Contemporary Applications of Mathematics & Food Chemistry

MATH512 FOSC328/628

Collaborative Learning Between Food Chemistry and Mathematics

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Overview

FOSC 328/628

FOSC328 (Food Chemistry) is a required course for Food Science and Technology Majors. This year 7 students registered for this course: 5 undergrads, 2 grad students; 6 Food Science Majors and 1 Chem-E Major.

Traditionally, food chemistry is taught as if it were an extension of organic chemistry. Most textbooks go through the chemistry of food, starting with water, followed by carbohydrates, proteins, lipids, vitamins food additives, etc.

However, in the food industry, food chemistry knowledge is used to troubleshoot problems:
Why has this food gone off in two weeks?
Why is this product tasting so bad?
Why does this product fall apart?
How did our competitor make this product?
Make a line extension for:
Low-fat /High Carb Diet
Fits this health claim
Organic
Is this ingredient what it says it is?
Does this product stay within government regulations for nutrient content?

By facing open ended projects, students gained experience in applying chemistry to food products.

MATH 512

Math 512 is the Math Department Capstone course for all BS majors and offers a unique opportunity for math and technical majors interested in exploring mathematical topics and their connections to the real world. This course focuses on modeling, experimentation, computation and the application of mathematical methods to open problems. Writing and verbal communication of mathematics and science play a central role in helping students manage their projects.

Previous problems include:

•Optimize the lower surface of an airbearing to maximize lift.

•Understand the interaction between heat and current in an array of thin wires to be used for a transdermal drug delivery system.

•Develop a mathematical description of the Briggs-Raucher oscillating chemical reaction.

Math 512 is an evolving course and welcomes input from a variety of contributors on many aspects of the course.

Project

This project was to create lines of communication between student teams in two distinct courses, FOSC 328/628: Food Chemistry and Math 512: Contemporary Topics in Applied Mathematics , both featuring large-scale, open problems.

Two teams from each class were designated to participate in this pilot study to work on a common problem that is rich in both food chemistry and mathematical content.

Profs Davies, Pelesko, and Rossi designed questions for each pilot team to aid them through the problem and to encourage them to communicate with other team.

Throughout the semester, the pilot teams were accessible to one another serving as both technical providers and consumers. We modified course activities to create new conduits of information between the pilot teams.

Students learnt to communicate with their peers working in a different discipline, in a variety of ways including impromptu discussions and meetings, verbal presentations and formal reports and verbal presentations.

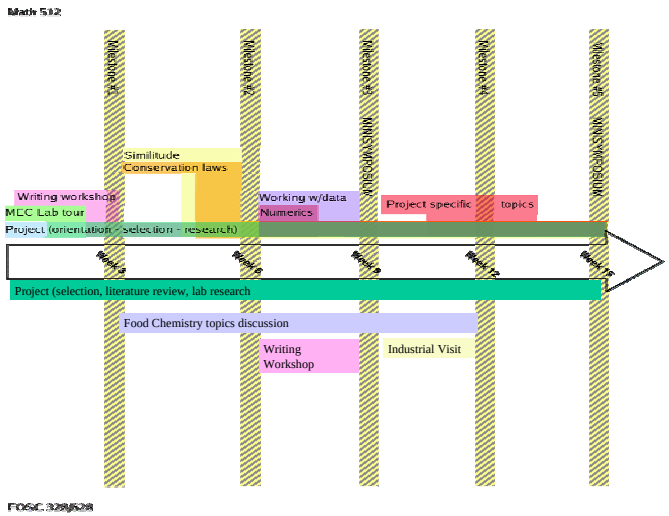
Impacts on student learning.

The general education goal chosen for this project was *written and oral and communication.* One of the purposes of the course was to improve *interdisciplinary communication* as both graduates of Food Science and Mathematics will work in interdisciplinary teams once in the workplace.

The students who participated in this project have acquired valuable experience in an environment that requires interdisciplinary communication.

Students were assessed on their ability to communicate. Each team wrote five reports throughout the semester and two mini-symposia were held.

Timeline



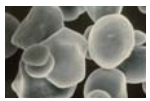
Summer Preparation

During the summer of 2004 two undergraduate students worked on this project. One math student, Kathryn Sharpe, was supervised by Dr.'s Rossi and Pelesko. She worked in the MEC Lab, which is an experimental laboratory housed in the Department of Mathematical Sciences. One Food Science student, Latonia Polk, was supervised by Dr. Davies. She worked mostly in Dr. Davies laboratory. The role of these two students was to attempt to start the projects that would be used in the fall. There job was not to complete these projects, but rather to act as test subjects. Are the experiments reasonably easy to carry out? Are they too time consuming? Can an undergraduate construct a model of these systems in a reasonable amount of time? In addition, Katy and Latonia were asked to interact – much as the students in Math 512 and FOSC 328/628 would in the fall. By observing their interactions, both the successes and pitfalls, we were better able to plan for team interactions in the fall. Katy and Latonia presented the results of their work at a symposium held by the Department of Mathematical Sciences in mid-August.

Our summer 2004 team in action. Two students worked exclusively on this project.

Student Problems

Cooking Starch



Water & heat

Two different approaches to starch gelatinization were taken.

•FOSC group looked at the effect of oil and emulsifiers on the texture and viscosity of corn starch gels

•MATH group studied and modeled the rate of starch gelatinization in rice and potatoes

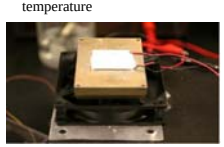
Starch gel

Emulsifier and Starch gel

Microwaved potatoes: White areas are cooked

Water Freezing Rate

The "Mpemba Effect" occurs when hot water freezes faster than cold water. The project was to mathematically and experimentally explain if and why water at a warmer temperature freezes faster than water at a cooler temperature



MATH used a thermoelectric cooler

FOSC used an adapted ice cream maker

Outcomes and Suggestions

•All projects were successfully written up in five reports and presented at both mini-symposia.
•Students didn't interact as much as we had hoped.
- •Students were based at different ends of campus:
  - •FOSC in Townsend Hall on South Campus.
  - •Math in Memorial Hall & Ewing Hall on Main Campus.
- •Conflicting class schedules:
  - • Students within one course and between courses.
  - • Hard to get together outside of class.

•These might need to be reconsidered next time we teach these classes together.
•First time FOSC students worked on open-end semester long projects.
- •Evaluations suggest that they wanted more lectures.
- •In future: reinforcement of relevance to food chemistry.
  - •Discussions of book chapters and relevant articles.
- •Progress in FOSC capstone (Spring 05) greatly improved compared to previous years.

References

•Barham, P. The Science of Cooking, Springer, London (2001)
•G. Christen and J. Scott Smith : Food Chemistry: Principles and Applications, Science & Technology System, West Sacramento, CA. (2000).
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