Instructional Program Review
American River College
2015 - 2016

Instructional Area: Instruction - C (Lawrenson)

Department: Science

Discipline: Chemistry

Submitted: Friday, March 4, 2016

Mission Statement

Over the last six years, please describe how your program has supported the College's mission as shown above.

Over the last 6 years, the Chemistry Department at American River College has served the greater Sacramento region by providing a range of chemistry courses that are designed to: (1) satisfy the requirements for advancement in career and technical education programs such as Allied Health and Funeral Services, (2) prepare students for transfer to 4-year colleges such as those in the CSU and UC systems, (3) teach and encourage college-level study strategies that will help students succeed in all their current and future college classes, (4) expand students' scientific literacy and instill a lifelong interest in, and respect for science and technology. The Department has also helped organize and support several scientific student clubs (AMSA ARC, Chemistry Club, Research Club) that provide opportunities for interaction with like-minded students, personal enrichment, self-development, and career-development in a fun, relaxed environment.
The Chemistry Department is proud of the high standard of chemical education it has provided over the last 6 years. This level of excellence has been achieved by a dedicated faculty and staff using course materials that are contemporary and reflect the current knowledge and research in chemistry, and by providing opportunities for students to work with modern, high quality chemical instrumentation. In doing so, the Department has helped students towards career and academic goals that will ultimately lead many of them into the well-educated workforce that is the future of the Sacramento region. Furthermore, chemistry classes teach students the importance of scientific rigor, and promote critical thinking skills that will create a more scientifically literate population, better able to evaluate the global environmental and technological challenges of the future.

Stated Outcomes and Recommendations from Previous Program Reviews

Recommendation from Previous Program Review Report

Were the previous program review outcomes, addressing **strenghts**, achieved and how did these outcomes improve student learning?

 ACS 2-year Objectives: Incorporate recommendations from American Chemical Society's 2-year college assessment report (12/23/14) to explore building partnerships with local industry and academic institutions.

Chemistry Department faculty (full-time and adjunct) and staff have formed and continued partnerships with local schools and colleges; Chemistry summer camp for local elementary school children, Regional Science Olympiad for middle/high school students, college classes taught at Encina High School and Inderkum High School, PACE summer program for local high school students, "Steps for Success" event to introduce high school seniors to ARC, Professional Development program in the MASE center at CSUS Sacramento, GAANN program to train graduate students in teaching pedagogy in collaboration with UC Davis. Chemistry faculty are also part of the Science Area Associates group that has forged partnerships with industry, and an adjunct faculty member is currently working with Lawrence Livermore and Novartis to incorporate 3-D modeling into the Chemistry curriculum.

 Basic Skills Modules: Review modules developed to help prepare students for courses.

Chemistry Department faculty have developed and run an orientation for incoming students (a "boot camp" that is currently available online) and a nomenclature workshop, as well as creating subject specific basic review packets for incoming students in Chem 400, Chem 306, and Chem 310, an adaptive test for Chem 400 student self-assessment, and a computer game that helps incoming students review basic skills.

 Cultural Competency: To increase our awareness of the diversity of the students and staff.

Chemistry Department faculty have attended STEM conferences focusing on under-represented groups, a Faculty Diversity Workshop through UC Riverside, and are part of the AAISSE program that supports and mentors African American students in the sciences. Many faculty have attended the "Hiring the Best" training course run by the district to promote the hiring of a diverse faculty, and also had additional training to become equity officers for hiring committees college-wide.

 Demolition/Rebuild of Chemistry Building: Replacing the existing chemistry building that is unable to handle our current student population, current technology, and is not aligned with current American Chemical Society's guidelines.

No progress has been made on this outcome.

 Department Faculty Handbook: Revise Chemistry Department Handbook

A specific Department Faculty Handbook is no longer required; there has been no need since the creation of a college-wide new faculty training program.

 Environmentally Friendly Experiments: Environmentally friendly experiments are in place and being put into place to reduce hazardous waste.

All lab courses are reviewed annually and changes are made, where possible, to reduce the quantity of chemicals used and to replace chemicals with lower environmental impact alternatives.

 Lab Equip/Supply Data Base: A current database of laboratory experiment requirements for courses offered that can be used for ordering supplies (reagents, chemicals, etc.), analysis of cost per student (or section), and quantifying waste streams. This is continually updated by the Chemistry Department technical staff.

A lab equipment and supply database has been created and is updated annually.

 Lecture and Lab Objectives: The department members will review all course objectives including laboratory objectives and develop student learning outcomes and SLO assessment for each course and each course series.

Within the last six years, the SLOs for every chemistry course have been reviewed and improved (as necessary) as each course was taken through curriculum. Authentic assessment of all SLOs has occurred on a three year cycle through the regular college SLO assessment process.

 Outreach: Annual participation in on-campus and off-campus community activities to increase community awareness of department (e.g. welcome day, ACS speaker, Early College High School, and green presentations)

Chemistry Department faculty and staff have organized and participated in many outreach activities including: Regional Science Olympiad for middle/high school students, Chemistry Club demonstration at “Haunted Halloween Fest”, a visit, lecture, and Q&A with Nobel Laureate Carol Greider, “Chemists Who Cook” fundraiser, “Demo Days” presentation, Department presentations on Welcome Day, STEM tutoring at a local parish for 7 - 15 year olds, PACE summer program for local high school students, “Steps for Success” event to introduce high school seniors to ARC.

 Publicity: Update department website and create a Facebook page to increase community awareness of department

The Department website is up and running within the official Los Rios District website. The information on the website is updated every semester. There is currently no Chemistry Department Facebook page.

 Student Access to SLOs: Facilitate student access to SLOs on-line and link pre-req SLOs (incoming students may be informed of what is expected of them in a given course). Add all course SLOs to dept website with links to review modules.

All faculty post their syllabuses, containing class SLOs, on D2L where they are easily accessible to all students. All SLOs are also posted on the Chemistry Department website, where they are accessible to everyone, including incoming students. There are currently no links to review modules on the website.

 Student SLO Alignment: Course and program level alignment with recommendations from nationally recognized science communities (such as ACS)

The program level SLOs are aligned with objectives proposed in the ACS 2 year college guidelines. Course level SLOs are aligned with course curricula, which are themselves aligned with lower division textbook content, common to all undergraduate institutions.

 Update/Replacement of Safety-Related Equipment: Up-to-date safety-related items or replacement of

equipment, e.g. replace explosive-proof refrigerators for hazardous chemical storage, solvent shed, etc.)as needed.

The following safety-related equipment has been purchased; an explosion-proof fridge/freezer; improved broken glassware containers for all labs; 10 mL and 50 mL EMD polyfix dispensors, used to dispense chemicals while keeping excess waste generation to a minimum - this increases student safety since reagent exposure is minimized; a demonstration cart with a safety shield that allows instructors to perform demonstrations with added safety; new soap dispensers for all labs. Additionally, metal stockroom shelves can corrode after long-term exposure to chemicals, creating a serious hazard, so these have all been replaced by wooden shelves, and the leaking roof above the instrument room has been fixed, as the water was creating a slipping hazard along with a potential electrical hazard. A safety supervisor has also been hired to help oversee all aspects of safety in the stockroom and classrooms.

Were the previous program review outcomes, addressing **challenges**, achieved and how did these outcomes improve student learning?

 A long term strategic plan: Development of a long term, strategic plan for our department that can accommodate growth and access for a diverse student population.

The educational master plan (EMP) serves as our long term strategic plan. This living document is updated annually and addresses all the Department's current and future needs.

 Adequate Faculty Staffing: An appropriate number of full-time faculty members.

In the last six years, the Department has lost two full-time faculty members to retirement and has hired two new full-time faculty. There has been no significant change in the number of Chemistry students during this period, so the one-for-one replacement of retired faculty has been sufficient.

 Chem. 311: Chem. 311 (discussion sections), specifically for core courses such as 305, 309, 400, and 420.

The Department has offered Chem 311 discussion sections supporting students in Chem 305, 306, 309, 310, 400, and 401 during the last six years. Although none were offered from 2010 – 2015 due to budgetry limitations, Chem 311 classes supporting students in Chem 305, 309, 310, and 400 are currently in session.

 Chem/Equipment Storage: Optimized/increased storage for chemicals and equipment.

A reorganization of the Chemistry stockroom has created additional storage space and made the lab demo equipment more accessible. The chemicals in the Chemistry stockroom are now organized using the Flinn method (which reduces chemical hazards by keeping apart chemicals that could react with each other), and are now more easily accessible due to an improved labelling scheme. The metal shelves in the Chemistry stockroom have been replaced with wooden shelves that are bolted to the floor. Wooden shelves are not susceptible to corrosion and bolted shelves cannot be knocked over. Large lockable cabinets have been installed in all lab rooms for the storage of chemicals and supplies relating to specific classes. Small, lockable cabinets have also been installed in all lab room for the safe separation and storage of concentrated acids and bases. A bigger Dewar vessel has been purchased for the safe storage of larger quantities of liquid nitrogen.

 Community Based Courses: Obtain FTE for regional specific courses, such as "green chemistry" or "solar energy". Wherever possible, integrate regional specific content into current courses.

No progress has been made on this outcome due to budgetary constraints.

 Conference and workshop attendance: Maintain currency in discipline and pedagogy consistent with ACS Guidelines for Two Year Colleges

Chemistry Department faculty have attended, organized, and presented at numerous conferences and workshops, including; Google "Innovate" Conference at ARC, "College - Making it Happen" seminar at CSUS, STEM Reading Apprenticeship, American Association of Schools and Colleges workshops, 1st Annual California Statewide Reading Apprenticeship conference, Threshold Concepts workshops, Faculty Diversity Workshop/Group through UC Riverside, Strengthening Student Success conference, Chemistry in Context 8th Edition workshop through ACS, STEM Solutions conference, UC Davis R.B. Miller symposium (organic chemistry), ACS symposium at UC Davis; "The Chemistry of Wine, Cheese, and Olive Oil", Chemical Education

Conference, Contextualized Teaching and Learning seminar, ARC Divisional Convocation meetings.

 Cross-Disciplinary Collaboration: Cross-disciplinary alignment of the chemistry curriculum with biology, earth science, physics, engineering and allied health curricula.

The Chemistry Department has met with the Math Department to discuss the alignment of basic-skills math classes with Chem 305, 310, and 400. Meetings with members of the Biology Department have ensured alignment of the new Chem 309 class with Anatomy and Physiology, and Microbiology. Input was gathered from teachers at many UCs and CSUs throughout the state to inform the overhaul of the Chem 310 curriculum. Chemistry faculty from across the District met to discuss alignment and consistency of Chemistry classes throughout the District. There is also frequent dialogue within the Chemistry Department to ensure alignment between all sequential classes (e.g. Chem 310 to Chem 400, Chem 420 to Chem 421).

 Currency of instructional technologies: Update classroom/lab instructional technologies (including computer applications such as molecular modeling software) to stay current with pedagogical advances.

To keep our instrumentation and instructional technologies aligned with 4 year institutions so that our students are not disadvantaged when they transfer, we have purchased an FT-IR spectrometer, a GC mass spectrometer, a UV-Vis spectrometer, Organic Chemistry NMR simulator software, 3 ELMO document cameras, a new InFocus projection system, portable InFocus projectors, 2 laptops, and several ipads. The new classrooms in the Fine Arts/Science building also have smart podiums.

 Equipment Maintenance, Repair and Replacement: An up-to-date inventory of all instructional equipment, including computers (laptop and desktop) for maintenance, repair, and adequate availability. The replacement of outdated equipment to reflect current standards (academic, research, industry, etc.)

The following replacement items were purchased: GowMac Gas Chromatograph Series 400, the latest version of a network printer for the chemistry hall way computer lab, 14 GLX data acquisition devices with pH probes, conductivity probes, and temperature probes, 6 organic mel-temp melting point apparatuses, 4 new balances, 3 Microlab FS-522 instruments, updated Microlab software, and 30 hotplates. In addition, the old, squeaky, unstable stools in some of the labs have been replaced. The NMR spectrometer has also been repaired and upgraded.

 Evening/Weekend Courses: Introduce additional evening/weekend courses upon expansion of additional lecture/lab facilities and campus support hours. Additional FTE is required to expand our course offerings.

Although we have been given additional FTE to replace the FTE lost during the low budget years, we do not have adequate lecture space or funding for extended stockroom support to offer these additional lectures at times favorable to student demand (evenings and weekend).

 Expand Course Offering: Expand all course offerings as FTE becomes available including the introduction of hybrid-online, hybrid-site, and off-site course option for current chemistry courses.

Over the last several years, the Chemistry Department's section offerings have increased, with the average section enrollment being amongst the highest in the college. We have added extra sections of Chem 310, 400, 401, and 420 to satisfy the larger demand for these classes. We also now offer a Chem 310 class off-site at Inderkum High School.

 Facilities: Obtain a new facilities that would accommodate new hires, changes in staffing, growing student population, additional course offerings, science student support services, and other departmental needs.

Two new classrooms have been built (Fine Arts/Science) to replace the two portable classrooms that were removed, but no additional lab or classroom space has been obtained.

 IA Help: More help in labs (IAs) and in study sessions. Help with grading student assessments.

A second, part-time, temporary IA has been hired (110 day maximum contract) to assist with setting up and running the labs, and running tutorial sessions. The Department now has four IA-led open-study sessions for students each week during the semester. Grading assignments does not fall within the remit of the IAs.

 Increase Technology Support: Improve WiFi access for all classrooms and laboratories.

The WiFi access has improved markedly in the main Chemistry lecture hall (room 420), but remains patchy throughout the Chemistry building.

 New Instructional/LRC Facilty: Additional facilities adjacent to current chemistry building to include lecture, wet lab, computer lab, LRC, storage, and faculty office space.

No progress has been made in getting a new Chemistry facility.

 Remodel of Room 420: Room 420 is our largest lecture hall and can accommodate up to three lab sections. However, it is antiquated and completely inadequate by today's standards. Over the last year some architectural aspects have been completed, but it still needs to be modernized in technological aspects.

Room 420 has been remodeled: the seats have all been renovated, the whiteboard has been modernized, extended, and brought closer to the students, a storage room has been added, the screen has been replaced and the bench/sink area has been refinished. Although the room has been improved, issues still remain with the projectors, which are incapable of accommodating the latest technology and are prone to failure.

 Science Skills Center program expansion: Increased funding of the Science Skills Center to provide appointments later in the day as well as more appointment availability during the daytime.

There has been no additional funding for the Science Skills Center.

 Science Student Support Services: Increase student access to instructional hours and support services (IAs, beacon, online, LRC, etc.)

Most Chemistry classes have at least one Beacon tutor available to students, and four open-study sessions run by IAs are offered in the Chemistry building each week. We are also currently offering Chem 311 discussion sections that serve students in Chem 305, 309, 310, and 400.

 Standards: Establish and maintain clear and concise standards by which pre-requisite courses are evaluated to ensure readiness/preparation of our incoming students with respect to literacy, content knowledge, and discipline-rigor.

No standards have been established to evaluate prerequisite courses outside of the Chemistry Department, but efforts are ongoing to help the Counseling Department in the appropriate placement of students. Within the Department, efforts have been made to ensure that the Chem 310 class effectively prepares students for Chem 400, and the data show that there has been a marked increase in the success of Chem 310 students in Chem 400 of the past six years. Although not a prerequisite class, the Chem 400 assessment test has also been evaluated for its effectiveness in assessing incoming students’ readiness to take Chem 400. A five-member panel of Chemistry faculty considered the relevance of each question in the assessment test, and decided that no more than half of the 44 questions effectively assess a student’s level of preparation. Ongoing data collection comparing assessment test scores to success in Chem 400 also suggests that the test does not provide an accurate and reliable measure of a student’s preparedness.

 Student Access to Computers: More computers within the Chemistry Department for students to support laboratory data analysis and student research.

The number of computers available to students within the Chemistry Department has not changed, but those in the Chemistry computer lab in the hallway of the Chemistry building have been updated. Students no longer require a special card to use the computers, making them more student-accessible. The computer lab area has also been reconfigured to bring emergency escape routes up to code.

 Student Study Groups: Dedicated areas available for student study groups within the science complex.

It has not been possible to provide students with dedicated study areas within the Science complex due to the large number of classes being offered in a limited space. This is unlikely to change until the Department moves to a new Chemistry/Science building.

 Technical Staffing: 1 instructional assistant for every 4 faculty as stated in the American Chemical Society guidelines

We have recently hired a second part-time instructional assistant (IA) and now have an improved ratio of 1 full-time IA for every 12 full-time equivalent faculty (previously closer to 1:20). The additional help

in labs, in lab preparation, and in tutoring that this provides will enhance student learning, although this could still be improved.

 Tutoring: Additional tutoring opportunities for chemistry students through the Instructional Assistants, Beacon, Science Skills Center, and the LRC

Most Chemistry classes have at least one Beacon tutor available to students, and four IA open-study sessions are offered in the Chemistry building each week. Chemistry students are routinely referred to the Science Skills Center and the LRC, and several Chem 311 discussion sections are currently being offered. Additionally, students can register at the LRC for the "Tutoring.com" website that offers 24/7 online tutoring.

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Analysis of Data: A 6 Year Reflection

Student Enrollments and Characteristics

After each data set below, provide a narrative reflection about the significance of the data for the program for the past five years.

Includes the following sections:

- Using the course enrollment and demographic profile. Are there any data that are significantly different then the college? If yes, can you explain why there is a difference?

  Overall, the student population of the college declined steadily during the period from 2010/11 to 2014/15. The total decline was 17% over the five year period. In contrast, the Chemistry Department student population suffered a 10% reduction in 2011/12, but recovered steadily over the next three years to regain the 2010/11 population level by 2014/15. Prior to the 5-year period represented by the data, the Chemistry Department had already cut most of its non-core classes. During the economic downturn, we therefore had to cut some sections of our core classes, which were later reinstated as the economic situation improved. It is possible that some other departments had more non-core classes than Chemistry, and that cutting these classes throughout the 5 year period, lead to the overall downward trend.
  The success rate of ARC college students (including those in Chemistry) didn't change significantly from 2010/11 to 2014/15. The college wide success rate was about 71%, whereas Chemistry had a slightly lower success rate of about 65%. Within our department, the success rate is always lower for Chem 400, the first chemistry class taken by many science majors. This classes need to be rigorous and challenging to adequately prepare students for future science classes. Consequently, the success rate is relatively low and this class accounts for almost 20% of chemistry students, bringing down the department average. The lower success rate is likely due to the wide range of abilities, preparation, and study skills of students taking this challenging class, and the failure of the Chem 400 assessment process to appropriately place incoming students.
  Assessing changes in the student population by ethnicity presents several problems, the biggest being the changing definitions of ethnicity in recent years. This is illustrated by the large decrease in the "unknown" and "other non-white" categories (over 6000 students college-wide), and the increase in the "multi-race" category, probably due to a change in the way these students self-identify. It is impossible to say how this might have affected the other categories, which makes it difficult to assess the actual pattern of population change by ethnicity. Another issue is the data themselves, which show the percent changes in each ethnic group over the five year period, without considering the overall reduction in student numbers. For example, the number of African-American students at ARC has fallen by 4.89% in the last 5 years, but this is because the overall number of students is lower. In fact the percentage of the student body that is African-American has actually increased by 1.26 % during that time, from 8.89 % to 10.15 % (although some, or all of this growth could be due to the change in self-identification noted above).
  Consequently, the change in the percentage of the college student body that identifies as each ethnicity should be compared with the same change for students within the Chemistry Department. These changes are as follows; African-American (College +1.26, Chemistry -0.45), Asian (College +1.85, Chemistry +0.32), Filipino (College +0.30, Chemistry +1.05), Hispanic/Latino (College +3.70, Chemistry +4.54), Multi-Race (College +1.63, Chemistry +1.62), Native American (College -0.03 %, Chemistry -0.08 %), Other Non-White (College -0.67 %, Chemistry -0.89 %), Pacific Islander (College +0.04 %, Chemistry -0.16 %), Unknown (College -10.39 %, Chemistry -8.07 %), White (College +2.39 %, Chemistry +2.39 %). When compared in this way, the changes in the Chemistry student population by ethnicity closely mirror those of the college. It should be noted, however, that relative to the overall college population, African-American students are underrepresented and Asian students are overrepresented in Chemistry; the data above simply show that the disparity has remained about the same during the last 5 years. As noted above, the success rate for all students is lower in Chemistry than throughout the college, so it is not surprising that individual ethnic groups also have lower success rates. There is quite a large variation from year to year, making any trends difficult to assess, but there doesn't appear to have been any significant changes over the 5 year period, and comparing the average success rates of students in Chemistry with ARC college students overall, no ethnic group performs significantly better or worse than the others.
  Applying the same analysis as above to the data regarding gender population; Female (College +0.14 %, Chemistry -3.35 %), Male (College -1.24 %, Chemistry +2.10 %). Here there does appear to be a difference between the college trend and the trend within Chemistry; more male students are taking

Chemistry classes than expected from the change in the college population. This is likely to be due to the slight reduction in pre-nursing classes (Chem 305, Chem 306, Chem 309) during the last 5 years. Since the majority of students taking these classes are female, their reduction would be expected to shift the gender balance within the department as observed. As with the success rates of different ethnic groups, the success rates of female and male students are lower in Chemistry than the general ARC student population, but again, the reduction is not significantly different for either gender.
Applying the same analysis as above to the data regarding age population, the Chemistry Department has had a slight increase in students in the 18-24 range relative to the general ARC population, and a slight decrease in students in the 25 – 39 range. This could also be related to the slight reduction in the number of pre-nursing classes taught in the department, as these classes tend to have more students in the 25-39 age range than classes in the core chemistry sequence. Again, we see that all success rates in Chemistry are lower than those of the general ARC population, but the differences are similar for all age groups below 40. However, there does seem to be a more significant difference for students age 40 and over; their success rate in Chemistry is significantly lower relative to the general ARC population. The relatively small numbers of students in these categories make any conclusions less clear, but it could be that many of these students have been out of academia for a long time and may have difficulties adjusting to the highly challenging nature of chemistry classes, especially the time required outside the classroom. In contrast, within the general ARC population, students 40 years and older succeed at a higher rate than younger students. This might reflect the choices of classes taken by older students; general interest classes rather than classes taken as part of a rigorous major.
Applying the same analysis as above to the data regarding class time population, the Chemistry Department has increased its afternoon and evening classes, and decreased its morning classes relative to ARC as a whole. Success data for both ARC and the Chemistry Department show no significant difference between students taking morning, afternoon, or evening classes. As discussed above, the Chemistry success rates are lower than those of the general ARC population.

- Does the difference affect the program, planning and/or student success?

  The only significant differences between Chemistry and the general ARC population are that the success rate is lower for all Chemistry students (and by about the same amount for all ethnicities, genders and ages), and students aged 40+ have a much lower success rate relative to the general ARC population. Both of these differences obviously affect student success, and as such affect our program, in that we want students to be more successful, and constantly work and plan to make that happen.

- What, if anything, can you do to address these differences?

  The two major differences are; (i) Chemistry has a low success rate in the entry-level science major class, Chem 400, and (ii) students aged 40+ perform worse than expected in chemistry classes. We believe that the root cause of the low success rate in Chem 400 is the inappropriate placement of students into this class. Consequently, we have been gathering data and working to improve the assessment process over the last few years. This effort was sadly undermined by the death of Jim Barr, who was working with us to evaluate the process and make the necessary changes. We have also had discussions with Chemistry faculty from our sister colleges within the Los Rios District in an attempt to clarify and standardize the assessment procedure from college to college. We hope to complete our overhaul of the process within the coming Program Review cycle.
  The lower success rate of older students may be linked to the fact that these students are more likely to study part-time and have families. It is possible that they are not becoming as familiar with the campus and its many resources as full-time students with fewer outside responsibilities, so it might be helpful in the future to make more efforts to connect older students with resources on campus such as MESA and the LRC, as well as student clubs.

Student Learning Reflection

Curriculum

For all programs with degree and certificates: How well do your courses support the program student learning outcomes? How do you know?

The Chemistry Department does not currently have any degrees or certificates.

Are students able to complete the courses required for your degrees and/or program in a "normal" timeframe?

The Chemistry Department does not currently have any degrees or certificates.

Explain major additions, changes, or deletions to the program's curriculum over the last six years.

Any remaining classes that were not part of the core Chemistry program were cut during the reduced budget years. The only remaining classes are required for science majors and students in the Allied Health fields.

Have all course and program outlines been updated within the last 6 years? Yes

Information Literacy

Information literacy is a college-wide goal. Using the checklist below, how do your courses help students learn to recognize when information is needed and give students the ability to locate, evaluate, and effectively use the needed information? Choose all that apply.

- [x] Lecture, in-class discussions, or activities
- [x] Research-based assignments
- [ ] Research workshop(s), led by a librarian or other research specialist
- [ ] Online library research guide or instructional video tutorials
- [ ] Individual guidance from a librarian or the instructor
- [x] Assigned readings or other course materials

Other

- [ ] Does not apply

List the courses in your discipline that include the components identified above.
(example: ENGWR 300, STAT 300)

Chem 305
Chem 306
Chem 309
Chem 310
Chem 311
Chem 400
Chem 401
Chem 420
Chem 421
Chem 423
Chem 495

If the questions above do not pertain to your discipline, please explain why your discipline does not include components of information literacy in your program.

This question is for English, ESL, and Business only (i.e. departments fulfilling ARC General Education Requirement II-A, CSU GE Pattern A-2, and IGETC Pattern A-1). How are information literacy skills evaluated in your program?

Student Success

After each data set provide a narrative reflection about the significance of the data for its programs for the past five years.

Provide a short, written reflection for the following sections:

- Course sequence and scheduling: How effective are course scheduling, offerings, and sequence in students completing their educational goal? How do you know?

  The creation of the Chemistry course schedule involves collaboration with schedulers in Physics, Biology, and Math to ensure that students can take all necessary classes with minimal time conflicts. Successful completion of the 2-year chemistry sequence is the main educational goal of Chemistry majors, prior to transfer. Success in Chem 421 is therefore a good guide to the success of the overall sequence, and this is tested via an ACS certified final exam, in which ARC Chemistry students consistently beat the national average (including 4-year schools).

- How successful are students in your courses? How do you know?

  Measuring the success of students in individual courses is complicated by the lack of standardized tests prior to Chem 421. Consequently any attempt to measure success by number of As, Bs, and Cs is purely subjective. Anecdotally, our students do well and are generally very happy with the education they receive in our classes. Again, anecdotally, our students have a good reputation after transferring to local 4-year colleges and seem to do as well, or better than the students who took their lower division classes at the 4-year school. Perhaps the best way to measure our students' success is through data that tracks their success in subsequent classes in the Chemistry sequence (305/310 to 400 to 401 to 420 to 421). These data are available from the research department and are used by most Chemistry teachers to track the success of their students as they progress through the Chemistry sequence. The data consistently show that after the first hurdles of Intro Chem and Chem 400, students are very well prepared and perform well in the subsequent classes. The culmination of the sequence is Chem 421, after which all students take the standardized ACS certified final exam. The consistent success of ARC students on this test provides a final, objective assessment that validates the prior, subjective assessments.

SLO Assessment

Please provide a summary of your discipline's SLO Assessment results over the last 6 years.

The purpose of SLO assessment is to inform and document the ongoing informal assessment process that all faculty perform. SLO assessment therefore supports the efforts of the Chemistry faculty in continuously reviewing and improving their course content and teaching methods. The Chemistry Department has been through 2 SLO assessment cycles over the last 6 years. In each cycle, every active course was evaluated using the Broad Assessment procedure, which involved student feedback in the first cycle and faculty assessment of student learning in the second cycle. The first class of the core chemistry 2-year sequence, Chem 400, was evaluated in more detail using the Focused Assessment procedure during both cycles.
All chemistry classes have received the top scores possible in Curriculum Tech Review of their SLOs, indicating that the course SLOs utilize Bloom's Taxonomy, are easily understood, address narrow topics, can be matched to at least one major topic, and are capable of authentic assessment (i.e. address real world situations, require critical thinking, and utilize course content knowledge).
The Broad Assessment was completed by most Chemistry faculty (full-time and adjunct) during each cycle, and involved over 800 students. The first cycle suggested that two SLOs were not being satisfactorily met and as a result of this assessment, the pedagogical approach to achieving the SLO was changed in one class (the assessment of the other unsatisfactory SLO predated the applicable material in class). The second cycle showed that all or most students were meeting faculty expectations for the SLOs that were reviewed.
The Focused Assessment used 4-6 multiple-choice questions (each question assessed a different SLO) common to all Chem 400 final exams to assess student learning. Students met or exceeded faculty expectations in 5 out of 6 SLOs during the first cycle, but in only 1 out of 4 SLOs during the second cycle. Where students were not meeting faculty expectations, actions were taken to reassess and revise teaching materials (lecture, homework, lab activities). The results from the second cycle also suggested potential problems with the assessment method (complicated, multi-part questions are not fairly assessed using multiple-choice questions: a student could get 3 out of 4 parts right, but if the final answer is wrong, their score would be zero for that question). Consequently, some of the SLOs are being reassessed using questions that more directly assess student learning.

Based on your discipline's SLO assessment work, what improvements to student learning have occurred?

During both assessment cycles, all Chemistry faculty were involved in reviewing and discussing the results of the Broad and Focused Assessment procedures, and in developing appropriate action plans to address instances in which students failed to meet faculty expectations. The results of the Broad Assessment procedure in the second cycle suggest that chemistry students are continuing to perform at a high level and are achieving the specified SLOs, and that improvement has occurred in the problem areas identified during the first cycle.
The Focused Assessment in the first assessment cycle included reassessment of some SLOs that had been tested during the previous cycle, and for 3 out of 4 of these, the student performance had increased (in some cases considerably), showing a definite improvement in student learning. The Focused Assessment in the second cycle was less successful, but the issues arose primarily with SLOs not previously tested, and as noted in the previous section, there are still questions to be resolved about the multiple-choice testing method (preliminary results suggest that students would have exceeded faculty expectations in one of the 'problem' SLOs if partial credit had been given). However, these latest Focused Assessment results are part of a consistent pattern of student improvement as Chem 400 works through all of its SLOs across several assessment cycles in the following way; (1) several SLOs are tested, (2) students exceed expectations in some but fall below expectations in others, (3) the reasons for these results are discussed, (4) materials and methods are created/changed to address the issues, (5) SLOs are retested, (6) students show improvement. The process then starts over with different SLOs.

List, as a set of outcomes, the discipline's plans for continuous quality improvement for student learning outcomes.

Expand Course Offering - Expand course offerings as FTE becomes available including the introduction of hybrid-online and off-site course option for current chemistry courses.

Currency of instructional technologies - Update classroom/lab instructional technologies to stay current with pedagogical advances.

ACS 2-year Objectives - Incorporate recommendations from American Chemical Society's 2-year college assessment report (12/23/14) to explore building partnerships with local industry and academic institutions.

Conference and workshop attendance - Maintain currency in discipline and pedagogy consistent with ACS Guidelines for Two Year Colleges

Distance Education

For every course offered in both Distance Ed and face-to-face formats:

For distance education courses: What percentages of your student population enroll in DE courses?

How successful are students who enroll in DE courses? How do you know?

Compare and contrast success rates for Distance Education sections of the same course offered in face-to-face sections. How does a distance education course differ from face-to-face? (e.g., offerings, scheduling, and success rates)

Vocational Programs Only

A. How well does your department prepare student for a job? What are the indicators?

B. Does your program provide any assistance with job placement? If so, describe the activities and include any data you have on results.

What evidence exists that program completers (or near completers) are successful on the job? What, if available, are their beginning salaries?

Findings

Based on the analyses and reflections conducted during the program review precess, answer the following questions:

- ***What other major developments and accomplishments occurred over the last six years?***

  The Chemistry Department continues to have very high productivity (average of 618 over the last 6 years), despite the large number of lab sections taught (every class has at least 3 hours of lab each week, and the number of students per lab section is limited due to space and safety restrictions). These numbers are the result of Chemistry faculty agreeing to teach larger than normal lecture groups (upwards of 80 students, in some cases), resulting in longer teaching hours for the same FTE.

  Chemistry faculty served on many college-wide committees and volunteered their services in MESA and the Science Skills Center, despite the extra time demands associated with teaching many hours of lab classes (1 lab hour only counts for 45 minutes in FTE calculations).

  Chem 310 has been completely overhauled to provide better preparation for students entering Chem 400, and statistics supplied by the Research Office show that the efforts have been successful.

  A new class has been created; Chem 495: Independent Research, in which students work with a faculty member on an independent research project.

  A Chemistry AS Transfer degree has been created and will be offered in the near future.

  A student Chemistry Club was created. The club has been a great success, providing tutoring and networking opportunities, as well as organizing student outings and performing chemistry demonstrations in the local community.

  The Chemistry Department budgeted wisely and maintained all its core offerings with minimal disruption to students during the "Great Recession".

Conclusions and Recommendations

Based on the analyses and reflections conducted during the program review process, answer the following questions:

1A. What are the strengths of the program?

The Chemistry Department provides excellent chemistry instruction. This is shown by the success of students in a standardized ACS certified final exam at the end of the 2-year core sequence as well as through informal student feedback in person and online.

The Chemistry Department offers both day and night classes, as well as off-campus classes in order to better serve the community.

The Chemistry Department has a diverse faculty representing all the major groups on campus.

Approximately 75% of chemistry classes are taught by full-time Chemistry Department faculty, as recommended by the American Chemical Society.

The Chemistry Department offers students the opportunity to use analytical instrumentation comparable with the best four-year colleges.

The Chemistry Department has an extremely stable and collaborative full-time faculty (the only full-time faculty to have left the Department in the last 10+ years either retired or took a job as a Department Dean at ARC).

The Chemistry Department runs, or helps to run, three excellent student groups; AMSA (American Medical Students Association) at ARC, the Chemistry Club, and the Research Club.

 The Chemistry Department provides excellent tutoring opportunities for students in the form of five weekly IA tutoring sessions as well as numerous Beacon study groups associated with individual classes.

1B. List, as a set of recommendations, your plans for maintaining the quality of the instructional program.

ACS 2-year Objectives - Incorporate recommendations from American Chemical Society's 2-year college assessment report (12/23/14) to explore building partnerships with local industry and academic institutions.

Outreach - Annual participation in on-campus and off-campus community activities to increase community awareness of department (e.g. welcome day, ACS speaker, Early College High School, and green presentations)

Cultural Competency - To increase our awareness of the diversity of the students and staff.

Demolition/Rebuild of Chemistry Building - Replacing the existing chemistry building that is unable to handle our current student population, current technology, and is not aligned with current American Chemical Society's guidelines.

Program Level SLO Alignment - Course level SLOs that align with program level SLOs (i.e. course level SLOs are mapped to program level SLOs when classes go through curriculum).

Student Awareness of SLOs - Increased student awareness of course level and program level SLOs.

Course Material Mapping to SLOs - Exam questions, homework questions, and lab activities are mapped to specific course level SLOs (to ensure that all materials address SLOs and to identify any SLOs that are not being addressed).

Informal SLO Assessment - All course level SLOs are assessed informally by instructors every semester, in addition to the formal SLO assessment process.

2A. What are the challenges of the program?

 Most core chemistry classes have long waiting lists and many qualified students are unable to take the classes they need each semester. The lecture/lab space and FTE currently available to the Chemistry Department is limiting the number of students we can serve.

 To maintain the high quality of the program, and to properly prepare students for transfer, our chemistry classes are necessarily difficult. The perception that community college classes should be easier than this can be a challenge.

 The inappropriate placement of incoming students that leads to low success rates in the gateway classes (Chem 310 and Chem 400). This is the result of prerequisite classes that inadequately prepare students for Chem 310 and Chem 400, and the ineffectiveness of the Chem 400 assessment test.

 An increasing number of students requiring special DSPS resources and accommodations.

 Changes in the requirements of the Nursing Program (they now only require one semester of chemistry and no longer require any organic chemistry component) have reduced the number of students in Chem 306 and Chem 309 classes, while increasing the number in Chem 305.

 Although some problems have been addressed, there are ongoing challenges concerning facilities, for example, projectors that don’t work (or work at a sub-optimal level) and electrical circuits that cut out if three hotplates are turned up to full.

 Recent changes in the way chemical waste is handled in the labs has created a significant increase in the amount of chemical waste. This creates challenges in terms of storage and the increased cost of disposal.

 Lab/lecture inequity that requires faculty that teach labs to work 33% longer hours for the same FTE. This translates to an extra 4.5 classroom hours per week for a Chem 400 teacher teaching 18 hours of lab and 3 hours of lecture for a 1.1 FTE, compared to a lecture-only teacher. The extra hours make it more challenging for Chemistry faculty to support student groups, provide extra student help, and to serve on College committees (even though we still do these things).

2B. List, as a set of recommendations, your plans for addressing these challenges.

Expand Course Offering - Expand course offerings as FTE becomes available including the introduction of hybrid-online and off-site course option for current chemistry courses.

Technical Staffing - 1 instructional assistant for every 4 faculty as stated in the American Chemical Society guidelines

Chem/Equipment Storage - Optimized/increased storage for chemicals and equipment.

Tutoring - Additional tutoring opportunities for chemistry students through the Instructional Assistants, Beacon, Science Skills Center, and the LRC

Currency of instructional technologies - Update classroom/lab instructional technologies to stay current with pedagogical advances.

Facilites - Obtain a new facilities that would accommodate new hires, changes in staffing, fluctuating student population, additional course offerings, science student support services, and other departmental needs.

Science Skills Center program expansion - Increased funding of the Science Skills Center to provide appointments later in the day as well as more appointment availability during the daytime.

Conference and workshop attendance - Maintain currency in discipline and pedagogy consistent with ACS Guidelines for Two Year Colleges

Science Student Support Services - Increase student access to instructional hours and support services (IAs, beacon, online, LRC, etc.)

Increase Technology Support - Improve WiFi access for all classrooms and laboratories.