I. Statement of Problem

After examination of student records and review of our own degree programs, the Biology and Chemistry Departments have found that the new graduation requirement of 45 upper-division (UD) credit hours seriously jeopardizes the timely progress-to-degree for our ~1400 majors.

II. Background & History

The new graduation requirement of 45 UD credit hours took effect in Fall 2012, after discussion by various groups, including CAPP. The 45 UD requirement replaced the requirement of 60 non-introductory (NI) credit hours, due largely to non-uniformity of the NI designation and difficulties in implementation that were associated with the complicated interpretation of the requirement. The implementation of the 45 UD credit requirement coincided with the change in total credits from 124 to 120.

The College of Natural Sciences was granted a 2-year exemption from the 45 UD requirement for its majors, because several of our faculty voiced concerns about the change in its proposal stages. The exemption period was granted to assess the situation for our majors and to provide for adjustments that should be made. This document summarizes the results of our assessment and proposes alternatives that will foster student success, as it relates to the matter of the 45 UD requirement.

III. Summary Highlights of Biology & Chemistry Departments’ Joint Evaluation of Majors, Graduates, and Programs:

1. Recent graduates and current majors do not meet new requirement. The academic records of recipients of undergraduate degrees in Biology (BA Biology, BS Biology, BS Marine Biology) and Chemistry (BA Chemistry, BS Chemistry) were examined for the 3-year period that encompasses AY 2010-2011, 2011-2012, and 2012-2013, as illustrated in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>&lt; 45 UD</th>
<th>45+ UD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All Graduates</td>
<td>308</td>
<td>154 (50%)</td>
<td>154 (50%)</td>
</tr>
<tr>
<td>2. Single Degree Recipients (incl. those with minors)</td>
<td>268</td>
<td>153 (57%)</td>
<td>115 (43%)</td>
</tr>
<tr>
<td>3. Single Degree Recipients (excl. those with minors)</td>
<td>236</td>
<td>146 (62%)</td>
<td>90 (38%)</td>
</tr>
<tr>
<td>4. Entered as Freshmen (i.e., excl. transfers)</td>
<td>129</td>
<td>61 (47%)</td>
<td>68 (53%)</td>
</tr>
<tr>
<td>5. Entered as Freshmen, Single Degree</td>
<td>95</td>
<td>56 (59%)</td>
<td>39 (41%)</td>
</tr>
</tbody>
</table>

1. UHM Academic Policy M5.320, “Upper Division Credit Requirement”, effective Fall 2012
III. Summary Highlights (cont'd):

2. The majority (~60%) of Manoa students who graduated with one degree would not have met the 45 UD requirement (Table 1, Items 2-3). Holding a minor only slightly improved these numbers, which is reasonable, given that the great majority of minor requirements are often lower-division courses.

We also included the question of how this rule would impact transfer students. During this period, there were 308 graduates in Biology and Chemistry, but only 129 of them entered Manoa as freshmen (Table 1, Item 4). The overall trend shows that the typical transfer student would have a slightly poorer outcome. Again, however, the majority of Biology and Chemistry graduates – across the board – do not have enough UD credits upon graduation to meet this requirement.

Finally, we note that these averaged data obscure more troubling results for a given, single year. In AY 2012-2013, there were 20 students who graduated with a BA or BS in Chemistry, of which only 5 (25%) had completed 45 or more credit hours of UD courses. Of these five students, four held a 2nd major, leaving only one single-degree recipient out of the entire year’s Chemistry graduates who earned more than 45 UD credits.

3. The analysis of degree requirements across campus highlights the features of our program that prevent most of our majors from earning 45 UD credits in a timely fashion.

   In a striking contrast to the great majority of other majors on the Manoa campus (for whom the 45 UD credit requirement is not a problem),

   - Biology and Chemistry majors must take a sequence of 100- and 200-level courses in 3 or more areas in the first 2 years. The Biology and Chemistry degrees call for a broad foundation in the sciences and math, requiring coursework in 3-4 areas (Chemistry, Biology, Math, Physics):

     - The courses in each of these areas are sequential. With the exception of 1st-year BIOL, the courses in each of 3-4 areas must be taken in-sequence & not concurrently.

     - Each sequence runs for 1-2 years, with a net credit count that accounts for most of the first 2 years. E.g., the BS in Chemistry requires 22, 11, and 9 LD credit hours in 100- and 200-level courses in CHEM, MATH, and PHYS, respectively, for a total of 42 LD credit hours. After these foundation courses are completed, then the student must take an additional 27 UD credits in CHEM courses. In contrast, the BA in Communicology requires a total of 33 credit hours, of which only 3 are LD (COMG 251, which does not have a specific course prerequisite). Similarly, the BA Psychology major will take 9 credit hours of required pre-major LD courses (PSY 100, 212, 225), and he/she may also take one LD course in a “foundation area”. All remaining major requirements for the BA in Psychology are UD, and there are no implicit or explicit requirements for courses in other departments.
III. Summary Highlights (cont’d):

- These sequences provide the necessary foundation for the respective majors and are prerequisites for courses within and across disciplines. E.g., the 1st semester of calculus must be completed before the 2nd semester of calculus and also before the 1st semester of physics. Figure 1 illustrates these relationships for the BA/BS Chemistry track. Similar prerequisite networks are also found at the higher level. E.g., CHEM 351 (Physical Chemistry I) requires the completion of at least 3 semesters of chemistry, a year of calculus-based physics, and 3 semesters of calculus.

![Figure 1](image-url)

**Figure 1. CHEM Major’s Sequence of LD Courses in CHEM, MATH, PHYS**

- **Biology and Chemistry majors cannot take most, if not all, UD courses (major-required or elective) before their 3rd year.** Our majors spend most of their first 2 years taking the core sequences in the math and sciences, so they do not take the 300- and 400-level courses, until their junior and senior year.

- **Biology and Chemistry majors have little room for the UD elective courses, particularly if the time-to-degree goal of 4 years is retained.** The student must take the major-required sequences in the first two years (all LD), and then he/she will take the major-required UD courses in the 3rd and 4th year, leaving the balance of the “space” in the 4-year plan to tackle the campus-wide requirements (diversification, focus, foreign language, etc.), many of which are not UD. In fact, there is very little room in the 4-year plans for the UD electives that are needed to meet the 45 UD minimum. The constraints lead to the next problem,

- **Biology and Chemistry majors will find that the only way to earn the 45 UD credit hours would be to lengthen their time-to-degree.** This solution is universally unacceptable, as we strive to reduce the average time-to-degree. Also, this “solution” flies in the face of the motivation behind reducing the total credit load from 124 to 120 credits. Here, we also note that the time-to-degree for Chemistry majors is 5-5.5 years, well beyond the benchmark.
III. Summary Highlights (cont’d):

- **Biology and Chemistry majors were never jeopardized by the 60 NI rule**, because many of the courses in the foundation sequences are/were NI. Many other UHM programs were able to make a seamless transition & have no problem with the rule, but the basic structure of our programs – with significant credit loads at the LD level – forms the basis of this new problem.

4. *The Chemistry and Biology degrees meet national standards and/or are comparable to other institutions’ programs.* The degree requirements for our undergraduate degrees were compared to similar ones nationwide, and there are no significant differences. Specifically, we found that the content of our respective programs are consistent with those of other programs. In some cases, the consistency is marked by a certification by a national organization. E.g., the B.S. in Chemistry is certified by the American Chemical Society, the largest professional society for chemists in the US.³

We note that the level of a particular course might vary from one institution to another. E.g., 2nd-semester organic chemistry might be a 200-level course at UHM, but it is a 300-level course elsewhere, even though the content of the courses is roughly identical.

IV. Consideration of Previously Proposed Changes

Prior to Fall 2012, numerous suggestions were made to address the perceived (now real) problem that faced our majors. We considered all of these options, as follows

- “*Should we renumber some of the required LD courses to the 300-level?*” Answer: NO.
  
The renumbering of, esp., 200-level courses to the 300-level to “shift” some of the credits to the upper level was suggested. However, the great majority of our LD CHEM and BIOL courses are also taught at the community colleges, so renumbering would create many new problems with articulation, among other considerations.

- “*Should we increase the number of major-required UD courses?* Answer: NO.
  
  We have already shown that the content of the Biology and Chemistry programs is consistent with what is taught at other colleges and universities. Thus, there is no substantiated need to add upper-level courses to address, e.g., a lack of rigor.

- *Should we decrease the number of major-required LD courses?*” Answer: NO.
  
The time needed to cover the foundations of chemistry, biology, math, or physics appear to be roughly consistent with what is done elsewhere, so existing classes cannot be removed from the lower-level requirements without severe negative impact on our students’ preparedness for the upper-level coursework.

³ Degree certification information found at the URL:  
V. Proposals for Consideration

Based on our extensive study, we request that CAPP and the Manoa Faculty Senate consider and approve one of 3 alternatives to the 45 UD requirement.

1. Combination of 25 UD & 35 major-required LD credits as an option:

   “To earn a baccalaureate degree, students must complete either a minimum of 45 upper-division credits or a combination of no fewer than 25 upper-division and 35 major-required lower-division credits.”

Programs that do not have problems with the 45 UD requirement are unaffected. For degree programs such as the ones offered by Biology and Chemistry, the typical undergraduate’s course load in the various 100- and 200-level classes across multiple departments is accommodated. The “35-25” breakdown was determined by evaluation of our current and past students’ records. It is also roughly consistent with the 60 NI requirement that was previously in place (i.e., 35 + 25 = 60). With this option, all but two of our recent BA CHEM majors would have graduated, and the two who did not meet the 25 UD requirement would have needed only 1 more 3-credit UD lecture course to meet the requirement.

2. Continuation of 60 NI credits as an alternative:

   “To earn a baccalaureate degree, students must complete a minimum of either 45 upper-division credits or 60 NI credits.”

This proposed alternative allows us to continue to apply the 60 NI requirement, which poses no problems for the Biology and Chemistry majors. However, if related policies and procedures have not changed since Fall 2012, then the recurrence of record-keeping (and other) problems that were experienced in the past should be expected.

3. Exemption for all Biology and Chemistry programs:

   “To earn a baccalaureate degree, students must complete a minimum of 45 upper-division credits. Exemptions are granted for all degrees offered by the Biology and Chemistry programs. Future exemptions are given on a case-by-case basis.”

This proposed alternative grants an exemption for all degrees in Biology (BA Biology, BS Biology, BS Marine Biology) and Chemistry (BA Chemistry, BS Chemistry, BA Biochemistry, BS Biochemistry), based on the information contained herein. It does not, however, apply to any other current or future program, so a similarly structured program will need to seek separate approval. It is conceivable that a new program in the basic sciences may share some key features to the various programs described here, particularly in newer areas that are cross-disciplinary in nature. For that reason, it may be preferable to use option (a) or (b).

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4 This exemption may be requested for all or other Natural Sciences programs, such as Botany and Physics, pending the outcome of their respective analyses.