

Goal

To improve student retention in STEM disciplines, and thus increase the number of graduates in STEM fields, by reforming the curricula of the Engineering and Life Sciences Calculus sequences at USF.

Motivation

- At USF, six-year graduation rates are under 60% for STEM majors while they are over 80% for business, nursing and education majors.
- Passing rates (C or better needed to advance to the next course) average 55% for Engineering Calculus I, II and III and Life Sciences Calculus I and II.
- Students often change their major before even taking a class in it, due to loss of motivation in basic science and math courses and failure to see the relevance to their major.

Thrusts

Project Based Calculus Instruction

- Introduction of “bridge” projects into Engineering Calculus II and III and Life Sciences Calculus II by giving students the option of replacing the final exam with a project report.
- Integration of practical examples and “mini-projects” into the classrooms of Engineering and Life Sciences Calc I.

Peer Leading

- Undergraduate peer leaders lead weekly, 50 minute cooperative learning inquiry sessions in Engineering and Life Science Calc. I.
- Curricula developed by faculty and graduate students focus on guiding students to discover concepts of calculus prior to lecture. Algebra and trigonometry warm ups are included.

STEM Mart

- Undergraduate tutors staff a “one-stop” tutoring lab with evening and weekend hours .
- They provide assistance in calculus and in introductory science courses such as chemistry, physics and biology.

Rationale

Calculus Passing Rates - 2006

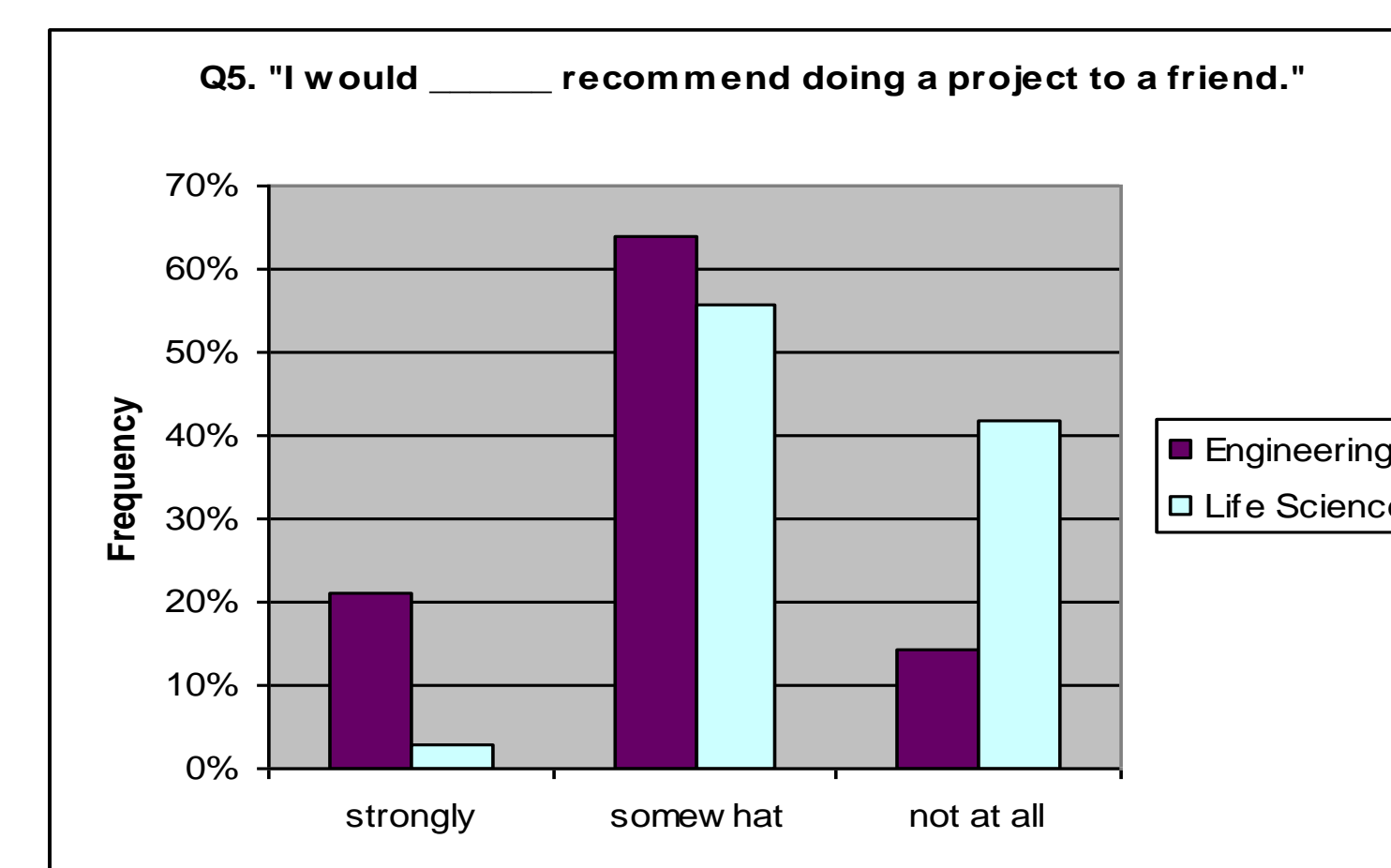
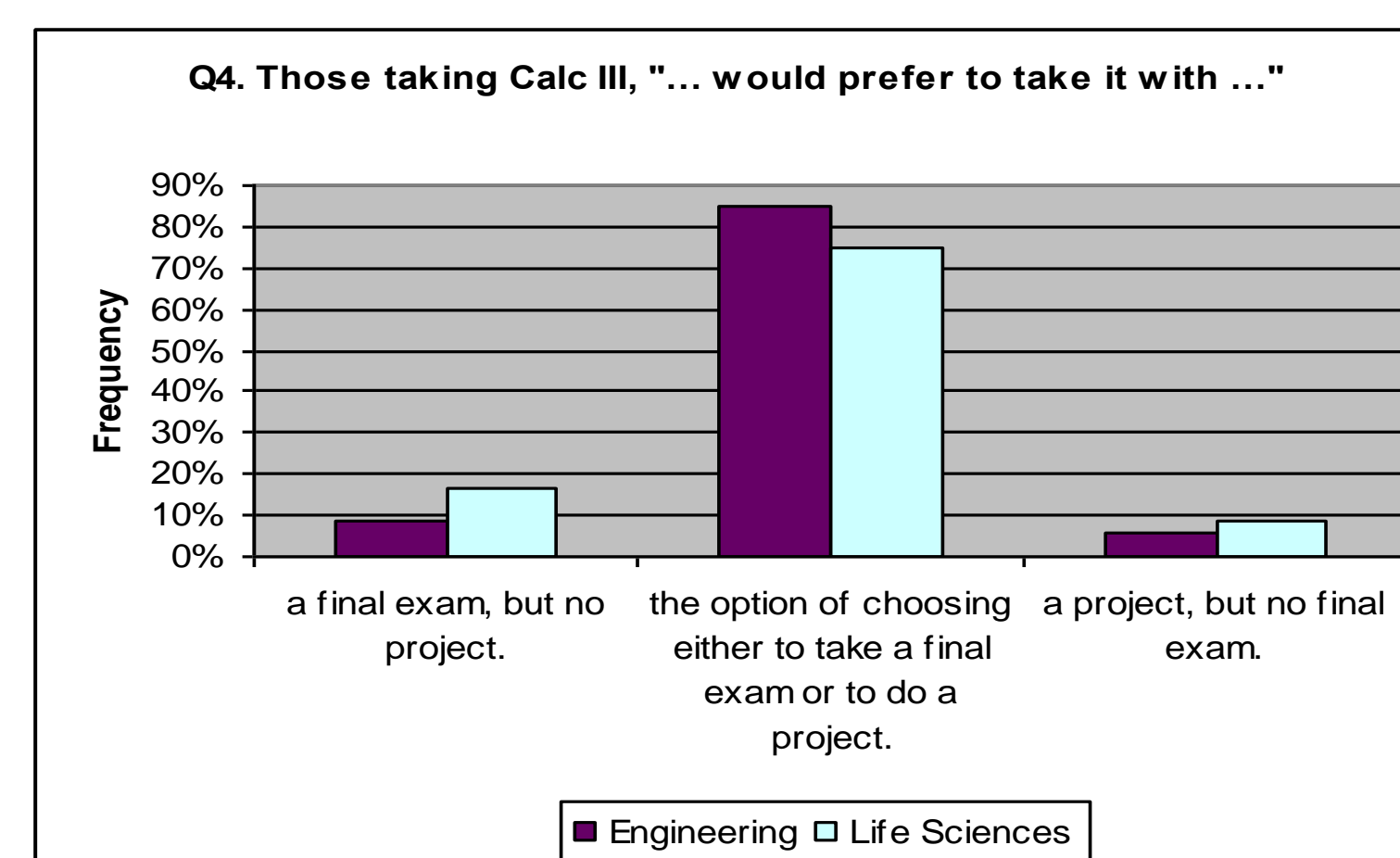
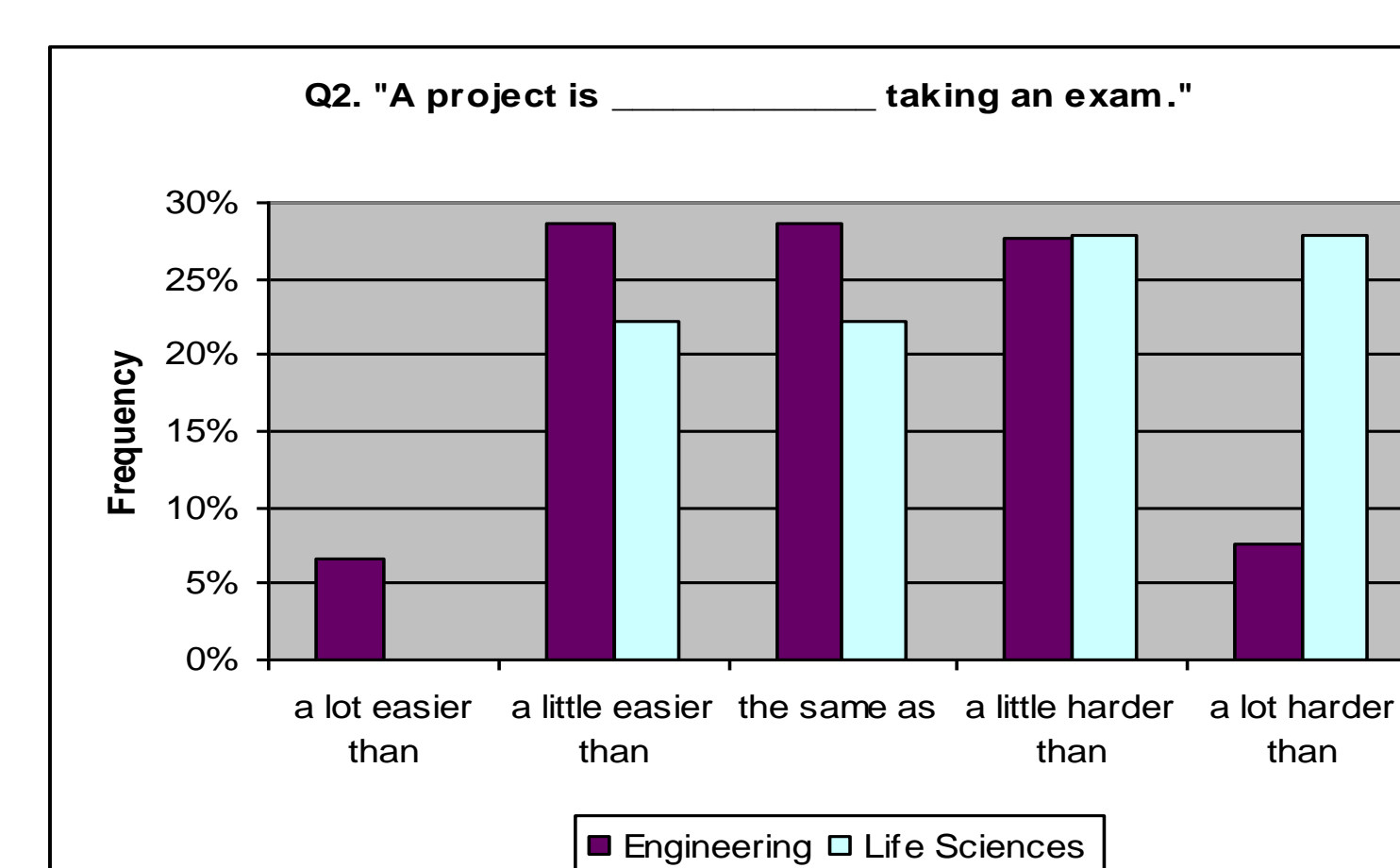
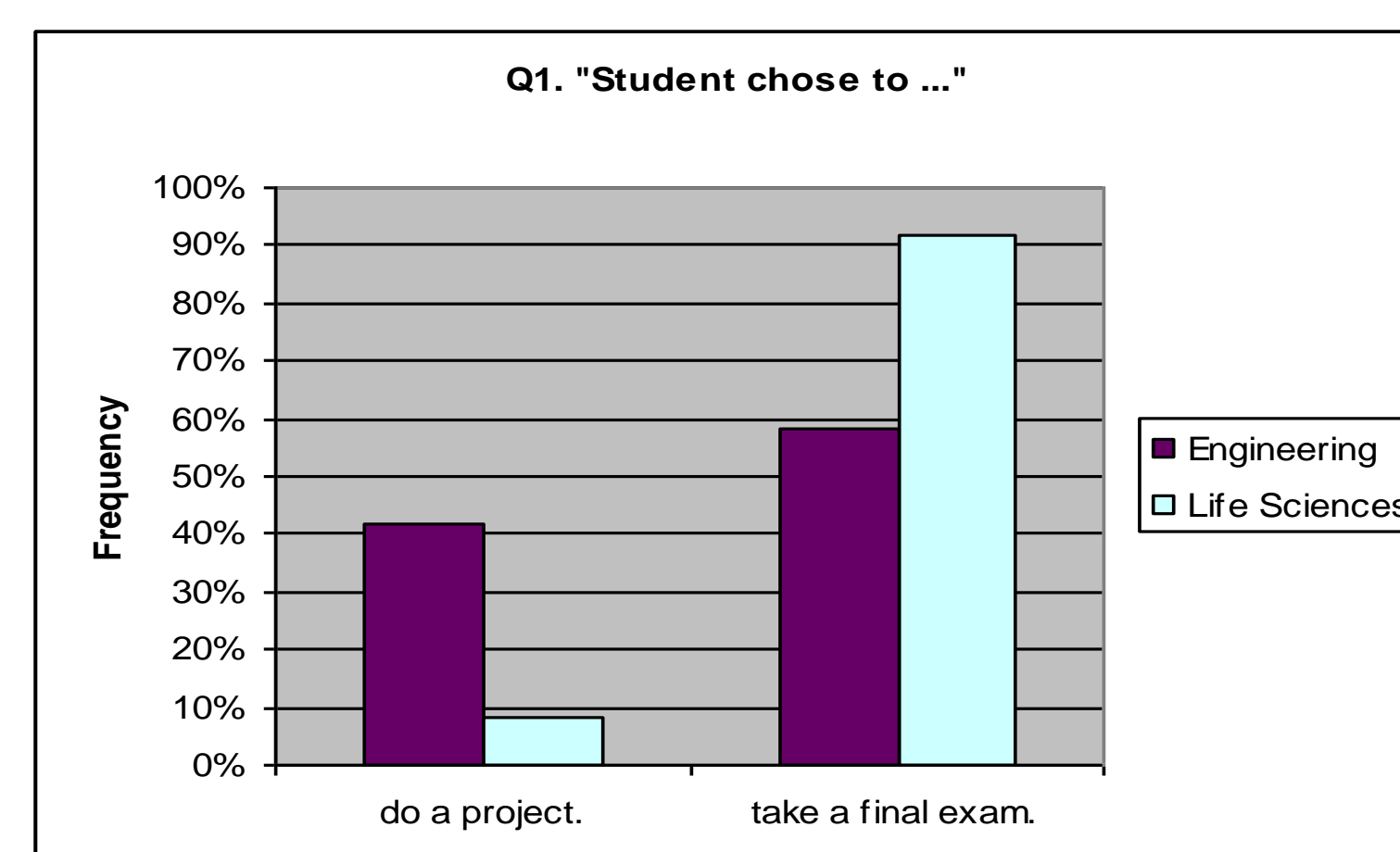
Section	No help session or project	Help session OR project	Help session AND project
Morning	49%	59% (help session)	85%
Evening	45%	67% (projects)	N/A

Focus on Project Thrust

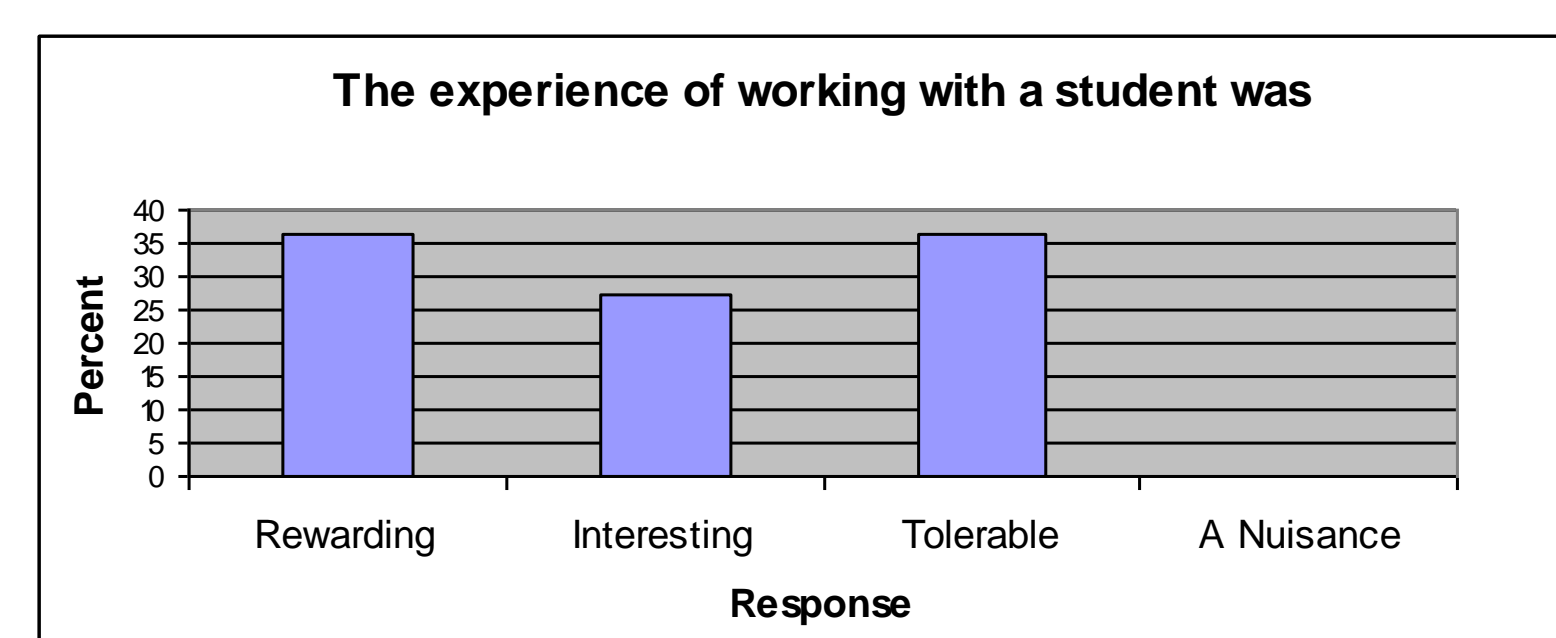
First Implementation – Fall 2008

- Students in three sections of Engineering Calculus II and one section of Life Sciences Calculus II were given the option of doing a project instead of taking a final exam.
- Forty-four engineering students and three life sciences students submitted projects. The project reports were submitted in a common format.
- Of the 47 projects submitted, 37 were suggested by engineering faculty, 3 from life sciences faculty and 7 from other sources, including industry professionals, faculty in other disciplines and the students themselves. A sample project is given to the right.
- During the spring 2009 semester students in three sections of Engineering Calc II, one section of Engineering Calc III and one section of Life Sciences Calc II are being given the project option.
- Preliminary polling suggests that approximately 100 Engineering Calc II, 40 Engineering Calc III and 15 Life Sciences Calc II students will select the project option.

Student Survey Results – Fall 2008



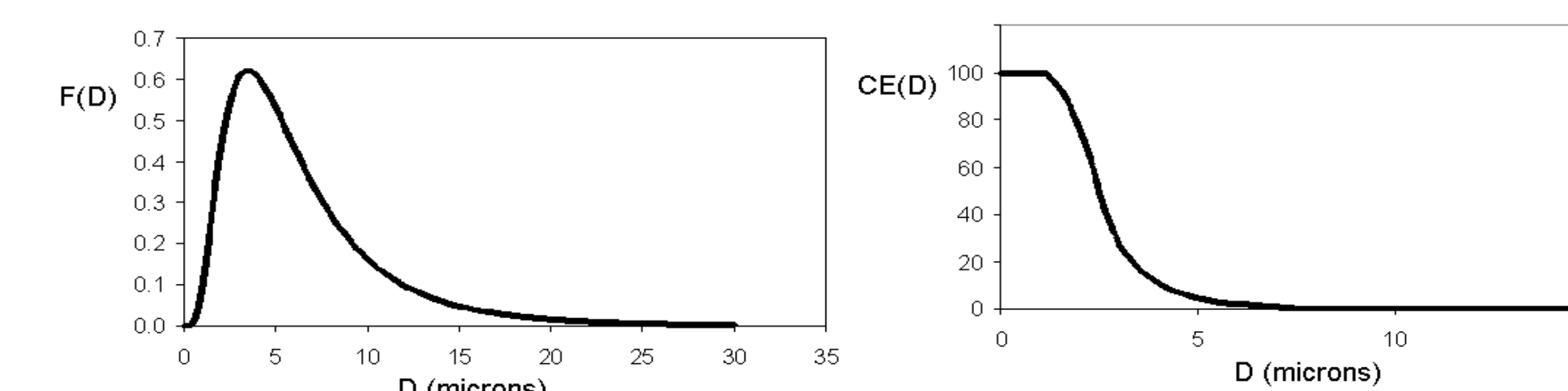
Faculty Survey Results – Fall 2008



The survey was of engineering faculty who suggested projects. Some found it to be a great mentoring opportunity. Common suggestions included shifting the time frame, ensuring that faculty who suggested the project see the final draft, and having sample problem statements and solutions made available.

A Sample Project

The student was given data for the distribution of particle nitrate (NO_3^-) in the atmosphere (left) and for the collection efficiency of a nitrate sampler (right) as a function of particle diameter.



The goal of the project was to calculate the fraction of nitrate in the atmosphere that would be collected in this sampler. The solution required numerical integration. This problem is of importance to atmospheric scientists.

Challenges in the Project Thrust

- Getting faculty to volunteer to suggest projects is difficult because it is not part of their assigned duties and they are already overloaded. Attempts to recruit via email failed. Now, we speak about the projects at the faculty meetings of individual departments and then speak to faculty one-on-one afterwards.
- Getting students in Life Science Calculus to choose the project option is difficult. The results at left suggest that this is because they believe the project will be more difficult than the final examination. We plan to have Life Sciences faculty speak to the calculus students directly to “sell” the idea of doing a project.
- Faculty are sometimes uncomfortable suggesting projects because they don’t have a sense of how difficult or involved they should be. We are disseminating samples of both problem statements and student solutions, the former via the project web site and the latter via an electronic journal of the best project reports.

An Opportunity

- The management of the projects is difficult because there are several different math instructors, a large number of students, and a large number of faculty from other departments who have suggested the projects. We were able to obtain internal funding from the university to develop a web application for the management of these projects.
- The application will function much like the reviewer interface of a professional journal.

The National Science Foundation (grant DUE-0756847) and the College of Arts and Sciences, the College of Engineering and the Center for 21st Century Teaching Excellence at the University of South Florida are gratefully acknowledged for their financial support