Form E-1-A for Boston College Core Curriculum

Department/Program: Chemistry

1) **Have formal learning outcomes for the department's Core courses been developed? What are they?** (What specific sets of skills and knowledge does the department expect students completing its Core courses to have acquired?)

   Yes, the department has developed learning outcomes for chemistry core courses which are consistent with those established by the University Core Committee for all core courses in natural sciences.

   Students completing chemistry core courses will:

   1. Expand their understanding of the principles, body of knowledge, and investigative strategies that comprise chemistry and its applications
   2. Develop a chemical and scientific literacy that will promote curiosity, respect for the scientific method, and general awareness of the limitations of scientific conclusions
   3. Recognize the role of scientific discovery, past, present and future, in interrelated concerns such as human health, societal well-being, and planetary sustainability
   4. Appreciate the role of science and chemistry in defining their relationship with the natural world and their position within the cosmos

   The university's core learning outcomes for natural sciences can be found at: https://www.bc.edu//bc-web/schools/mcas/undergraduate/core-curriculum/core-requirements.html#2_courses_in_natural_science

2) **Where are these learning outcomes published? Be specific.** (Where are the department's expected learning outcomes for its Core courses accessible: on the web, in the catalog, or in your department handouts?)

   These learning outcomes are published on the Chemistry Department website. They can be accessed under *Academics* → *Undergraduate* → *Core Courses*: https://www.bc.edu/content/bc-web/schools/mcas/departments/chemistry/academics/undergraduate/core-courses.html

3) **Other than GPA, what data/evidence is used to determine whether students have achieved the stated outcomes for the Core requirement?** (What evidence and analytical approaches do you use to assess which of the student learning outcomes have been achieved more or less well?)

   In 2020-21, assessment tools were developed for and utilized in CHEM1105-6 Chemistry and Society I-II.

   Five times throughout the semester, an anonymous survey was given to students using the online platform Qualtrics to gauge overall satisfaction. In tandem with this quantitative measure, text-entry boxes allowed students to explain and offer feedback. Also, in the last week of classes, students were

invited to respond to reflection prompts on the course's online discussion forum. A high number of students (49% of the class) responded to at least one of the prompts, selected from the following:

- What is something you discovered in chemistry this year that you tell people about?
- Is there something you encounter on a daily or semi-regular basis now that makes you think of the invisible world of molecules?
- Did you have an Aha! moment this year?
- When looking at a chemical structure, what did you think before this semester and what do you think now?
- What should the future of chemistry look like?
- Do you have any thoughts on how chemistry education (or science education) to the general public can be improved?
- What's your pick for a molecule (or material, process, or technique) that changed history?

The 68 responses, many several paragraphs long, gave a rich resource from which to analyze the sentiments of students towards chemistry and assess success in meeting the targeted outcomes.

4) **Who interprets the evidence? What is the process?** (Who in the department is responsible for interpreting the data and making recommendations for curriculum or assignment changes if appropriate? When does this occur?)

The instructor for Chemistry and Society, Prof. Joseph Morabito, and the Chair of Undergraduate Chemistry Studies, Prof. Lynne O'Connell, interpret the evidence together. Prof. Morabito compiles the results, and then he and Prof. O'Connell analyze and interpret the data and discuss changes to the curriculum/assessments. This occurs during the summer.

5) **What were the assessment results and what changes have been made as a result of using this data/evidence?** (What were the major assessment findings? Have there been any recent changes to your curriculum or program? How did the assessment data contribute to those changes?

Some common sentiments expressed by students in their end-of-semester reflections were:

- I surprised myself with my ability to comprehend concepts in chemistry despite coming in believing that chemistry is too difficult for "someone like me"
- My experience with chemistry in high school—in particular its emphasis on calculations—left me thinking it a dull subject, but this course's focus on connections with society improved my view
- Instructor enthusiasm and abundant real-world connections were the main reasons I was able to connect more with this class than with previous chemistry classes
- Everyday experiences like smelling a scent or washing my hands with soap now conjure up pictures of what's happening at the molecular level
- I was able to explain to roommates and family members the chemistry behind everyday occurrences such as the diffusion of an aroma or solutions to global problems such as battery storage for renewable energy

- The final project (in which students gave a group presentation on a topic involving chemistry of their choosing, often with a personal connection) was instrumental in seeing how chemistry connected with my daily life and the things I care about

Feedback indicated that connections to daily life, society, and current global issues resonated most with students, and so the decision was made between fall and spring semesters to double-down on these aspects. Starting in Spring 2021, material began to be structured according to a societal question or problem rather than a scientific category. For example, the lesson "liquids and solutions" became "water sanitation and life expectancy". This shift in perspective allowed teaching of the same scientific principles, but through a lens that is relevant to students' lives and that emphasizes the critical role played by chemistry in extending human lifespan and improving quality of life.

Less favorable student feedback on surveys mainly related to the difficulty of chemistry content on quizzes. Specific changes that were implemented as a result of this feedback were (i) the addition of review sessions before quizzes, (ii) greater alignment between quiz questions and the check-for-understanding questions that accompanied each lesson, and (iii) providing a PDF of the check-for-understanding questions to make it easy for students to print and mark up. In their end-of-semester evaluations, many students mentioned the ability to give regular feedback as a strength of the course, and several specifically called out the review sessions and adjustments to the quiz structure as positive changes.

6) **Date of the most recent program review.** (Your latest comprehensive departmental self-study and external review.)

June 2016: A Periodic Report is required by the American Chemical Society for our majors program every 5 years. Our report was filed in May 2015, and we received notification in June 2016 that our program meets all the requirements of the ACS Guidelines. Several items were cited as "commendable" such as our support for renovation, high quality of instrumentation, vast array of in-depth course selection, and outstanding student research.