Biology

SUMMARY OF IDENTIFIED ISSUES

The various regional groups used the 'Topics for Future Discussion' from the 2000-2001 year end report as the initial basis for discussion. From these topics, two key questions were identified. First, what is appropriate content for a lower division core curriculum in the biological sciences? Second, can the CAN course descriptors be modified to accurately reflect this content? Participating faculty also discussed a new proposal calling for a general education (GE) transfer pattern for science students. These discussions generated an additional question: What would be the contents of such a transfer pattern for biology majors? These three questions were the focus of discussions at regional and state meetings this past year.

Question 1. What is the appropriate content for a lower-division core curriculum in the biological sciences?

An analysis of lower-division core curriculum content began with several assumptions. First, core curricula vary considerably among community colleges, CSUs and UCs. This diversity reflects the expertise and philosophy of each institution's faculty as well as limitations of budget and facilities. Second, any attempt to generate an Intersegmental Major Preparation Articulated Curriculum (IMPAC) should embrace this diversity rather than reduce it. Third, the actual content of the various core curricula was probably not as diverse as course organization and course sequence make it appear.

With these assumptions in mind, faculty groups at the various regional and statewide meetings attempted to define key elements common to most lower-division core curricula. The results are presented as a table in Appendix A. The content was divided into six key **Topic** areas: diversity, ecology, evolution, genetics, cell biology and biochemistry. Detail was then added to each of these topics as a list of key **Elements**, each with associated content. Ideally, the table of Topics/Elements as developed is intended to state clearly the minimum criteria for a lower-division core curriculum, which when completed by students at community colleges will allow transfer to CSUs and UCs with junior-level standing in the major.

There was only minor disagreement among faculty concerning the curriculum content represented in this document. However, some specific issues became evident during discussion of this core content. As you peruse Appendix A consider the follow comments made by faculty.

1. Although **Topics** in the grid (diversity, ecology, evolution, genetics etc.) are arranged in a macro to micro sequence, this arrangement is not intended to suggest a teaching sequence. It is assumed that faculty at each institution will arrange the Topics/Elements according to its own expertise and philosophy.

2. The **Elements** placed under each topic are intended to represent sections common to lower-division core courses in the field. They are not intended to be lecture topics but groups of lectures that would normally take 1-2 weeks to complete, the equivalent of a 30-32 week core curriculum.
3. The organization of **Elements** under each **Topic** is not intended to suggest a sequence for developing and teaching undergraduate core courses. They are intended as a set of criteria against which individual core curricula can be assessed.
4. The content of each **Element** is intended to suggest a definable body of knowledge. It is not however intended to limit inclusion of additional content. Faculty expressed a desire to include specific content derived from their particular expertise. Although the specific content cited by these faculty does not necessarily appear in the core content, its inclusion is not precluded.
5. Some components of each **Element** are often assigned primarily to an associated lab course or are supported directly by laboratory experiments. In other cases, the knowledge is conveyed primarily via lecture. No attempt has been made to assign content to laboratory time although some effort was expended to identify key laboratory elements appropriate to a core curriculum. Further details remain to be identified.
6. As it stands, this core curriculum does not meet all needs of either community colleges or California's four-year institutions. Some community colleges (CCs) cannot provide for all of the core content. For instance, faculty from smaller CCs may have problems with content in molecular biology, especially a laboratory component, due to budgetary concerns or facilities. In these instances, comparison with the proposed core curriculum may highlight weaknesses, allowing for subsequent curricular changes and fiscal arguments to support them.
7. Conversely, some California State University (CSUs) and University of California campuses (UCs) teach certain specific core content that is not addressed directly by curricula at most CCs and many CSUs and UCs. For instance, physiological ecology is taught as a core element or a core course at some CSUs and UCs. Although this element is included with discussion of animal, plant and microbe diversity in curricula of most CCs and many UCs and CSUs, this approach that may not meet the criteria of institutions teaching it as a separate core element. While in some instances, minor curricular changes may be the solution to such problems, in other cases the budgetary and/or facilities constraints may make it difficult for CCs to adjust. The proposed core curriculum will allow identification of such content, and provide a basis for discussion and resolution that is more broadly based than individual articulation agreements.

In summary, the proposed lower-division core curriculum is a potential critical step toward development of an Intersegmental Major Preparation Articulated Curriculum for the biological sciences. While providing for a set of topics and elements that characterize a core curriculum, it does not limit content, restrict organization of content nor dictate philosophy. It will make it relatively easy to identify key elements missing from the transfer core curricula of individual institutions, i.e. community colleges, which can then be addressed. With such a core, it will also be relatively easy to identify core content that is specific to individual CSUs and UCs and is therefore not a component of the proposed core or likely to be within the experience of transfer students. Accommodations or recommendations that will minimize the impact on transfer students can then be generated. It provides a set of criteria against which individual articulation agreements may be assessed. This approach to defining a core curriculum does not necessarily

demand major curricular changes. And finally, it provides a vehicle for easily modifying core content.

Question 2: Can the CAN course descriptors be modified to accurately reflect core content?

The answer to this question was addressed at the statewide meeting in April. Once the core curriculum was clarified and content added, the faculty group formulated an answer with two distinct but mutually dependent approaches to CAN articulation. First, the group defined a CAN core curriculum (transfer pattern) comprising the **Topics** and **Elements** in Appendix A. With this approach, individual institutions can articulate to the CAN core curriculum by demonstrating that the sum of their core courses included the entire CAN core **Topics** and **Elements**. Second, the group rewrote the present CAN descriptors to match the proposed CAN core curriculum. This approach provides a set of clearly define courses to be used by institutions already aligned with the existing CAN courses. With a defined core curriculum, rewriting the CAN descriptors proved to be a relatively simple task. The proposed CAN course descriptors are presented in Appendix B. These descriptions are limited to courses included in the lower-division core, and do not include courses such as anatomy and physiology, which were not addressed in the discussions.

Question 3: What should be the components of a general education (GE) transfer pattern for majors in biological sciences?

Science faculty from UC Davis proposed a general education transfer pattern to provide science and engineering students an alternative to the IGETC pattern. This proposal attempts to address the following problems specific to science and engineering majors who follow the IGETC pattern. First, science students who complete IGETC often transfer with severe deficits in the math and science requirements for the major. This outcome for students occurs because the minimum math and science requirements stated in IGETC were designed, and work well for, most non-science majors but are suitable for most science majors. For example, math for liberal arts meets requirements for many non-science majors but calculus is required for most science majors. As a result of following IGETC pattern, many science students transfer with serious deficits in prerequisite and corequisite science and math courses, which delays completion of upper division courses in the major and delays graduation. The alternative GE proposal addresses this problem by setting the minimum science and math requirements for transfer to correlate with the minimum requirements for the major. Second, science and engineering majors who complete both IGETC and the major requirements in math, science and engineering must in many cases complete 70-80 units before transfer. The proposal addresses this concern by reducing non-science GE transfer requirements (Humanities, Social Sciences, Arts, etc.) by two courses and then guarantees that transfer students must take only two additional GE courses at the receiving institution.

A number of benefits accrue from this proposal. It allows students to apply more units to major requirements by delaying some GE courses until transfer. By meshing GE and major requirements, the proposal minimizes the total units required to complete the combination of the major and GE requirements for transfer. Allowing science students to delay some GE courses until after transfer has two benefits. It permits them to mix GE courses with their upper division major courses and it guarantees they can complete their lower-division GE according to the provisions of the GE proposal in lieu of meeting all of the GE requirements of the receiving institution. All these benefits combine to reduce time to degree completion at the receiving institution without compromising academic integrity. The key element to this proposal is that it provides to science and engineering students a clearly define and efficient transfer path.

The benefits of this proposal clearly apply to biology majors, who must complete biology core courses plus minimum math, chemistry and physics requirements for the major in addition to GE courses. A potential GE transfer pattern for biology majors was submitted to get the ball rolling (see Appendix C), but a number of significant problems must be addressed before advancing beyond the proposal stage. These involve the minimum math, chemistry and physics requirements. While some institutions require a single semester of calculus, others require two semesters, and still others require calculus plus a semester of statistics. Completion of a year of inorganic chemistry is required at virtually all institutions, but not all require a year of organic chemistry. The physics requirement also varies considerably from one institution to another. It was pointed out by biology faculty that setting the minimum math, chemistry, and physics requirements to those in the proposal (Appendix C) effectively dictates curriculum changes for many universities. That is not the intent. If biology faculty find the concept of an alternative GE transfer pattern acceptable, we must come to some agreement about the minimum requirements.

IDENTIFIED TRENDS/FUTURE DIRECTIONS

Discussion at the regional and statewide meetings suggested several potential trends within biology curricula, although these were not a primary topic of discussion. (For summary information of CSU and UC biology curricula see Appendix D.) The possible trends are enumerated below for purposes of continued discuss at next year's meetings.

1. There seems to be a tendency to increase lower-division coursework in the major beyond the two-semester (three-quarter) core outlined in the existing CAN sequences. Presently one third of the CSUs and UCs have core sequences longer than one year. In addition, faculty from several CCs indicated they were either in the process of creating or already had created a third semester (or fourth quarter) to enhance the molecular biology elements of their core curricula.
2. A number of institutions representing all three higher education segments offer a diversity-cell-biology-molecular biology framework in lieu of a botany-zoology-cell biology core. Whether or not this represents a trend is debatable (see Appendix D for comparisons).
3. Many institutions have eliminated the cell biology requirement for diversity of life, botany and zoology courses to allow students to take these courses before completing chemistry and to provide time for students to complete chemistry prior to taking a course in cell-molecular biology. Presently, chemistry is a requirement for the cell-molecular-genetics component of the lower-division core curriculum at 22 of the 27 CSUs and UCs, and is required as a prerequisite for all core courses at 11 CSUs/UCs.

These observations raise two very important questions that need to be addressed at regional meetings next year. First, should the core transfer curriculum for biology be three-semesters (or four-quarters) instead of two-semesters (three-quarters)? Second, should chemistry be a requirement for any core course that includes cell/molecular biology and genetics?

RECOMMENDATIONS FOR THE DISCIPLINE

Faculty attending the statewide meeting agreed with the following recommendations:

1. The biology core curriculum developed at this year's IMPAC meetings (Appendix A) should be proposed as a CAN sequence.

2. The biology core curriculum should be sent all CCs, CSUs and UCs for review and comment of the content.
3. New CAN descriptors for the biology core sequence, rewritten to be consistent with the proposed core curriculum, should be recommended for approval in conjunction with approval of the core sequence.
4. Chemistry should be recommended as a prerequisite for all core courses that focus on cell biology, molecular biology, or genetics.

RECOMMENDATIONS FOR SUPPORT COURSES

These were not discussed at this year's meetings but should be addressed next year.

TOPICS FOR FURTHER DISCUSSION

While the generation of a proposed transfer core curriculum at this year's meetings is perceived as very positive by participating faculty, a number of associated issues remain to be addressed.

1. The length of the core curriculum should be evaluated. Should the transfer curriculum be a single year or longer? If longer, how long?
2. What portion of core curriculum units should be assigned to laboratory time?
3. Is it necessary to state which components of the core should be assigned to laboratory work or should this decision be left to each institution?
4. Is it necessary to define a set of laboratory skills expected of transfer students? And if so, what skills should be included?
5. Do biology faculty agree with the concept of a GE alternative to IGETC? If so, what should be the minimum math, chemistry and physics requirements?

RECOMMENDATIONS FORWARDED/TO BE FORWARDED TO CAN

The proposed core curriculum, as well as new CAN descriptors, should be forwarded to CAN for consideration following review of these proposals by CC, CSU and UC faculty groups.

OUTREACH PRESENTATIONS MADE BY MEMBERS OF THIS GROUP

The lead discipline faculty will present the findings and recommendations to the faculty of Irvine Valley College at the beginning of the fall semester. Additional plans for presentation to other colleges and universities are pending.