

A Literature-Based Senior Level Instrumental Course

One of the skills that chemistry graduates often lack when they enter into the workforce or go on to further their education in graduate school/medical school is proficiency in comprehending, critically analyzing, and communicating scientific literature. Especially in the graduate school setting, students are often expected to develop this skill quickly without much in the way of direction or practice. They are asked to develop research proposals and provide input into the direction of their dissertation work through careful analysis of the literature base. This can be a very difficult transition for students that have had limited exposure to scientific literature as undergraduates. We felt a need to better prepare are students for their transition into a more mature scientist. As a result we have developed a senior-level Instrumental Analysis course that is largely literature-based.

Lectures

The course meets twice a week on Tuesdays and Thursday mornings for 75 minutes for lecture and discussions and on Thursday afternoons for 3 hours of laboratory work. Tuesdays are reserved for lectures on different instrumental techniques. This part of the course was taught in a fairly traditional fashion. The course covered UV-vis, fluorescence, atomic absorption and emission, FT-IR, Raman, NMR, mass spectrometry, X-ray spectroscopy, GC, HPLC, SFC, electrophoresis, Auger Spectroscopy, SEM, and AFM. Stress was placed on function of the instruments, appropriate types of analysis that can be performed on a given instrument, and strengths and weakness of competitive methods. In the latter part of the course questions were routinely posed during lecture that attempted to facilitate the mental process necessary to select an instrumental method that is most appropriate for addressing a given problem.

Literature Assignments

Thursdays are literature days; we discuss a recent research article (usually from Analytical Chemistry) in considerable detail. The students were given an article a week in advance along with 5-8 questions to be answered. Their answers were collected prior to the class discussion on the article. With leading questions from the instructor the class engaged in a spirited discussion about the literature article. Debate about the authors' experimental design and interpretation of their results often develops. This format occurred throughout the first half of the semester. Students were given semester-long individual literature assignments that culminated in a PowerPoint presentation on Thursdays during the second half of the semester. During the first 3 weeks of the semesters students find a current research field of their interest to focus on for their projects. They were asked to delve into the literature cited in their original papers to provide some background material in their presentations. The presentations were graded on the basis of Grasp of fundamentals, Depth of analysis, Background research, Command of material, and Organization of presentation. Their fellow students were given an article that their fellow classmates selected to highlight their chosen field of study. Literature assignments from these articles were prepared by the instructor. These assignments were due the lecture following the presentation of their classmate.

Lab work

The laboratory component of the course consisted as project-based laboratory modules. Students worked in teams of three and four and were encouraged to divide up

tasks and work effectively as a team. Each team was given a four-week project. The tasks to be performed and ultimate goals of the project were explicitly stated. This information along with pertinent literature papers were provided to the students one week in advance of the first lab period for the given project. During the lab period on week 1 each group was instructed to use the literature articles as a guide in designing a “plan of attack”, which constituted an outline of a project plan, including experimental details. The instructor guided them through this process. The group members were instructed to formally submit this outline on the following Tuesday (one outline per group). The students received a group grade for this outline. Week 2 and 3 were used to perform the necessary experiments to complete the project. During week 3 they are given the information for their next project.

Week 4 was used to organize and evaluate the data collected the prior two weeks for the project, and to determine if any further experimentation is needed. During this laboratory period they are required to design the experiments that need to be performed for the next project (the “plan of attack” that is due the following Tuesday.)

Reports were due the Tuesday after week 4. They were graded and returned promptly that Thursday. Lab reports were written in the style of the research articles that they have been reading in the literature review portion of the course (abstract, introduction, theory and experimental, results, conclusions, references). The reports were required to be revised. The final grade for the lab report was an average grade between the original and revision. The course contained four of these projects.