

## **162c The Proper Place for Beer in the Undergraduate Curriculum**

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Graduates from bioprocess engineering courses will be responsible for producing such modern products as monoclonal antibodies for drugs, enzymes for detergent, and DHA for baby formula. This might lead one to expect that current students can learn little from brewing, a process older than recorded history. However, from an instructional point of view, brewing provides a well documented example of a bioprocess in action while being sufficiently complex to allow for thoughtful application of theory. CHEG 452: Bioprocess and Biochemical Engineering concludes with a problem-based unit centered on the brewing of beer. The problem is entirely student driven, from the phrasing of the initial problem to the selection of measurement methods to the collection and analysis of data. This paper discusses the objectives, outcomes, and process for the student brewing problem in the Fall 2004 semester.

To start the unit, students wrote proposals describing the variables they wished to change and hypothesized what the outcomes would be. The instructor selected the best proposal, circulated it to the class, and then held a brain-storming session to plan the experimental protocol. Based on this, groups of two or three students were each assigned a component (such as sugar) and asked to recommend a measurement method for that compound, and to secure the needed reagents and equipment. Variables tracked included volume of gas evolved, total sugar concentration, ethanol concentration, pH, dissolved oxygen concentration, and suspended yeast concentration. Student teams cleaned the equipment, started the brewing, and took measurements every one to four hours. The comparison of the data to the hypotheses formed the basis of the course final exam, and the tasting of the beer (in small amounts by students of appropriate age) formed the basis of dinner at the professors' house.

The feedback for this part of the course was very positive. Students gained an appreciation of “real” bioprocess data and of the need for process sterility to a much greater extent occurred with previous in-class experiments.. The process was safe, clean, and of great intrinsic interest to many students, and will be repeated again in future years.