

## MEMO

May 31, 2004

TO: Dr. Richard Rakos, College of Science

FROM: Robert Wei, Coordinator of Assessment for BS Chemistry *Robert Wei*

SUBJECT: 2004 Annual Assessment Reports for BS Chemistry

Over 600 chemistry programs in colleges and universities in the US including ours at CSU) are approved by the ACS (American Chemical Society). Many departments seek ACS approval and advertise that they are approved to assure students that they have high-quality programs in chemistry. Most departments participate in the ACS-examination program as a means of maintaining their ACS-certified programs. The Department of Chemistry at CSU maintains two tracks for the BS program in chemistry. One is a program approved by the ACS and which follows the guidelines established by the ACS. The other track (pre-professional track) is not directly applicable to requirements set for the ACS-track, with less extensive requirements in chemistry and a significant component in the biological sciences. The pre-professional track also leads to a minor in biology and it meets particular criteria for chemistry majors for a professional degree. Presently, the assessment process focuses on the ACS-proved track and documents to assure that the *three* stated goals are implemented. The Department Undergraduate Committee (DUC) is involved in the development of the assessment program for the BS degree in chemistry and serves as the principal body to coordinate the various activities in the implementation of the stated goals. The Committee meets twice a year and the second meeting this will be held sometime in June-July to review all the assessment materials that have been collected for the academic year 2003-2004.

**Goal One and Outcome Measures:** As an ACS-approved program, we strive to follow the guidelines established by the American Chemical Society. The goal 1 is to "develop sound background in the core areas of chemistry." Two outcome measures are employed. One is the standardized ACS tests in the areas of *General Chemistry, Organic Chemistry, Analytical Chemistry/Instrumental Analysis, Physical Chemistry, Inorganic Chemistry, and Biochemistry*. The ACS-exams provides a meaningful assessment of the learning that takes place in our undergraduate chemistry curriculum. Some of the tests (General Chemistry I, Organic Chemistry I, and Biochemistry) were given at the end of the first semester while others (General Chemistry II, Organic Chemistry II, Physical Chemistry, Inorganic Chemistry) at the end of the second semester. The performance data by our students on the tests are analyzed and compared to national norms as the data by the Exams Institute become available. The trends of the test performance will be monitored and analyzed at least twice a year henceforth.

First and second year course sequences (organic chemistry and general chemistry) are taken by a large number of students in various academic plans as part of the pre-professional training, as part of the core curriculum in chemistry, or to fulfill different career objectives. Comparative performance by the CSU students on the ACS exam thus help to evaluate whether our students are acquiring broad knowledge of chemistry as it was intended. Students who are in the ACS- approved program, in addition, take core courses that are essential in gaining a wide range of advanced chemical concepts and quantitative approaches. Student performance on the ACS-examinations in the core areas ( physical chemistry, organic chemistry, inorganic chemistry, biochemistry, and analytical chemistry) is an important tool for assessing 'sound background in the core areas of chemistry.'

### ***Outcomes/Research/Findings/Reviews/Actions for Goal 1***

° ***ACS-exams.*** The Department staff assist in the logistical aspects of gathering and filing data concerning the ACS-examinations. The faculty assigned to the core courses administer the exams and the answer sheets are sent to the Exams Institute. We initiated the process of becoming part of the national norm so that the results by our students will be compared to those of other ACS-approved programs in the country. The Institute provides data tables that show the raw scores and percentile ranks for each normal score allowing individual student scores to be compared. The Committee (Department Undergraduate Committee) will analyze the data in sometime in July and decide what steps are needed to improve our programs in chemistry. Since this is the first year we are making systematic efforts to use the ACS-exams as assessment tool, this year's data will serve as the reference for future tests. The specific information that have been collected or need to be collected for review and analysis are:

- a. National *norm* for the ACS-exams in:
  - General Chemistry I
  - General Chemistry II
  - Organic Chemistry I
  - Organic Chemistry (Comprehensive)
  - Physical Chemistry (Comprehensive)
  - Analytical Chemistry/Instrumental Analysis (not administered)
  - Biochemistry (one semester)
  - Inorganic Chemistry (one semester)
- b. Rubrics and Student Performance for:
  - General Chemistry I and II
  - General Chemistry Lab I and II
  - Organic Chemistry I and II
  - Organic Chemistry Lab I and II

### ° ***Classroom Learning***

As the secondary measure, classroom learning as a principal part of academic achievement is integrated into the assessment process. Intents are to evaluate pedagogical achievements in various areas of knowledge in chemistry which complements the data from the ACS-exams. The Committee will identify the range of pedagogical concepts and principles students are expected to acquire in the first-year and core courses. Since the first and second year courses (general chemistry and organic chemistry) have many sections that are taught by a diverse group of full- and part-time instructors, a significant degree of variability in teaching as well as in grading schemes tends to occur. Thus, in order to maintain consistency in teaching quality among the different sections of the courses, the General Chemistry Committee developed the guidelines which include level, nature and depth of instructional offerings. All instructors assigned to the courses provide rubrics and performance data at the end of each semester which are filed. For the upper-level courses that are required for the chemistry curriculum, a centralized dossier is kept for each student as soon as their major is declared which is kept current until the student graduates. The undergraduate adviser (Associate Chair for Undergraduates) and the Committee examine all student dossiers and associated information at least once each semester. During the evaluation at the end of the second semester, the Committee will begin to develop a format that identifies and organizes the various topics that are taught in each course.

The specific information that is required for assessment are:

Rubrics and data on class performance for the following courses:

- General Chemistry I
- General Chemistry II
- Organic Chemistry I
- Organic Chemistry II
- Analytical Chemistry
- Instrumental Analysis
- Inorganic Chemistry
- Physical Chemistry I
- Physical Chemistry II

***Goal Two and Outcome Measures*** (Develop oral and written communication skills)

As indicated in the ACS guidelines for chemistry departments, development of effective written and oral communication skills is an essential aspect of the chemistry curriculum. While students learn the skills through the presentation of seminars, term papers, etc, several upper-level courses required for the chemistry curriculum have been designated to assess student progress in communication skills.

° ***Oral Communication skills*** The performance from the course *Student Colloquium* (CHM 472) is used as a primary assessment tool to evaluate progress in oral communication. A rubric for assessing student performance includes a specific set of

criteria to evaluate student's ability to consolidate their chemical knowledge and express ideas clearly and effectively by presenting scientific/technical information such as term papers, problem sets and for assigning grades. The criteria for acceptable communication skills include appropriate organization of technical/scientific data in graphic and tabular forms, correct analysis and ability to interpret the data and draw proper conclusions, correct use of scientific notations/symbols, effective time utilization, levels of rapport with audience, proper use of visual aids, correct use of spelling and grammar, and clarity of expression. Each of the criteria is then evaluated by use of such scale as excellent(E), satisfactory(S), or unsatisfactory (U).

Additional assessment materials that can also be used for assessing the oral communication skills include abstracts of any papers presented at the ACS meetings, and honors and awards received at the professional meetings for their oral presentation. The instructor of the course file the evaluation sheet in the students dossier.

**Written Communication skills** Two upper-level courses in chemistry are used for assessing student learning progress in written communications, *Physical Chemistry Lab I (CHM 426)* and *Advanced Instrumental Analysis Lab (CHM 416)*. These courses, designated as Writing Across Curriculum courses, are well suited for evaluating student progress. Copies of sample student reports from these courses are then filed. The criteria evaluating written communication skills are detailed in the rubrics. Further, the posters and other written materials presented at scientific meetings and associated information, e.g. journal articles (published/accepted), can be added to the student file as evidence for student progress and achievements in written communication skills. The following information is needed for review by the Committee:

- ° Rubrics and data on class performance for Physical Chemistry Lab I and Advanced Instrumental Analysis Lab
- ° Identify the performance of chemistry majors in the above courses

### ***Outcomes/Research/Findings/Reviews/Action for Goal #2***

The instructor of Student Colloquium (CHM 472) evaluates student's performance for his/her file and places the class data in the course file at the end of semester. The person in charge of the courses, Physical Chemistry I and Advanced Instrumental Analysis Lab) files data in group (class) file. In addition, those reports receiving unsatisfactory grades are filed in the students file.

### ***Goal Three and Outcome Measures (problem solving skills)***

Development of problem solving skills is an essential aspect of learning chemistry. For assessment purposes, two upper-level courses are designed to evaluate learning in problem-learning skills: Physical Chemistry I (CHM 310) and Inorganic Chemistry (CHM 446). Students acquire various chemical concepts and principles largely through problem solution. These courses are required for chemistry majors in the ACS-approved track. Instructors in charge of these course submit rubrics which include objectives and contents of the course and the criteria for grading. They are filed in the

file for Problem Solving Skills. In addition, the person in charge of the course file includes sample assignments or tests along with the group performance. In addition, written reports from the independent research courses may be used as evidence for student progress in problem solving skills.

The following information is needed for review by the Committee:

- ° Rubrics for Physical Chemistry I and Inorganic Chemistry
- ° Sample Assignments or Tests
- ° Class performance with identification of chemistry majors

