Annual Report on Program Learning Outcomes Assessment

Program: *BA in Chemistry (Option A and B), BA in Chemistry: Biochemistry, BA in Teaching Chemistry; CH 101/102*
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1. **List the learning outcomes for the program**:
    1. *The Chemistry Department has developed five knowledge-based learning outcomes, four performance/skills-based learning outcomes, and one affective-based learning outcome. The Undergraduate Programs Committee (UPC) has proposed, with the support of the chairman, to assess our largest and most basic general chemistry offering, CH 101/102, to determine if we are meeting the goals and objectives established by the chemistry faculty teaching the course and the students enrolled in the course. The primary focus will be on the "on-sequence" tandem, CH 101 in the Fall semester, CH 102 in the Spring semester, then based on these findings, coordinate the "off-sequence" tandem, CH 101 in the Spring, CH 102 in the Fall. This large class satisfies the general chemistry requirement for numerous majors across several BU Colleges, as well as for the premedical track students. The course sequence can be applied to the chemistry major and minor with the additional requirement of a "make-up" lab course, CH 201 (Quantitative Analytical Chemistry Laboratory, 2 credits), designed to ramp up the laboratory skills of students wishing to become chemistry majors and minors, bringing them into correspondence with the CH 109/110 and CH 111/112 general chemistry tracks, which have more intensive labs. Each fall, approximately 800 students register for CH 101, with approximately 100 registering for the off-sequence CH 101 in the spring semester. Of these students, as many as twelve, and as few as two, have become chemistry major graduates over the past five years. Over the past five years, the chemistry major class has averaged 29 graduates, with an average of 6 progressing through the CH 101/102/201 sequence. The main pathway for chemistry majors in general chemistry is Intensive General and Quantitative Analytical Chemistry (CH 111/112) or General and Quantitative Analytical Chemistry (CH 109/110). The audience for CH 101/102 is, thus, overwhelmingly pre-medical STEM majors who will not become chemistry majors – making CH 101/102 the largest service course offered by the chemistry department among the many such courses taught each year. In addition to satisfying the Pre-Medical general chemistry requirement, the CH 101/102 sequence is also required for the following majors:*
        - *Biology*
        - *Biology – Behavioral Biology Track 1*
        - *Biology – Cell Biology, Molecular Biology & Genetics*
        - *Biology – Ecology & Conservation Biology*
        - *Biology – Neurobiology*
        - *Biology – Quantitative Biology*
        - *Biomedical Engineering (ENG)*
        - *Human Physiology (SAR)*

- *Neuroscience*
- *Nutritional Science (SAR)*

2. *The primary learning outcome for general chemistry is to ensure that students have mastered the foundational material of chemistry in order to advance into the traditional chemistry sub-disciplines (inorganic, organic, biochemistry, physical chemistry), as well as to be able to apply fundamental chemistry concepts to the fields of study as defined by their respective majors. The general chemistry for all pre-medical students as well as the majors listed in the point above speaks to the fundamental importance of chemistry, the molecular level science, in the broad range of STEM disciplines. It is thus crucial that CH 101/102 succeed in establishing this foundation.*

3. *In combination with the lecture, the laboratory component of CH 101/102 is designed to hone the analytical skills of the students. Chemistry is an experimental science, and so training in experimental techniques, both intellectual and manual, is critical to the advancement in the understanding of the subject. Students achieve a competency in laboratory skills, including the use of basic instrumentation, data analysis, and the reporting of experimental results*

4. *In addition to the lecture, the required discussion sections and the use of the on-line resource, ALEKS, are designed to build problem solving skills and deepen the understanding of general chemistry. CH 101/102 continues to be at the forefront in the use of educational technology in the classroom (clickers, ECHO video taping of lectures, and on-line tutorials). We will assess the value of these investments in the learning outcomes of the course.*

5. *Concern about the effectiveness of the on-sequence CH 101/102 in achieving its learning goals came to a level of urgency over the past year. As background, such large general chemistry classes are significant pedagogical challenges on every campus across the country, particularly in the Fall semester. Freshman arrive on campus, disproportionately pre-medical (numbering in the thousands at BU), in comparison to the number that actually will apply to medical school (<10%), and thus have considerable grade concerns. Furthermore many are students with poor study habits and other issues of maturity that are not yet commensurate day one for the rigors of a quantitative science course. The reputation of general chemistry as a "weed-out" course to be feared precedes their arrival, long before they've even attended their first class, also contributing to a potentially tense class environment. Across the country, the attrition rate for a general chemistry class such as CH 101 exceeds 25%. This past spring, concerns over the workload, and overall time demands of the course, particularly for CH 101, had risen to the administrative levels within CAS. Complaints about general chemistry are not new – concepts can be difficult to visualize for students whose chemistry background can range from very poor to excellent. Nonetheless, concerns were raised by CAS, SAR, and departments and the pre-medical office whose students form the vast majority of CH 101/102 student body about the effectiveness in teaching general chemistry concepts, and the time demands of the course. The organic chemistry faculty who teach CH 203*

(Fall semester sophomore year), and depend upon effective teaching in CH 101/102, have also raised concerns about the mastery of general chemistry principles in their students. Thus it became apparent that an assessment of CH 101/102 was necessary at this time, and ultimately would be part of an overall assessment of all two semester offerings of general chemistry (CH 101/102, CH 109/110, and CH 111/112). .