

Template for Comprehensive Program Review -- Chemistry 2013-2020

General and Overview

1. Describe your program's most significant opportunities and significant challenges.
(Narrative)

- It is an exciting time to be part of a growing university. Recently, UWGB has added majors in mechanical engineering, engineering technology, water science and nursing. The Pandemic is also driving more students to the pre-professional programs and human biology degrees. All of these programs require a basic understanding of chemistry. More students will need to take our lower level chemistry courses. Some of these students will stay on and decide to complete a major in chemistry.
- A successful chemistry department is dependent upon a suite of modern, high quality, and properly maintained instrumentation. In order to continue offering majors that are accredited by the American Chemical Society (ACS) we are required to have a functioning NMR and instruments from at least four of the following five categories: optical molecular spectroscopy, optical atomic spectroscopy, mass spectrometry, chromatography and separations and electrochemistry.

We were recently awarded Lab Mod funds to purchase a new 60 MHz NMR instrument. This size instrument is perfect for our teaching labs and allows us to provide hands on access to our undergraduates. However, it is the lowest quality instrument available and is not research grade. We do not have a high-field, research instrument.

At this time, we are fortunate to have at least one instrument from each of the other categories. We have an IR and UV-vis, which are both relatively new instruments that are run by computers that have modern operating systems. However, all of our other instruments are aging. Although they have been meticulously maintained to this point, most are becoming unreliable and some are completely failing. The ICP-AES seems to work only sporadically now. The GC-MS often will not tune properly and gives extremely noisy data. The potentiostat has aged beyond repair. We do not have a working polarimeter.

The software that controls our old instruments, runs on old drivers that are only supported on Windows 98 or XP. The computers that run our GC-MS, fluorimeter, and potentiostat have all recently died. It is increasingly difficult to find old computers, that are still in working condition, to replace these computers when they fail.

Very limited funds exist for replacement of these major instruments, computer hardware and software programs. Without proper instrumentation in working order,

it is difficult for students to perform advanced projects and it can hamstring scholarly research. We also risk losing our ACS accreditation.

2. What are some things that would help make your program and its students more successful? (Narrative)
 - The Chemistry department believes that reducing class sizes in our introductory courses would make our students and our program more successful. For example, capping lectures at 48 students would allow instructors to better meet each student's needs. Additionally, we see a huge workload discrepancy between the small classes at our Additional Locations and the large sizes of the same courses at the Main campus. A smaller course cap would help balance faculty workload at all locations and allow all faculty to teach by using more high impact practices and provide more time to help individual students.
 - Our students would also benefit from a more integrated peer tutoring and mentoring program. Undergraduates are currently able to earn credit for serving as a TA. This role has been a successful addition to a few of our courses at the TLC. We would like to expand this work to help reach more students. A budget to support these efforts could make the program more successful. It could help us retain more students both to the University and to the Chemistry Department.
 - Within the last several years, math 104 was added as a pre-requisite to Chem 212. This helped improve math performance greatly and our students found more success in completing freshman-level chemistry. However, the merger with the Additional Locations has shown that this pre-requisite specifically, might hinder our students more than it helps them. If students need to take math 104 first, they often must push the freshman-level chem 212 course off to their second year of study. In adding the math 104 pre-requisite, we have limited access to our courses and we may have inadvertently increased time to degree. It is an issue that deserves more attention and data collection. A subcommittee should be formed to review the math prerequisites.
 - The Main campus has a Lab Manager who works to set up most of our undergraduate labs. However, this position does not exist at the Additional Locations. This puts the burden on the faculty to do all purchasing, inventory and waste management. If there isn't enough time for faculty to devote to this, these things become safety issues. This extra responsibility should at a minimum, be counted as part of faculty load.
 - We have ongoing equipment needs. Our instruments are aging and need constant maintenance. (See #1 above.) One faculty member has a 3-credit reassignment to help maintain the instruments on the Main campus. An instrument budget is essential.
3. What are some program accomplishments worth highlighting? (Narrative)

- In fall 2020, we focused our efforts on getting our chemistry majors and minors back in the chemistry lab during the Covid Pandemic. With limited space and severe social distancing restrictions, we were not able to meet in-person for all lab sections. However, nearly all students, at all locations, completed chem 214 (second semester general chemistry lab) in-person or hybrid. All students completed chem 305 (second semester organic chemistry lab) completely in-person. All students completed chem 331 (biochemistry lab) hybrid. All students completed chem 413 (instrumental analysis lab) hybrid. In spring 2021 our efforts will continue. We will also add Chem 311 (analytical chemistry lab) completely in-person. It is critical that we continue to graduate well trained chemists. We are proud that we didn't delay graduation for any student or put any student in a position where they would need to retake a lab course to gain hands on access that any future employer or graduate school would expect.
- We are proud to offer majors that are certified by the American Chemical Society (ACS). This rigorous certification ensures that we provide our students with a standard of education that is recognized worldwide as the best preparation for a career in professional chemistry. In addition, the general chemistry degree we provide for our students is also very strong. All of our students learn to work safely in the laboratory, to design experiments, to operate modern instrumentation, to analyze data and to present results. The majority of all UW-Green Bay Chemistry majors work as research assistants on faculty projects and some complete their own independent projects.
- Additionally, we would like to highlight the merger of the additional locations. The process of combining our faculty into one department was not straightforward or easy. The faculty at the additional locations were forced to make a lot of concessions to their classes and their typical teaching loads. The department still needs to make a more concentrated effort to meet in-person (when safe to do so) to form stronger relationships. However, we are pleased that we now offer our students the same chemistry curriculum, at all locations.

4. Have there been any significant changes that have affected your program? (Narrative)

- The merger with the additional locations has been a very significant change for chemistry. The department combined 10 faculty from the Main Campus (2 lecturers and 8 tenured or tenure-track) with 4 faculty from the Additional Locations of Sheboygan, Manitowoc and Marinette (all tenured or tenure-track). We needed to adopt one curriculum. Fortunately, the basic chemistry courses needed by our majors and minors was the same at all locations. This speaks highly about the stability of our program. However, we adjusted pre-requisites of some courses and we also combined our nursing chemistry courses on the Additional Locations from a 2-semester sequence to a 1-semester course to match the Main campus offerings. This offers students a more straightforward path and shorter time to degree.

However, the combination of the nursing chemistry courses has resulted in chemistry faculty teaching fewer chemistry courses and instead teaching more FYS and general education courses.

- The Covid-19 pandemic has had a huge effect on our program. Over the past year, the department started offering courses online and hybrid for the first time. These changes have made our courses more accessible for our students. Many students have found that they prefer these flexible options. We will need to continue to provide our courses in as many formats as possible.

5. Where do you want your program to be 5 to 7 years from now? (Narrative)

- The chemistry department is able to grow. We have faculty with expertise in each of the 5 basic divisions: organic, inorganic, analytical, physical and biochemistry. We would like to add more emphases to our major to attract more students. In particular, we would like to work with the biology department to add a biochemistry emphasis. We would also like to work with the nutrition faculty and add a food chemistry emphasis. Both proposed emphases would require new courses and additional faculty.

Demand

All data in this area is provided with the materials. (Graduates, majors, minors, etc.) This space is for any commentary you would like to apply to that material. (Narrative)

- Chemistry has proven to be a resilient major. We have seen a slight increase in the number of majors recently. We have enough students to continue offering our upper level courses on a regular basis. Our graduates are well-trained and are successful in gaining admission to graduate and professional programs and in finding employment in the chemistry field.

	2019-20	2018-19	2017-18	2016-17
Number of Chemistry Majors	78	78	71	64

- At the same time, we continue to lose chemistry minors. We are unfortunately finding more and more students take the minimum amount of chemistry needed by their major and are not completing a chemistry minor. Chemistry can still be a daunting subject for students, even for those that have completed our introductory courses. We need to continue to work to help students overcome that stigma. Completing a minor in chemistry can open up many job opportunities for students. Unfortunately, UWGB does not require students to complete a minor for graduation and more students are choosing to graduate without a chemistry minor.

	2019-20	2018-19	2017-18	2016-17
Number of Chemistry Minors	56	53	65	77

Internal

1. Program goals (Mission, vision, learning outcomes; present as narrative/lists)
 - The Department provides a problem focused undergraduate education in chemistry, that promotes critical thinking and student success. Students may start at any of our four locations where we offer all of our required supporting courses: principles of chemistry 1 and 2, principles of physics 1 and 2, calculus and analytical geometry 1 and 2, and organic chemistry 1 and 2. This amounts to 36 out of 57 courses required for a general chemistry major. After completing these courses, students must finish the remainder of the chemistry major at the Main campus.
 - The Chemistry Faculty are productive scholars and are highly involved in CATL programing, community outreach and are engaged with our local section of the American Chemical Society. Our undergraduates are very active in our research laboratories. We collaborate with several local companies that offer internships for our students. We serve “Eco U” with our Environmental Chemistry emphasis.
2. Curriculum development (Lists, brief narrative if appropriate)
 - Recently, chemistry faculty have started teaching first year seminars and gateway to phoenix success courses. We value their importance to the University as a whole and are committed to continue offering them.
 - In spring of 2021, we are offering a sustainability general education course for the first time. It is named, Sustainability Chemistry, Chem 168.
 - We offered organic chemistry in “bootcamp” format at the Main Campus in January 2020 for the first time. This course has been taught in the same format at the Manitowoc location, for many summers. The bootcamp course brings students that are typically not UWGB students to both locations and has had a positive impact on our program.
3. Connections to other programs (Lists, brief narrative if appropriate)
 - Chemistry is a huge service department. Our classes enroll more nursing, human biology and engineering students than chemistry students. This year, we will offer 6 sections of chem 108/109. There are some students who take this course for general education, but the majority are pre-nursing students. This course is not included in the chemistry major or minor. Human biology students fill most seats in our chem 211/213 and 212/214 and our chem 302/304 and 303/305. These are the freshman and sophomore level lecture and lab courses our majors and minors also take.

- Chemistry faculty also consistently teach courses in other programs such as: engineering, engineering technology, math, environmental science, human biology and nutritional sciences. We also teach FYS and GPS courses and in graduate programs including the Master's in Environmental Science and Policy and the Master's in Biotechnology.
4. Number of courses offered (Overall number provided in materials. Chairs: short commentary if appropriate. Provide a sub-grouping of various modalities by percentage. For example, what percentage of your program is available online, hybrid, etc.?)
- This is a difficult question to answer, this year. Previous to the pandemic, our courses were taught 100% in-person, with the only exception being a 1-credit online Lab Safety course. The pandemic caused an immediate shift to 100% online courses. This year, 2020-2021, we focused on getting our students back in lab, either in-person or hybrid. However, we didn't have enough lab space or equipment with the social distancing rules in place to offer the option to all of our students. Surprisingly, we have found that more students prefer the online options, even for lab. This will be interesting to monitor when the pandemic is over. In addition to wanting as much face-to-face instruction to return as possible, chemistry faculty will continue to offer a robust online curriculum.
5. Diversity of students, faculty, and curriculum (Overall number provided in materials. Chairs: short commentary if appropriate; provide examples from curriculum if appropriate.)
- The department fosters a diverse community and works hard to create an environment of inclusivity. More than half of our chemistry majors are female. About a third of our majors are first generation. However, we unfortunately continue to graduate very few or no students of color in chemistry. A targeted peer-mentoring program might help.
 - The chemistry faculty strive to meet the needs of our students through high-impact practices and pedagogies, including undergraduate research, POGIL, peer mentors, internships, community outreach and service learning projects. Additionally, the department will continue to offer more online courses into the future to provide access for more students.
6. Gen Ed, FYS/GPS, CCIHS (Lists)
- First year Seminar
 - Chem 198
 - Chemistry and Society
 - The Genomic World: Exploring DNA, Genes & Heredity
 - Scientific Literacy and Recognizing Pseudoscience

- Solving Mysteries Through Chemistry
 - Understanding Pseudoscience
- GPS Seminar
 - Comm Sci 146
- Gen Ed: Natural Science
 - Chem 108
 - Chem 211
 - Chem 212
- Gen Ed: Quantitative Literacy
 - Chem 211
 - Chem 212
- Gen Ed: Sustainability
 - Chem 168
- CHISS
 - Chem 211/Chem 213
 - Kristal Boyer: Elmwood High School
 - Julie Hahm: Greendale High School
 - Tom Heier: Howard's Groove High School
 - Cheryl McCann Niles: Pewaukee High School
 - Jen Owen: Kiel High School
 - Tina Porath: Oconto High School
 - Julie Retza: Crivitz High School
 - Seth Rueter: Seymour High School
 - Pamela Salm: Sheboygan Falls High School
 - John Sebranek: Green Bay Southwest
 - Chem 212/214
 - Tom Heier: Howard's Groove High School
 - Jen Owen: Kiel High School

7. Program support and staffing (Chairs: History, trends, and future needs. Depending on program, could be connected to accreditation.)

- Currently, the chemistry department is well staffed. We have faculty with expertise in all 5 major categories of chemistry including: organic, inorganic, analytical, physical and biochemistry. We also have a nutritional biochemist. We have 12 tenured or tenure-track faculty members and 2 fulltime lecturers. Both the merger and the recent addition of this second lecturer position have helped to eliminate the need for ad-hoc instructors. The department would like to expand by offering a biochemistry emphasis and a food chemistry emphasis. In this case, we would need additional faculty.

8. Cost per credit hour (TBD)

External

1. Outreach: student/faculty partnerships, collaborations, participation with organizations or individually (Lists)
 - The chemistry faculty are very involved in the ACS professional organization. Most are members of the National organization. Some members have attended and presented at Regional meetings. Mike Zorn served as the 2018 Chair of the NEW local ACS section.
 - Faculty attend the yearly UW Chem Faculties Meeting. This is a rotating meeting that is hosted by a different UW System campus each fall. Green Bay is due to be the next host. A substantial amount of work will go into planning for this event.
 - The Chemistry Department is actively engaged in many outreach programs and activities. Chemistry faculty often travel to local schools and libraries to give chemistry demonstration shows. The Cool Chemistry Show, developed by Amy Kabrhel, at the Manitowoc and Sheboygan campuses has become the most popular, by far. Chemistry students perform the demonstrations and the instructors serve as the emcees. Some additional examples of outreach include:
 - Volunteering with the Einstein Project
 - Assisting with the Green Bay High School Academic Competition
 - Mentoring of high school chemistry teachers
 - Giving guest lectures, keynote speeches and research talks
 - Leading field trips to chemical companies
 - Assisting with Phuture Phoenix Week
 - Volunteering during Sophomore Day
 - Volunteering with Majors fair
 - Offering help with Campus preview days
2. Contributions to regional infrastructure (Lists)
 - We have developed a strong collaboration with Millipore Sigma, a chemical company with a plant in Sheboygan Falls, WI. Faculty, members of career services and students were invited to tour the company. We then hosted leaders of the company at UWGB. An alumnus is now a member of the Millipore Sigma leadership team. He returns to campus yearly to speak to many chemistry classes. He helps educate students on the interview process and what it is like to work in the chemical industry. He also recruits students to internships and permanent positions within the company. In summer 2020, Millipore sigma donated more than \$400,000 of equipment and glassware to the College of Science, Engineering and Technology. The Chemistry Department plans to expand our relationship with Millipore Sigma by working together to develop problem-based learning experiences for students in our laboratory courses. We are also excited about the possibility of Millipore Sigma providing us with some research opportunities. However, we are still establishing what those

might look like.

3. Scholarly activity of faculty (Lists that are not all-inclusive; maybe seek to highlight the different areas/types of activity)

The department has very talented and productive scholars and teachers.

- The faculty boast impressive research achievements. Many members have been successful at integrating our undergraduates in bench top research projects, much of which has been successfully published in top journals. During the review period Chemistry faculty have published more than 32 research articles in scholarly journals and have been awarded 2 patents. Impressively, Mandeep Bakshi has published 10 of these papers himself, all in ACS journals.
- The Department continues actively soliciting extramural funds for the support of undergraduate research in chemistry and graduate research in environmental science. The department is also active in the use of Classroom and Laboratory Modernization funds and one-time funds to address the ongoing need to maintain laboratories and instruments. Some additional examples of funding sources include the Kay Levin foundation, Sandmire Grants, the Medial College of Wisconsin, University of Michigan Water Center, UW Sea Grant and WiSys Prototype Development Fund. In total, during the review period, chemists have been awarded over \$1.2 million in grants. Mike Zorn is the department's top grant writer, having been awarded over \$745,000 in grant money.
- Chemistry faculty actively participate in Teaching Scholars, CATL training courses and the Instructional Development Institute. Faculty have been recognized for outstanding teaching through UWGB Student Nominated Teaching Awards. During the review period, chemistry faculty were awarded \$2,000 in teaching enhancement grants. In 2016, Julie Wondergem was awarded the Experienced Teacher SNTA. In 2019, James Kabrhel was awarded the Underkofler Excellence in Teaching Award. In 2020, a course designed in part by Kiel Nikolakakis for the masters in Biotechnology program, won a distinguished course award from the Association for Distance Education for Independent Learning.

Student Success

1. High-impact practices and individualized-learning opportunities (Some data provided; lists and/or brief narrative)

- Collaborative Assignments and Projects. Students are encouraged to work with a lab partner in our undergraduate teaching laboratories. Partner work allows students to develop both listening and leadership skills. It is essential that they learn how to collaborate on lab procedures to obtain data and write reports.

- Undergraduate Research. We strive to get our chemistry majors in a faculty research lab as early in their career as possible. By the time students graduate, most have spent at least one semester conducting faculty-lead research.
 - Community-Engaged Learning. Chemistry faculty and students are very involved in the Phuture Phoenix program. Phuture phoenix targets 5th grade students from disadvantage backgrounds in communities in and around Green Bay. We bring them into the chemistry labs and show them that science is fun and exciting. We try to inspire them to start thinking about a future that includes a college education and science.
 - Capstone Courses: The chemistry capstone class is Instrumental Analysis. In this class students gain hands on access to instruments and practice analysis of data. They use the instruments to solve unknowns and present their data in either a research paper or poster presentation.
2. Retention (TBD. Note: if program-level data is not provided, maybe list some things your program does that you believe aid in retention.)
- Undergraduate research is a cornerstone of the chemistry department. It transforms the college experience into a richer more involved academic process for students. Through the close mentorship of professors, undergraduate research fosters independent thinking and complements coursework in ways that lead to success after graduation. During the period of the review, chemistry faculty have provided 123 credits of undergraduate research.
 - We are able to provide some students with direct experience in an industry setting at local companies. Some students complete internship work for payment, while others earn credit. During the review period, chemistry faculty served as mentors for students who earned 7 internship credits. Some established internships available to our students include:
 - Millipore Sigma, Sheboygan
 - Ahlstrom-Munksjö, De Pere
 - Nature's way, Green Bay
 - Schreiber, Green Bay
 - HMI, Manitowoc
 - Pro Solutions, Green Bay
 - Some chemistry faculty like to have undergraduate students work in their courses as teaching assistants or peer mentors. An undergraduate TA is a student who performed really well in a previous semester's course. They often hold study sessions for the new students. Some TAs receive payment and others work for credit. During the period of the review, chemistry faculty have generated 26 credits of TA experience.

- Faculty serve as advisors to a variety of undergraduate student organizations. Some include:
 - Chemistry Club
 - Phi Theta Kappa (PTK) Honor Society for Two-Year Universities
 - Pre-Nursing students
 - Pre-Health Club
 - Pre-Pharmacy Club
 - Phi Kappa Phi

Mission Relevant

1. Relevance to mission (Narrative or lists as appropriate)

- The mission of the Chemistry program at UWGB is to provide students with a solid understanding of chemical principles, hands on use of modern instrumentation, experience in experimental design, and the ability to analyze data and present results. We offer a problem focused undergraduate education, that promotes critical thinking and student success. Students may start at any of our four locations where we offer all of our required supporting courses: principles of chemistry 1 and 2, principles of physics 1 and 2, calculus and analytical geometry 1 and 2, and organic chemistry 1 and 2. Students then finish their Bachelor's degree at the main campus and select one of our 3 options: General Chemistry Major, ACS approved Chemistry Major and the ACS approved Environmental Chemistry Major.

2. Cultural enrichment (Narrative or lists as appropriate)

- One of the most thrilling things for an instructor, is to welcome back alumni to our classrooms. Every semester, our former students ask to come back and make presentations to our current students to tell them about their experiences in pharmacy school, chemistry graduate school, and in chemical industry. Chemistry is a very employable major. We feel it is very important for our current students to learn about as many opportunities that exist as possible. We also host recruiters, both from industry and academia and take students on field trips to local companies. Some examples from fall 2019 include:
 - Classroom presentations
 - Chemistry graduate school, Concordia University – Savannah Saldana
 - Chemistry graduate school, Cornell University – Erin Stache
 - Pharmacy School, UW Madison -- Jess Linderud
 - Chemical Industry, Millipore Sigma – Eric Tiegs
 - Chemistry Recruiter, Aerotek -- Apeksha Lakshmi Koka
 - Pharmacy Recruiter, UW Madison, Lindsey DeCarlo
 - Field Trips
 - Millipore Sigma
 - Chem Design

3. Access (Does the program have any agreements with other institutions? For example, a transfer agreement with a technical college.)
- We have an articulation agreement with NWTC's Laboratory Science Technology Associate Degree. Students complete 67 credits of chemistry, math, physics and some additional general education courses at NWTC which transfer to UWGB.
 - We are engaged in the HHMI Inclusive Excellence "Access to Success" project, that is aiming to increase the number and diversity of students who transfer from Wisconsin Technical Colleges System (WTCS) Liberal Arts Transfer (LAT) programs to UW System institutions and graduate with their B.S. degree in science, technology, engineering, or mathematics (STEM).
 - We have a BACHELORS/ PHARMD dual degree partnership with Concordia University. Although this degree leads specifically to a UWGB major in Human Biology, if students take Analytical Chemistry as their upper-level elective course, they will also earn a UWGB minor in chemistry.