

External review of the University of Arkansas at Monticello Chemistry Program

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I. Review of Program Goals, Objectives and Activities

A. Are the intended educational (learning) goals for the program appropriate and assessed?

It is clear from the learning objectives that the School of Mathematical and Natural Sciences want to ensure that all students will be successful in their chosen career path. The Chemistry program is more of a service program. There are a total of 14 other majors on campus that include chemistry courses. The faculty have taken care to design their curriculum and learning goals to the diverse needs of their program.

B. How are the faculty and students accomplishing the program's goals and objectives?

After looking through the university's website and the chemistry five year program review document, it is evident that the incoming students are from lower income families and substandard math education backgrounds. The sheer multitude of scholarships available through the university speaks to the financial needs of your students. According to the lifted section of the program review quoted below, the chemistry program spends their time and energy to help and engage their students.

"The UAM Tutoring Center employs many of our majors as work-study students to tutor lower-level chemistry students. Not only is this a benefit to the lower-level students, but it gives the tutors a much deeper understanding of the material, and also allows them to hone their teaching skills prior to going into the MAT or other graduate programs.

Sigma Zeta Math and Science Honor Society is an active student organization which fosters group camaraderie and allows students to network with others in the School. The students in the Sigma Zeta chapter participate in various service projects throughout the year, including working with the Southeast Arkansas Regional Science Fair and the ACTM Regional Mathematics Contest. They host a biannual Science Center cleanup day in which classrooms and laboratories are deeply cleaned, and unused or obsolete materials and equipment are removed. Members often work with high school students on various events on campus, such as Advanced Placement test preparation events, to promote interest in the sciences and mathematics.

The UAM Medical Science Club is a group consisting of pre-professional students. This group has several chemistry majors as members. This group promotes pre-professional studies and also provides a social outlet for the students. The Medical Sciences Club sponsors visits by recruiters from various medical, pharmacy, and veterinary schools, and promotes talks from UAM graduates who can share their experiences with current students. The club sponsors visits by groups of UAM students to medical schools, dental schools, pharmacy schools, and graduate schools.

The UAM Research Program for Minority Students (UAM-RPMS) is a Science, Technology, Engineering and Mathematics (STEM) program which promotes research

skills for students who are members of underrepresented minorities. The program provides a stipend to the students, involves the students in STEM research, and provides funds for the students to travel and present their research results at state, regional, and national meetings. The program began with a substantial grant from the Arkansas Lewis Stokes Alliance for Minority Participation (ARK-LSAMP, funded by the National Science Foundation), and has since transitioned to being funded completely by UAM. This program has been very successful; many students who have participated in UAM-RPMS have been accepted to graduate schools, medical schools, and other post-graduate programs.”

C. How is the program meeting market/industry demands and/or preparing students for advanced study?

A majority of the chemistry majors at UAM go on to medical school, dental school, pharmacy school, etc. The faculty are constantly ensuring that their curriculum aligns with the needs of the state’s health professions schools. Their addition of the biochemistry degree helps these students even more because the faculty have made sure that it includes all of their needed pre-requisite courses. It takes time and additional effort on the part of the faculty to keep up with the ever changing demands of the health professions schools.

D. Is there sufficient student demand for the program?

In 2014 and 2015, the chemistry program graduate numbers are 11-12 graduates which is doubled the number of graduates in previous years. This statistic alone says that the demand for this program is sufficient and growing.

E. Do course enrollments and program graduation/completion rates justify the required resources?

This program is not only justified in their required resources, they are LONG overdue for some real resources being expended on them.

II. Review of Program Curriculum

A. Is the program curriculum appropriate to meet current and future market/industry needs and/or to prepare students for advanced study?

The chemistry faculty have taken great care and invested hours of research to align their curriculum with the area dental schools, medical schools, pharmacy schools, and graduate schools. They have recently designed and implemented a new biochemistry track, in order to better meet the needs for their pre-professional health students. I realize that southern Arkansas does not have a huge market for bachelor’s

degree chemist. Cotton and soybean farming use chemicals but do not employ chemist in the fields. However, a chemistry degree does serve as a good preparation for many other professional areas after graduation. The UAM faculty show a good understanding of how to prepare their students for the future.

B. Are institutional policies and procedures appropriate to keep the program curriculum current to meet industry standards?

The area that needs to be addressed in order to ensure that this program has the ability to keep up with the changing chemistry needs is the pathetic quantity and quality of instrumentation for student use. A general chemistry lab should have more than just a single pH meter. The lack of equipment has forced the faculty to fill their lab courses with worksheet activities instead of real hands on experiments. It is so prolific that the students have commented that they want less lab courses. Part of any good science experience is to form a hypothesis, carry out experiments, analyze the data, and draw conclusions. The data collection opportunities for your chemistry students currently is horrifically tiny. For general chemistry labs, there are small hand-held devices that come with multiple types of probes for endless variations of experimental designs. If you have a lab class with 24 students, you could start out by purchasing only 8 devices with a set of 3-4 probes. Each year you could build the number up to 12-24 as needed.

As for the organic chemistry labs, there are reasonable table top ATR-FTIR instruments. You would have to spend the most money on a tabletop NMR. The last bare essential would be a GC-MS. Just keep in mind that the GC-MS will have to have funding for the helium gas needed to run it throughout the year. To be fair, the GC-MS could also be used in your analytical and instrumental labs as well. For the biochemistry, analytical, instrumental labs will need a good quality UV/Vis spectrometer and fluorometer.

C. Are program exit requirements appropriate?

D. Does the program contain evidence of good breadth/focus and currency, including consistency with good practice?

The chemistry program has set out a well-rounded degree program for students who will have different post-graduate plans. For those students who might want to pursue a graduate chemistry degree, there is the opportunity to participate in research projects. With the biochemistry degree track, there is a streamlined plan to prepare those students who will be moving onto professional health programs. This biochemistry degree offers the students a better grounding in the fundamentals of the human body than does just a regular biology degree.

E. Are students introduced to experiences within the workplace and introduced to professionals in the field?

Here is another area that is need of some work. While the faculty do take the time to invite in outside professionals, there is more that could be gained by taking students out into the professional world. It seems to always come back to the money for

what this program needs. However, sending your research students to national and international meetings would be a great opportunity. For those students considering graduate school or who are undecided, arrange visits with graduate programs within the state. Or, if Louisiana Tech is closer than Fayetteville go there. If there is an area company that has a quality control lab, perhaps you could arrange a visit.

F. Does the program promote and support interdisciplinary initiatives?

I am sure this program would love to support interdisciplinary research projects and such. However, given the overload of work where could they squeeze that in?

G. Does the program provide respect and understanding for cultural diversity as evidenced in the curriculum, in program activities, in assignment of program responsibility and duties; in honors, awards, and scholarship recognition; in recruitment?

There is a diversity among the faculty and students that is well represented in this program.

III. Review of Academic Support

A. Does the program provide appropriate quality and quantity of academic advising and mentoring of students?

B. Does the program provide for retention of qualified students from term to term and support student progress toward and achievement of graduation?

From academic year 2013 there were six chemistry graduates. In 2014 there were eleven and 2015 had twelve. This program has doubled their output while resource allocation and faculty numbers have remained stagnant. The growth areas for the future will be in the math and sciences.

The department as a whole provides a tutoring center in order to help promote student retention. Students who are unsuccessful in science courses are most likely to be the ones with the weakest math skills. According to the mathematics program review document approximately 65% of the incoming freshmen are required to take at least one remedial math course. Given this statistic alone, I am surprised at the number of science majors UAM graduates. This ultimately must mean that the faculty and university efforts in recruitment and retention are working well.

IV. Review of Program Faculty

A. Do program faculty have appropriate academic credentials and/or professional licensure/certification?

The UAM chemistry faculty come from a diverse background that cover many of the 5 specialty areas in chemistry. The one area weakness seems to be a faculty member with a rigorous background in physical chemistry. It is clear that with the continued growth of your program a new faculty position will be critically needed. Perhaps it would be best for your program to consider a physical chemistry or material science faculty member.

B. Are the faculty orientation and faculty evaluation processes appropriate?

There are several aspects upon which a faculty member is evaluated: student evaluations, peer evaluations, professional development activities, classroom data, etc. There were references to the fact that American Chemical Society standardized exams are also used to evaluate courses and student achievement. It would be nice if a yearly course summary of this data had been included for the evaluation of the program.

C. Is the faculty workload in keeping with best practices?

No, it is clear that the chemistry faculty are having their contact hour teaching loads increased from year to year. As the program continues to grow with the addition of the biochemistry track, it will only get worse. Right now, it looks like there is plenty of evidence that a new full-time position is needed.

V. Review of Program Resources

A. Is there an appropriate level of institutional support for program operation?

The quantity of resources that the chemistry program was functioning within 2012-2015 could barely be called resources. Frankly, I'm amazed at how successful your graduates turned out considering they were clearly at the bottom of the barrel, or below, for resources. The failure by the university was across the board: the facilities should have been condemned, the equipment available for student use is pathetically sparse, the faculty workloads were excessive, and I can only assume the pay was on par with the facilities. It is more than apparent that the chemistry program's dedicated faculty put their student's before themselves.

In reviewing the lab course syllabi for the lower level chemistry courses, the lack of student equipment is evidenced by the number of experiments that are just on paper activities. Even the students are aware of the lack of good lab experience by their desire to cut out the lab courses from the curriculum. The best way to engage and excite students about science is to let them get their hands on it.

It is noted that the university is currently constructing a new science facility. The university needs to keep in mind, that all science careers these days use highly technical equipment. If you want to continue to be able to graduate successful scholars; they need to be able to see and touch real equipment. In this day and age, the instruments are becoming smaller, more affordable, and more rugged. However, there is also the annual upkeep to consider as well. If the university spends \$500,000 on a bare minimum of equipment, then an annual maintenance budget of \$30,000 should be allotted for just maintenance. Every administrator chokes when they see the money it takes to keep a good science program going. The difference between the cost of the new science building versus the cost of a new classroom and office building is quite indicative of the cost differential between science and literature.

B. Are faculty, library, professional development and other program resources sufficient?

The library resources are also at the bare minimum with only having access to the American Chemical Society online journals. I am aware that even in the library needs that a chemistry program is expensive. However, with the ACS online journals and interlibrary loan programs, it is possible to still expose students to the wider universe of science.

Amazingly, the faculty have found ways for professional development on their own. Their participation in the Arkansas Academy of Science, Arkansas INBRE, and the Arkansas Space Grant Consortium. Since the department as a whole only has a budget of \$6600 for professional development, it is unlikely that more than 2 professors a year could travel to present at a national meeting. When you consider that the chemistry program has to share that measly amount with the rest of the department, it is clear why the faculty have stayed in Arkansas to get their professional development. It would look better on the university as a whole if they could muster the funds to send an outstanding chemistry research student and their mentor to a national ACS meeting. There could even be an internal competition among the students. It would be a way of providing your students with an eye-opening chance to see what opportunities are available to them.

VI. Review of Program Effectiveness

A. Indicate areas of program strength.

The new biochemistry degree track seems to streamline a degree for your students who are interested in pursuing health sciences (i.e. medical school, dental school, pharmacy school, physical therapy, etc) careers after graduation. The chemistry faculty of UAM are best strength of your program. They all teach large contact hour loads, attend regional and national conferences, and participate in state level STEM initiatives. They should be commended on their excellent work with such limited resources.

B. Indicate the program areas in need of improvement within the next 12 months; over the next 2-5 years.

It is clear that another full-time faculty member is needed for this program. It should be a person that adds diversity to the program. A physical chemist or a material science faculty would help round out the program very well.

There needs to be a long-term plan for financially backing the needs of this program. Because it has been neglected for so long, it will take some time to build up to the equipment level needed to be true hands-on science degree program.

The lab courses need to be completely revamped in order to encourage the students to learn. The faculty have done the best they could with the seriously limited resources. It is the limited resources that have resulted in the large number of paper-based lab experiments. The students deserve the opportunity to actually use equipment to make measurements themselves.

There should also be a better system for documenting/tracking the outcomes of all of your students in all of your courses. The program already uses ACS standardized exams to evaluate their courses. However, in the five year program review there were no scores given. For example, the program could use these exam scores to compare between students with good ACT scores and students without in general chemistry 1. This would provide the administration concrete proof that their open enrollment policy is just creating student debt for no net gain in education. If the faculty take the time to compile their students' exam data, it would document learning that has occurred in your courses. As an exit exam, the chemistry program could document and compare their program using the ACS Diagnostic of Chemistry Knowledge exam as well.

C. Indicate areas for program development based on market/industry demands that have not been identified by the institution.

It is clear that the chemistry program faculty have a full and complete understanding of how to make their program marketable. All they require is the financial backing in order to achieve greatness at even higher heights.

VIII. Review of Program Research and Service

- A. Are the intended research and creative outcomes for each program appropriate, assessed, and results utilized?

Dr. Huang, Dr. Taylor, and Dr. Williams are working closely with students in research projects. These students have had the opportunity to present their work at regional ACS meetings. It is a great experience for undergraduate students to present their work to other scientists. It would be great if these professors would have the opportunity to take their students to present at national meetings as well as regional ones. Of course, this would require money from the university to make it happen.

IX. Local Review Comments

- A. How is the program meeting market/industry demands and /or preparing students for advanced study?
- B. What program modifications are needed?

X. Report Summary

- The UAM faculty have been doing an excellent job under ridiculously underfunded and overworked conditions.
 - From the description of the existing science building, it should probably just be condemned. There is a new science building in the works.
 - The quantity and quality of the chemistry program's equipment for student use is dismally small and outdated.
 - The great work of the faculty has made their program relevant to the students who graduate with a degree; and, serves the needs of many other degrees on campus is outstanding.
- With the new facility, there should be a significant portion of moneys set aside to purchase instrumentation for all chemistry course areas: general chemistry, organic chemistry, analytical, biochemistry, and physical chemistry.
- For a student population that comes in so mathematically deficient, the chemistry program works hard to help all of their students succeed.
- The university as a whole works hard to provide as much financial support as possible to their student body. It would be nice if the university administration would recognize that paying a decent salary to qualified faculty and providing quality facilities for their students is just as important.