protein Data Bank (PDB) and various literature databases such as PubMed and SciFinder. Each lab report requires citations of the primary literature. The protein purification project requires students to develop a proposal based on primary literature.

7.3 **Written communication**

4990: Students write a series of critiques on a minimum of five departmental seminars given by visiting researchers from other universities or industry. They also prepare both a poster and seminar presentation on a selected research topic. They also write a detailed abstract on their presentation topic and produce a professional resume.
3080/3090: Students produce 8 extensive (4-10 page) lab reports each semester.
5530: Students submit a lab reports in the format of a full research journal article, which includes title, abstract, experimental section, results and discussion, and conclusions.

7.4 Oral Communication

3080/3090: Students give two oral presentations summarizing experimental results, observations, potential pitfalls and lessons learned, and conclusions.
4990: Students give a 15-minute oral seminar based upon a chosen research paper/topic, and give a poster presentation at a department-wide poster symposium.
5520: Students do a ~15 min literature presentation based on a recent JACS communication.

7.5 Ethics

5530: A two-student team is formed to conduct each experiment and they are required to work as a team, respect team members, and develop a spirit of teamwork including sharing advice and support.

7.6 Safety

2315/25: Students complete a safety scavenger hunt and quiz at the beginning of each term as part of the Check-in process.
3005: Lab safety training is conducted at the beginning of the lab course. General safety topics are covered and specific safety issues related to specific lab experiments are stressed prior to each lab.
5650: Lab safety training is conducted at the beginning and specific safety issues related to specific lab experiments are stressed prior to each lab. As part of the final lab project, students must obtain MSDS sheets for all chemicals to be utilized and address any special safety requirements in their report.

Section 8: Program Self-Evaluation

8.1 Describe the program self-evaluation activities that your department has undertaken over the past five years. Provide quantitative information, if available.

Since 2011 student course evaluations at USU have used the IDEA system, used at ~400 colleges and universities. Students provide feedback and rank both the teacher and the course. The resulting data can be compared to the nation-wide IDEA database, to discipline-specific IDEA data, or to USU cumulative results. The Department consistently ranks in the "higher than average" category, at approximately the 70th percentile compared to the national IDEA database.

Senior chemistry majors take an exam designed by faculty composed of 60 questions, in the subject areas of general chemistry; organic; inorganic; physical; analytical; and biochemistry. The questions are tied to specific learning objectives and used to evaluate retention of key concepts.

The ACS Instrumental Analysis examination is used as the final exam in Instrumental Analysis, CHEM 5640, a core senior class required for Chemistry majors. The class average has ranged from the 73rd to the 85th percentile in the past five years.

Departmental majors participate in a survey administered by The College of Science to graduating seniors. The survey asks about satisfaction and suggestions for improvement in overall program quality, laboratory and classroom instruction, advising, and satisfaction with instrumentation and facilities. The results show our seniors have very positive feedback regarding their undergraduate program. However, results show that nearly half of students did not meet regularly with an advisor. To address this, two years ago the Department began using a peer advisor (described in the next section).

8.2 Describe how the results of your department's self-evaluations have been used to improve student learning, student skills, exploration of alternative pedagogies, and the effectiveness of the chemistry program.

To address the finding that half years ago the Department began using a student peer advisor (a carefully chosen and trained junior or senior major in the department). One of the peer advisor's duties is to individually contact each major annually, and to invite them to schedule an appointment to get their degree program set up in Degree Works, the university advising software package.

In CHEM 3060 and 3070, Physical Chemistry I and II, a homework system was instituted in which 5 problems are assigned, one of which is the subject of a quiz at the following class meeting. At the next class meeting, the student who performed best on the quiz makes a short presentation explaining their problem-solving approach to the rest of the class. This has proven to be pedagogically effective, and highly popular with students as reflected in their IDEA comments.

The Physical Chemistry lab (3080 and 3090) added an oral peer-teaching experience. The system takes advantage of the fact that student teams do not undertake the same experiment each week, but all do the same set of experiments by the end of the term. Student teams give a short presentation and share advice and suggestions on experiments they have completed, but which the other teams have not yet done. They cover pitfalls to avoid, precautions to take, and conclusions from the data. Many students commented favorably about this in their IDEA evaluations.

Final Comments

Please comment on (in as much detail as you wish) changes in the last five years in faculty, diversity initiatives, professional development, support personnel, facilities, capital equipment, curriculum, and any other items related to your program that you believe would be of interest to CPT. We are especially interested in any new programs you are about to undertake. Use additional sheets, if necessary. Please do not include actual self-evaluation documents or reports.

Faculty: Over the past 5 years the number of total faculty has risen from 17 to 21. This number includes one new lecturer position, giving us a total of two. A third lecturer has been hired who will begin in the summer of 2018. Examples of teaching training and mentoring activities include: funding to attend the Cottrell Scholars Collaborative New Faculty Workshop (four in the past 5 years); Process Oriented Guided Inquiry Learning (POGIL) workshops (three attendees); and participating in USU Center for Innovative Design and Instruction (CIDI) workshops (three attendees).

Diversity: Our two most recent faculty hires are both women, one a tenure-track hire and the other the lecturer who will join the department this summer. This will bring our female representation to four out of 21, an improvement over the two out of 17 five years ago. We recognize the need to further improve our faculty gender diversity.

Research activity: Over the last 5 years our faculty members secured 43 external grants from the NIH, NSF, DOE and other sources, with a total amount exceeding $10 million. During this time our faculty had 415 publications. Most of our faculty members have undergraduate research students in their labs and most grants contain funding for hiring and paying them. The 2018 College of Science Undergraduate Researcher of the Year was a Chemistry major, with two co-authored papers in major journals. All undergraduate research students with accepted abstracts to present a poster or oral talk at a conference receive funding to cover their travel costs.

Teaching instrumentation: The Department has been successful in recent years in adding several pieces of major research equipment, some of which are used in undergraduate laboratory courses. These include a Bruker Advance III HD Ascend-500 NMR Spectrometer, LC-MS system, and an Epsilon Electrochemical Workstation. New UV-vis spectrometers were purchased specifically for the lower division teaching labs. Limited permanent funding sources are available to support new teaching instrument acquisition. In some cases, faculty teaching small upper division lab courses use research equipment in their own laboratory in the absence of suitable teaching instrumentation.