

Chemistry

SUMMARY OF IDENTIFIED ISSUES

The major issues that the chemistry discipline grappled with during the IMPAC meetings were: modes of articulation for organic chemistry; the feasibility of a one-semester course encompassing general chemistry, organic chemistry, and biochemistry targeted specifically for the pre-nursing curriculum; the prospect for creating an alternative general education transfer curriculum suited for the sciences and engineering.

Articulation of the first course in general chemistry among the California community colleges and all of the four-year institutions now works well. Students typically receive full credit when transferring between the segments of higher education in California for a completed one-year sequence of general chemistry. Because of reasons important to the local institutions (e.g. availability of laboratory equipment and space, integration with other disciplinary offerings, expertise of instructional personnel, and selection of course materials such as textbook) it is impossible to dictate perfect articulation of individual semesters or quarters across the system of higher education in California. Students are advised to complete the entire year's sequence at a single institution, and attempts to do otherwise may lead to repetition of some topics or, perhaps more poignantly, complete omission of important conceptual material, that may result in remedial requirements and slowed progress to degree. The traditional one-semester lower-division course in quantitative analysis, where offered, also articulates well. Increasingly, however, this course is disappearing from the curriculum offerings, commonly for lack of student interest at the community colleges. Some community colleges are able to maintain interest in this course and in several local situations, it serves the community vibrantly, but in large across the system, it is on the wane. The four-year institutions have responded to the absence of lower-division quantitative analysis by providing the material in upper-division courses.

However, there is a considerably more difficult issue with the year's course in organic chemistry. This course is sometimes a lower-division course, sometimes half lower-division and half upper-division, and sometimes all upper-division. The nature of the material, the evolution of the complexity through the course, and the sophistication and importance to modern chemistry easily justify its upper-division designation. On the other hand, because of its centrality to chemistry and to other sciences, it has undeniably become the traditional subject material for the second year of study of chemistry, which is traditionally regarded as part of the lower division. The expense of the laboratory and modern instrumentation purchase and maintenance become an issue for the quality of the student laboratory experience. All of these factors compound the problem of articulation between the community colleges and the four-year campuses. There have evolved three basic patterns of articulation of this course: 1) complete articulation of the community college course with the course offered on the four-

year campus; 2) articulation with a non-majors course on the four-year campus, or to a portion of the majors course, with a bridging course offered at the four-year campus; 3) articulation only on a student by student basis for those students scoring acceptably on a diagnostic examination (characteristically the American Chemical Society final examination in Organic Chemistry for which there are national norms available). Each of the patterns has been found workable in achieving articulation for students between the four-year institutions and the community colleges, but the system as a whole must work toward the day when increasingly pattern 1) is successful.

Very spirited cross-disciplinary discussions between nursing faculty and chemistry faculty have characterized the regional and statewide IMPAC meetings centered on the concept of a single-semester course targeting the pre-nursing students that will cover those topics of importance to nursing from general chemistry, organic chemistry, and biochemistry. There is an existing course offered both on community college campuses and four-year campuses that is a two-semester course covering this breadth of material for students in allied health fields. The nursing programs in California are under pressure to produce more nurses for California's health care system and identified preparation in chemistry as a stumbling block for smooth articulation of students between the associate's degree in nursing programs and the bachelor degree nursing programs. The latter have generally required the equivalent of the two-semester course described above, or more, whereas the chemistry requirements for the associates degree programs vary widely from no chemistry requirements beyond high school, to the two-semester course. Students desiring to expand their professional credentials were often finding themselves needing to take remedial courses in chemistry when seeking to continue their nursing studies in the bachelors programs, commonly resulting in disappointment, discouragement, and possible abandonment of pursuit. The associates degree programs are under severe constraints on the total number of units required for the degree so that an across the board additional requirement of two-semesters of chemistry seems insupportable. Nursing faculty posed the possibility of creation of a one-semester course to accomplish their goals to the chemistry faculty. Across the system there were a few campuses that had experience with a one-semester course to achieve the goals of the nursing faculty. Some of those campuses felt the course to be eminently successful and others have regarded the course as something of a problem child with a very checkered history. Those faculty with experience with the two-semester course find it difficult to foresee success of a one-semester course that covers that breadth of material. A task force chaired by James Armstrong, Chair of Chemistry at City College of San Francisco undertook the job of developing curricular content of the desired course, drawing upon the experience of those campuses that were already teaching a similar course and upon additional input from faculty in biology and nursing. The work was accomplished largely over the Internet and capped by an extra evening session joint meeting of nursing, chemistry, and biology faculty at the statewide IMPAC meeting. The creation of this course content is a unique achievement of the IMPAC project. There is no other forum in which it could have occurred. The opportunity for the cross-disciplinary meetings of nursing, chemistry, and biology faculty and the statewide scope of representative faculty permitted this achievement. The widespread implementation of the course will depend on local faculty reconciling the myriad additional problems that it may cause. The impact on local resources, either negatively by withdrawing interest in the two-semester course that serves other disciplines, or by redirection of resources where the two variants will both have adequate demand, the resolution of nursing faculty to implement an explicit chemistry requirement, and the curricular creation and approval procedures are all issues that will need to be addressed on each individual campus and undoubtedly multiple approaches to resolution of those issues can be foreseen.

Science faculty at four-year campuses regularly advise transfer students who arrive on campus with their general education requirements completed at the community colleges, but who in the process of doing so, have neglected their lower division preparation in the major. Such students necessarily face a curriculum upon transfer that requires a minimum of an additional year to repair and may be as severe as an additional two years that are added on to the time to degree before they are in a position to begin upper division work in the major area. It is generally good advice to students to complete their general education requirements, or much of them, during their time at community colleges, but this should not be done at the neglect of lower division preparation for a science major. Chemistry faculty devoted much discussion time to the possibility of trying to address this issue by the creation of an alternative to the Intersegmental General Education Transfer Curriculum (IGETC) that, while encouraging the completion of general education requirements, would likewise ensure that the lower division preparation for the major was likewise completed. Taking a hint from the curricular planning of students who spend their entire undergraduate careers on a single four-year campus, the discussions lead to the idea of deferring perhaps two courses of the IGETC curriculum to be completed on the receiving campus, and detailing the essential lower division work in mathematics and the sciences to be explicit courses that ensure progress in the major. Chemistry faculty have been participating in the cross-disciplinary discussions with biology, computer science, engineering, geology, mathematics, and physics faculties and the articulation officers to try to develop an effective alternative. There arise in these discussions two conflicting goals, one to detail the needed lower division preparation expected for a student transferring from a community college in these majors, the other to find a common, least harmful, set of specifications to be grafted into the IGETC pattern. The resolution of these alternative goals is necessary for this effort to be successful. For an alternative to IGETC to be successful, it must be at least as simple as IGETC and presentable in a one-page format. A rough construction meeting these objectives has been assembled that can be refined with more discussion, at IMPAC and in related forums, specifically the California Articulation Number (CAN) System Board, the California Intersegmental Articulation Council (CIAC), the Intersegmental Committee of Academic Senates (ICAS) and the individual academic senates of the segments of higher education in California. During the development of this rough construction, the need for improved CAN course descriptors has become apparent.

IDENTIFIED TRENDS/FUTURE DIRECTIONS

Increasingly community college district administrations are recognizing the importance of modern instrumentation for instruction in chemistry, particularly organic chemistry and providing the necessary resources. As more community college chemistry departments become equipped with the instrumentation to provide their students with high quality laboratory instruction, the four-year campuses must continue to reexamine their concerns about articulation of organic chemistry courses offered at the community colleges. For higher education to meet the needs of the students of “Tidal Wave II,” full partnership with the community colleges is required. Organic chemistry is increasingly the nominal second-year course for chemistry majors and the ability to complete the first two years of the curriculum in the community colleges is important for transfer students to be at the same point in their academic studies as those students who started on the four-year campuses.

COMMENTS FROM STATEWIDE MEETINGS AND THE GENERAL FIELD

FROM THE BAY REGION MEETING

Chemistry disciplinary discussions began with consideration of the creation of a suggested parallel to the Intersegmental General Education Transfer Curriculum (IGETC) that would emphasize completion of lower division major requirements for an Intersegmental Science and Engineering Transfer Curriculum. Some initial remarks questioned the utility of such a vehicle and suggested instead the widespread publication of discipline specific lower division curricula in the community college catalogs. It was stated that community college counseling tends to emphasize advice on the achievement of an AA degree with little or no attention to curricula leading to a Bachelor's degree. An impediment to publishing such information in community college catalogs may be the fear of substantial increase in the catalog size.

A lengthy and fruitful exchange regarding the issues of transfer of credit for community college organic chemistry courses to the four-year campuses ensued. Three models of articulation for this course are presented by the four-year campuses across the state: 1) simple complete equivalence between the community college course and the course on the receiving campus; 2) articulation to a non-major's course or a portion of the major's course with a bridging course offered on the receiving campus; 3) articulation on a student by student basis after the student demonstrates an achieved competency in organic chemistry by passing a diagnostic examination, such as the American Chemical Society final examination in organic chemistry. Community college faculty expressed concern that the latter model of articulation treats their students with disproportionate suspicion in many cases. A portion of the problem arises because of the designation of at least some of the organic chemistry sequence as an upper division course at the receiving campus. Community college faculty asked about the program of study for students at the receiving campuses and whether organic chemistry is, in fact, traditionally taken by students in their second year. It was generally acknowledged that, as quantitative analysis as a separate course in lower division is waning in popularity and significance in the chemistry curriculum, students commonly take organic chemistry in their second year, and in that sense, it is appropriate for community colleges to offer the entire organic sequence. The possibility of four-year faculty devising a model course outline, perhaps differentiating between topics and laboratory experiences that were essential versus those that were ideal came forward. It is possible that a revised CAN descriptor for organic chemistry could be developed to serve this purpose. Some community college faculty felt that it remained their responsibility to present a course description of an organic chemistry course that they can teach to the four-year campuses since they would be delivering the instruction.

The role of quantitative analysis in the lower division curriculum was discussed. While it is tending toward disappearance as a separate course at many institutions, there was widely voiced support for the importance of the practical laboratory experience that it provides and its role in capping the student's intellectual development in the understanding of chemical equilibrium, principles of measurement and sampling, and chemical separations. These topics are of perhaps greater importance for students pursuing studies in allied fields than for chemistry major students as the latter will revisit these topics in upper division coursework. Continuation of viable quantitative chemistry courses in the community college curriculum is important for continuation of these skills in many environmental and forensic laboratories across the state.

Afternoon cross-disciplinary discussions were divided between a session joint with the other physical sciences and engineering and a session with nursing faculty. The session with the other physical sciences discussed the possibility of further development of an alternative to the

IGETC program that would be more suitable for science and engineering majors. Valuable contributions to the discussion were provided by the articulation officers present who were able to provide considerable insight into the functioning of the present IGETC, and limitations to which an alternative would need to adhere. For significant further progress on the development of an alternative to IGETC, a concrete proposal needs to be drafted so that the detailed needs of the individual disciplines can be incorporated. Discussions with nursing faculty centered on their expressed need for a one-semester course incorporating those elements of general chemistry, organic chemistry, and biochemistry that are important for nursing. The nursing faculty expressed the desire for the creation of a California Articulation Number (CAN) descriptor for such a course. Some chemistry faculty who were present and have offered such a course for a few years expressed a willingness to participate in drafting a descriptor for such a course for consideration for adoption by the new CAN system.

FROM THE SOUTHERN REGION MEETING

Discussion began with reaffirmation of the importance of completing one-year course sequences at a single institution. Students will have a more cohesive education if they complete the full year sequence at a given institution. Individual campuses inevitably choose slightly different sequencing of the material for a myriad of locally relevant reasons. Articulation of a completed sequence is therefore considerably more successful than attempting to articulate only partially completed sequences. A specific point of that type in the general chemistry class is whether chemical equilibrium is taught in the first or second semester. Increasingly the topic is moving to the second semester. CSU San Marcos's sequencing of general, organic, organic, general in successive semesters for two years for chemistry and biology students continues to meet with success. The rearrangement from the traditional general, general, organic, organic sequencing of the first two year curriculum permits students more opportunity to get their math skills up to the required level for the very quantitative aspects of general chemistry which they then do not meet until their fourth semester of study. San Marcos does not have majors that want only general chemistry so this sequence serves their students well. Use of ACS standardized final exams in both general chemistry and organic chemistry is common. These multiple choice style exams are significantly different format from locally developed problem style exams, but if students are forewarned about the changed format, they adjust to it in stride. Community college faculty reported that CSU San Diego handles equivalency for organic chemistry courses for the chemistry majors on an individual student basis rather than approving articulation of the course.

In discussion about counseling chemistry majors, community college faculty reported that they encourage their counseling staff to send chemistry majors to the chemistry faculty for counseling. Rosemont College has implemented a BS transfer curriculum that assists students in curricular planning. The four-year campuses re-emphasized that the information they need to determine course equivalency is often not included in packets submitted for articulation requests. These include detailed course syllabi, texts used, reading and problem assignments, laboratory experiments performed and hours of laboratory per week. A recommendation to CIAC for routine inclusion of this information could speed academic review of the articulation agreements.

Strong skepticism about the pedagogical wisdom of attempting to package a single semester course covering general chemistry, organic chemistry and biochemistry was expressed. It appears to many that such a course would be either superficial or brutal. It was pointed out that it only makes sense for community colleges to offer such a course if there is either local

demand for it from their own nursing program, or if the CSU campuses statewide nursing faculty embrace it.

The afternoon cross-disciplinary discussions were in two sessions, the first joint with other physical sciences and engineering faculty, the second with nursing and biology faculty. The first session centered on the possible creation of a parallel to the Intersegmental General Education Transfer Curriculum (IGETC) that might be termed the Inter-segmental Science and Engineering Transfer Curriculum (ISETC). The goal would be to encourage completion of some general education requirements in a fashion to assure that those units were indeed furthering the student's progress in the major as well as satisfying general education requirements. A straw-man core was distributed for discussion and met with conceptual endorsement. The goal would be to get agreement that a student who completed ISETC would be required to complete no more than two additional lower division general education requirements. The structure of ISETC would be such that at least the central core of one year of calculus, one year of general chemistry and one year of physics with calculus would be assured. Students would continue to be encouraged to complete additional major requirements, but the targeted general education would assure a base upon which further regular progress in the major might be assured.

FROM THE NORTHERN REGION MEETING

Discussion of the importance of students getting good advice for planning their chemistry major curriculum was the opening topic. It is important for chemistry faculty to indicate to their counseling offices, their willingness to advise prospective chemistry transfer chemistry majors on their curricula, if appropriate, and to provide the counseling staff with correct information regarding the transfer process for their courses. Any misinformation that they find students perceiving should be communicated to the counseling office.

An extended discussion about the desire of nursing faculty for a one-semester course in general, organic, and biochemistry ensued. CSU Chico chemistry faculty are working with their nursing department to have the second semester of their two-semester general, organic, and biochemistry be the desired course. They are adjusting their prerequisites for the course to being a good high school chemistry course and using an advisory diagnostic examination to assist students to assess their level of preparedness for the course. For those students not doing well on the diagnostic, the first semester course is available to them to hone their skills before attempting the second semester. Other thoughts include having the recovery course start a few weeks after the required course so that students who tried too high with inadequate preparation can be picked up in a suitable course without their losing excessive curricular time.

The information needed for determination of articulation of community college courses to four-year institutions was a subject of general discussion. The more information provided such as course syllabi, texts used, laboratory experiments performed, instructor résumés, and final examinations used, the more readily a course evaluation can be completed. Community college instructors would appreciate similar information originating from the four-year institutions, so that they can adjust their courses to more closely match those being offered at four-year institutions.

The afternoon cross-disciplinary meetings were in two sessions, the first with other science and engineering faculty, and the second with nursing and biology. The first session centered on the possible development of an alternative to the Intersegmental General Education Transfer Curriculum (IGETC). There is much discontent with IGETC among engineering schools, but they have a long-standing agreement on coursework for articulation from community colleges.

This may prove to be an alternative model for what has developed in the discussion for a science alternative to IGETC. The discussion with nursing and biology focused on the nursing faculty's interest in a one-semester 4 or 5 unit course that would cover those aspects of general, organic, and biochemistry that are of importance in nursing.

FROM THE LOS ANGELES METROPOLITAN REGION MEETING

Discussion began with a description of the various agencies and organizations involved in facilitating transfer among the segments of higher education in California and their interaction with the IMPAC project.

The three models of articulation for organic chemistry between the community colleges and the four-year institutions were discussed. Those models being: 1) full articulation of the courses between the institutions; 2) articulation of the course to a receiving institution's course for non-majors or for a portion of the course with the receiving institution providing a bridge course to complete the student's background; 3) articulation only on a student by student basis upon demonstration by the student of competency in organic chemistry through passing a diagnostic examination, typically the American Chemical Society final exam in organic chemistry. While the latter model gives more uncertainty to the transferring student, several community colleges have excellent working relations with the 4-year institutions using that model and will commonly administer the examination to their own students before the student has transferred.

A preliminary discussion of the possible creation of an alternative to the Intersegmental General Education Transfer Curriculum (IGETC) for science students indicated broad based support for such an alternative. The difficulties of creating a meaningful one-semester 4-5 unit course covering topics of interest to nursing from general, organic, and biochemistry were discussed.

Afternoon cross-disciplinary discussions were in two sessions, the first with other science and engineering faculty regarding a possible alternative to IGETC, and the second with nursing and biology faculty to discuss the creation of a course outline for a one-semester general, organic, and biochemistry course for nursing.

RECOMMENDATIONS FOR THE DISCIPLINE

1. Continue vigorous participation in the IMPAC process.
2. Pursue the creation of an alternative vehicle for science students similar in intent to the IGETC that serves other disciplines so well.
3. Engage in resolving the local issues that may arise in meeting the chemistry instructional needs of the nursing discipline.
4. Participate in the new CAN evaluation process as it evolves.

RECOMMENDATIONS FOR SUPPORT COURSES (IF DISCUSSED)

None

TOPICS FOR FURTHER DISCUSSION

The faculty of the discipline of chemistry will need to pursue the following issues.

1. Consider development of improved descriptors for the chemistry courses that have CAN descriptors and help in the creation of a new one for the one-semester GOB (generic, organic, biology) course.
2. Continue the dialogue regarding articulation of organic chemistry courses.
3. Participate in the refinement of the concept of an IGETC-like agreement that will better serve the chemistry major.
4. Discuss the new teaching technologies available with the Internet and how they can be best exploited in teaching chemistry.
5. Initiate cross-disciplinary discussions to review the general chemistry and organic chemistry course content.

RECOMMENDATIONS FORWARDED/TO BE FORWARDED TO

CAN

Use the IMPAC project as a functional statewide faculty grouping to assist in developing revised procedures for course review and designation.

ASSIST

CIAC

Continue to participate in the IMPAC process. Help to refine the fledgling alternative to IGETC so that science and engineering transfer candidates may be better served.

OUTREACH PRESENTATIONS MADE BY MEMBERS OF THIS GROUP:

ORGANIZATION	DATE/PLACE	PRESENTER'S NAME	NUMBER PRESENT
UC Davis College of Letters and Sciences advisers	UCD campus April, 2002	William Fink	30
CIAC	Annual conference Sacramento, CA	William Fink	100