Department of Biological and Irrigation Engineering
Application for the
Utah State University Department Teaching Excellence Award
2007

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Statement of Departmental Philosophy of Teaching and Learning

The Department of Biological and Irrigation Engineering (BIE) believes that excellence in teaching is at the core to students, staff, and faculty success. By providing students with the best possible education, the department benefits from outstanding students and enhanced research quality. The department has made a commitment to combine best practices in education, with a caring faculty, and a focus on integrating research into the education experience.

Eight years ago, the Biological Engineering (BE) undergraduate degree program was at a low point of only ten undergraduates. The program had suffered from a lack of vision for the undergraduate program. After eight years of development and a commitment to continuous improvement, the program currently has ninety-three undergraduate students (Figure 1). Critical in this revitalization were the core values of active learning for students, integration of research in all levels of the undergraduate experience, and a departmental commitment to each student as an individual.

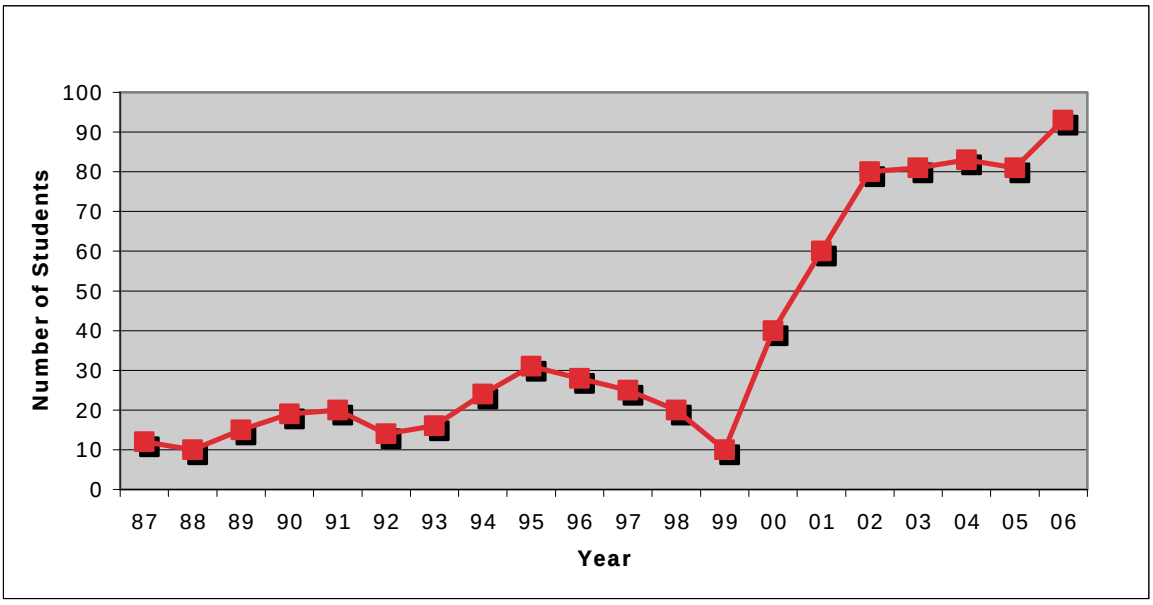

Figure 1. Biological Engineering Undergraduate Program Enrollment.

Active learning is an essential element in making the learning experience of any student come alive. In engineering the students learn by doing rather than just listening to a lecture as the dominant teaching method. Courses have been restructured to include active learning elements such as discussions, team problem-solving, experiments, and research projects. Traditional lectures have been minimized and are being supplemented with electronic media and student-led presentations. This approach has also allowed the department to better address the breadth of student interests in Biological Engineering, which is distributed primarily among the Biomedical, Bioprocess, and Bioenvironmental

sub-disciplines as seen in Figure 2. By selecting topics of study based on their interest, students are empowered and more fully integrated into the program.

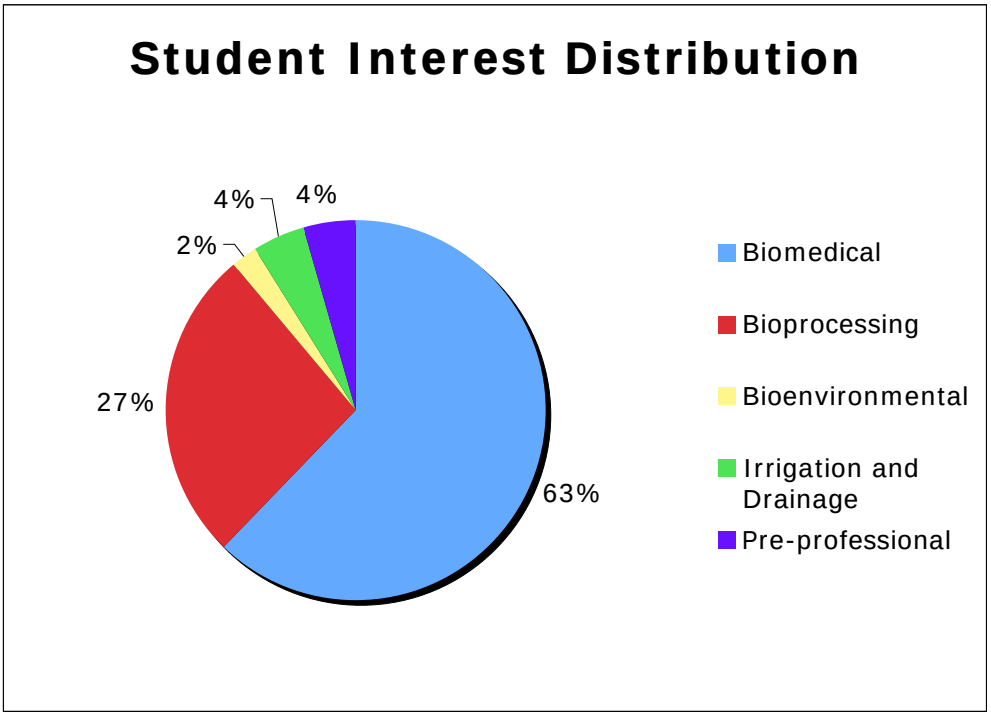

Figure 2. Biological Engineering Undergraduate Student Interest Distribution at Utah State University.

The department believes that undergraduate participation in research is a fundamental part of the undergraduate experience. Students who have experience in research are more engaged in their coursework, confident in their abilities, and have greater motivation to pursue advanced degrees. Additionally, they are more desirable to potential employers. The department has a strong commitment to the success of each student. We encourage and help students with different learning styles and abilities to succeed in the program. This marks a departure from the traditional engineering approach where it is our job to "weed out those who can't cut it." The traditional attitude tended to select only students that fit a specific mold of learning, while others tended to drift away with the feeling that engineering was an impersonal and inflexible field. Historically, if students were not completely focused from early-on in their studies, they would fail and be forced to change colleges. We recognize that not all undergraduates enter the university with the same experiences, study skills, and motivation to succeed immediately. The BIE faculty learn about each of the students individually and help them to gain the skills and enthusiasm for the major so that they can be successful. In response to a recent open-ended survey question students clearly indicated that "enthusiastic," "caring," "personal interaction" with the teachers was the most effective aspect of their educational experience.

Section 1. Commitment to sustained excellence in teaching and learning

The BIE Department has made a commitment to developing a culture of teaching excellence as a core value for the overall success of the department and the students who graduate from the program. Our philosophy that experiential learning, combined with an integrated research and teaching program, will provide our students with the best possible educational experience. The department strives to provide excellence in teaching each course. This has been demonstrated for the past five years by the teaching evaluation scores for the department (Table 1). The department has consistently exceeded the evaluation averages for the College of Engineering and is often above the averages for USU in both overall quality of the course and instructor effectiveness scores.

Table 1. BIE Department Teaching Evaluation Scores

Year	Semester	Overall Quality of Course			Instructor Effectiveness in Teaching		
		BIE	College	USU	**BIE**	College	USU
2002	Spring	**5.1**	4.7	4.9	**5.2**	4.8	5.0
2002	Fall	**5.2**	4.6	4.9	**5.3**	4.6	5.0
2003	Spring	**5.0**	4.7	4.9	**5.0**	4.8	5.0
2003	Fall	**5.2**	4.5	4.9	**5.2**	4.5	5.0
2004	Spring	**4.5**	4.7	5.0	**4.6**	4.7	5.0
2004	Fall	**4.7**	4.7	5.0	**4.6**	4.7	5.0
2005	Spring	**4.8**	4.7	5.0	**4.8**	4.7	5.1
2005	Fall	**5.2**	4.8	5.0	**5.3**	4.8	5.1
2006	Spring	**5.1**	4.8	5.0	**5.1**	4.9	5.1
2006	Fall	**5.0**	4.7	5.0	**5.1**	4.7	5.0

While teaching evaluation scores are not the only measure we use, they help the department to identify areas that need improvement from a student's perspective. In instances where the department averages have declined, we have been able to identify specific changes or areas that required attention. The lower values reported in 2004 were the effect of a combination of new faculty, new courses with associated laboratory sessions, and efforts by the department to lay the ground work for improved teaching overall. With the implementation of many of the improvements, including a new teaching laboratory, additional TA support from the department, and the addition of a technology education specialist as part of National Science Foundation Department Level Reform (NSF-DLR) Planning Grant, the scores have risen to the previous levels.

Much of the work during this period will provide templates that will allow for future faculty to develop courses and associated laboratory exercises in a structured manner that will minimize start-up time.

The core teaching philosophy that has been established over the last five years supports:

a) Integrated research as part of the educational process. Undergraduate students are encouraged to participate in research. They are supported by faculty mentoring and departmental support to attend national professional conferences to present their research.
b) Experiential learning is a critical part of courses. Each course continues to add hands on problem solving, laboratory experiences and discussions to provide the broadest range

possible of learning opportunities. In the spring of 2006, when the department lost the faculty member that normally teaches the Tissue Engineering course, we were able find an interim lecturer to teach the class. Several faculty worked with the interim instructor to develop laboratory and field trips in keeping with our teaching philosophy that it is critical to provide the students with hands on learning opportunities.

c) Integration of the best practices and use of technology to enhance the learning experience for the students and make the best use of contact time with the faculty in the classroom. Standard templates for WebCT have been developed through the NSF-DLR grant. These will allow a standard feel for department courses and allow supplemental materials to be presented outside of the classroom so that student contact time can allow for more experiential learning activities.

The relative newness and rapid increase in size of the Biological Engineering Undergraduate Program has required substantial investment in the program including a new teaching laboratory, laboratory equipment to support the need to develop hands on activities for the students and a requirement for Teaching Assistants to help teach the larger classes.

The department and college have invested over $270,000 in laboratory development and equipment over the past five years. A dedicated undergraduate teaching laboratory, which supports department courses, undergraduate research, and capstone research projects, was completed during the summer of 2005. More than $100,000 has been invested in the laboratory development and supporting equipment. Further, the department has supported additional equipment in a wet laboratory in the Engineering Laboratory Building and individual faculty laboratories to support undergraduate research. The faculty allow use of their personal research facilities for teaching when needed.

With the rapid increase in size of the undergraduate program and the need to ensure the continued quality of courses, the faculty requested that the Department Head provide funding for TAs in order to support hands on learning. Historically the department has never had funding for Teaching Assistants; however with the departmental switch to a hands-on learning emphasis it became apparent from the 2004 student evaluations that faculty needed dedicated TA support to successfully deliver quality laboratory based courses. During the last two years funding has been procured to support several TAs. Funds from the Departmental Teaching Excellence Award would be utilized to support existing and developing laboratory courses.

The department has evaluated each new hire based on their ability to provide synergy to the teaching and research mission of the entire department. Each faculty member plays a critical role in allowing the department to provide the breadth of opportunity that our students deserve. Both the potential courses and how that person interacts with students are part of the selection process. As part of the annual review process each member of the department is evaluated on teaching, research, and service activities.

The department has been on the forefront of determining and utilizing the best practices for engineering education. We recognized that to meet the demand for future engineers we must attract and retain a qualified diverse group of students. To do this we must provide an environment that challenges our students, yet makes them feel welcome at the same time. To do this requires the creation of a radical new environment as compared to previous methods for teaching engineering. The challenge to meet these expectations provides an environment that not only allows, but encourages innovation in teaching. Examples of recent activities in the department include:

a) Pairing established faculty with new faculty to share the teaching load and allow mentoring and feedback during the new faculty start-up time.
b) Utilization of instructional design to support teaching efforts.
    i) The NSF DLR grant is an example of the integration of Instructional Technology students to assist with course content and instructional development beyond the role of the traditional teaching assistant.
    ii) A graduate level course was developed utilizing problem based tools from the Instructional Technology Department.
c) Multidisciplinary teaching of courses that provide opportunities for students from different disciplines to take a course together and utilize skills from both groups. Recently a graduate course in Biophotonics was taught to students in both Biological Engineering and Electrical Engineering. Teams were formed that required students from each major to collaborate on projects that used expertise of both groups.

The BIE department has been active individually, as well as in collaboration, in seeking grants for projects to improve teaching and learning. Recent grant proposal in these areas include (BIE collaborators are underlined):

1. *NSF-DLR: Re-Defining Biological Engineering in an Integrated Research and Cooperative based Undergraduate Curriculum.* D.W. Britt (P.I.), T. Taylor (Co. P.I.), K.T. Nguyen (Co. P.I.), National Science Foundation, September 1, 2004 – July 30, 2006. $100,000 (awarded). Collaborative activities with Dr. David Wiley and Ph.D. Candidate Mark McConkie, Department of Instructional Technology, College of Education, Utah State University.

2. *NIH-HHMI: Biology and Engineering Undergraduate Research Scholars*, A. Anderson (P.I.), D. Britt, T. Taylor, R. Sims (key personnel). 05/01/2006 - 04/30/2011. $2,199,134 (declined, resubmission planned).

3. *NIH-HHMI: Graduate Fellowship in Neural Sciences.* P. Ruben (P.I.), D. Britt, A. Zhou, K Nguyen, (key personnel). June 01, 2006 – May 31, 2011. $1,000,000 (declined).

4. *NSF-IGERT*: Flask to Field: An Integrated Curriculum for Students in Engineered Microbiological Systems. R. Sims (P.I.), A. Anderson (Co. P.I.), D. Britt (key personnel). National Science Foundation, July 01, 2005 – June 30, 2010. $2,900,000. (declined).

5. *NSF-ITEST-The populations, organisms, and environmental program – an integrated educational experience for teachers and students*. Paul Schreuders (P.I.), Joanne Bentley (Co. P.I.), David Britt (Co. P.I.), Christine Hailey (Co. P.I.), Timothy Taylor (Co. P.I.). National Science Foundation, July 01, 2005 – June 30, 2007. $1,173,000. (declined).

6. *NSF-EXT: The Women Oriented Resources & Life Development Program - Reaching Out Through Biological Engineering.* Paul Schreuders (P.I.), Joanne Bentley (Co. P.I.), David Britt (Co. P.I.), Christine Hailey (Co. P.I.), Timothy Taylor (Co. P.I.). National Science Foundation, July 01, 2005 – June 30, 2007. $600,000. (declined).

7. *NSF-GK12*: The Utah Engineering Education Partnership. . Paul Schreuders (P.I.), Ron Sims (Co. P.I.). National Science Foundation. July 01, 2005 – June 30, 2008 $1,501,687 (declined, resubmission currently in review).

8. *USU ADVANCE: The Development of Biomedical and Environmental Engineering Curricular Materials for Use in High School Biology Courses.* Paul Schreuders (P.I.), Joanne Bentley (Co. P.I.), David Britt (Co. P.I.), Laurie McNeill (Co. P.I.), Kytai Nguyen (Co. P.I.), Timothy Taylor (Co. P.I.). January 1, 2005 – December 31, 2005. $2,000 (awarded).

Section 2. Ongoing assessment and improvement of teaching and learning quality

The department has developed a continuous improvement process that evaluates the program on a yearly basis to ensure that that the program is meeting the mission of the department, the needs of the students, and addressing input from potential employers. The process begins with the objectives of the department for desired skills and abilities of students upon graduation (Table 2).

Table 2. Department Student Objectives

Number	Suggested Description
1	Students have proven themselves to be proficient in mathematics, the sciences, and engineering.
2	Students have shown a capacity for investigation and experimentation, including the analysis and interpretation of data, as well as the ability to design a cost-effective biological or irrigation system.
3	Students have exercised their engineering skills as part of a multi-disciplinary group, and have demonstrated the capability to communicate verbally, in writing, graphically, and through engineering media.
4	Students have demonstrated the ability to solve engineering analysis and design problems utilizing both fundamental engineering principles, as well as modern engineering technology and tools.
5	Students have demonstrated an understanding of the standards of professional conduct and ethical responsibility, in addition to the role that an engineer plays in modern global society.
6	Students have manifested recognition and commitment to the need for life-long learning as a professional, and have broadened the scope of their interests beyond engineering to include awareness of the world around them.

These objectives were developed by the faculty of the department in collaboration with the Departmental Industrial Advisory Board.

The department has two committees that are responsible for evaluating the teaching effectiveness and issues with courses, course content, and curriculum. The curriculum committee is responsible for the details of courses and teaching effectiveness within the department and feedback to other departments that teach required courses in the program. The ABET (accreditation) committee ensures that the continuous improvement process is followed each year. The departmental internal quality assessment program functions on a yearly cycle that provides a documented history of course materials, faculty self-evaluation, department team evaluations, and finally a faculty consensus and report identifying area for improvement (Figure 3.).

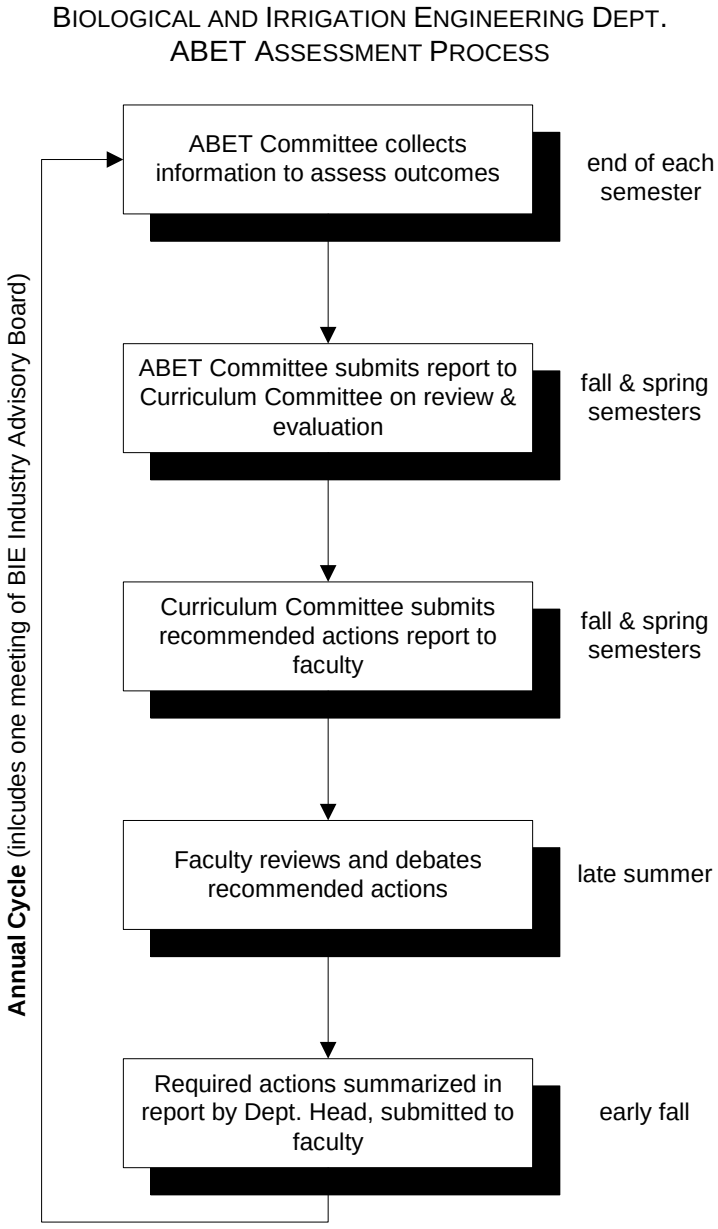

Figure 3. BIE Department Assessment Plan Flow Chart

Section 3. Faculty development for teaching

With the demands on faculty to excel as researchers as well as educators it is imperative that each new hire has the research skills necessary to survive in the academic environment. Because tenure track faculty have such strong demands to publish research findings, we recruit faculty who have strong research backgrounds. This means that it is important to instill a belief in teaching excellence in the new faculty through mentoring and example by the more senior faculty. The BIE department has a culture of excellence in teaching and is an environment where each of the faculty has great respect for the talents that each other brings to the department. In this environment a great deal of learning occurs based on modeling from others.

With new faculty we have provided mentoring by pairing new faculty with senior faculty during early courses. This allows the junior member to teach and learn in a secure environment where the senior member can provide feedback and hints on teaching. Recent examples in the department include Dr. Kwon and Dr. Taylor teaching BIE 2400, thermodynamics, during Dr. Kwon's first semester; Dr. Britt and Dr. Taylor teaching BIE 2330, Biomaterials Engineering, during Dr. Britt's first semester; and Dr. Taylor mentoring Dr. Nguyen during BIE 3870, Junior Design. In turn, Dr. Britt co-taught BIE 3000, Instrumentation, with Dr. Zhou as the course was handed-off to Dr. Zhou. Senior faculty also have an open door policy for newer faculty. This allows discussions about courses they are teaching and general teaching issues. Evidence of the effectiveness of this program is the rapid improvement of new faculty teaching evaluation scores and feedback as well as the overall improvement of the department average teaching evaluation scores in the past two years. We are extremely proud of these accomplishments considering the transition to more laboratory intensive classes during this time frame.

Additional activities designed to benefit and retain new faculty include: 1) A standardized WebCT template to allow new faculty to develop courses electronically with reduced effort; consultation with Instructional Technology collaborators on developing teaching and delivery approaches best suited for each individual faculty member. Mark McConkie from the Instructional Technology department has been a vital member of the NSF-DLR team.

The department culture of integration of teaching with research also provides a good opportunity for new faculty members to participate in the laboratory meetings of other faculty members. During this participation the senior faculty model interactions with undergraduate researchers.

The department curriculum committee provides a central place to evaluate teaching needs and issues in the department. In addition, the NSF-DLR program has provided a core of faculty that are evaluating the best practices in teaching as well as methods to integrate the curriculum to provide an excellent program for students.

The faculty have been active in the American Society of Engineering Education at the regional and national level, presenting papers at the Rocky Mountain Regional meeting in 2005 and at the annual meeting in Chicago in June, 2006. This organization provides a platform to discuss engineering specific pedagogy and issues. Likewise, we have used the Institute of Biological Engineering as a medium to present our efforts as they pertain to the rapidly evolving field of Biological Engineering.

However, regardless of the professional society hosting the conference, our department emphasizes that our educational activities are highly modular and can be adopted by any department where research is a primary focus. USU is a research institution, and we feel that it is in our best interest to leverage research into our education efforts. This is beneficial to students who need to leave the university with real-world skills. This supports faculty whose tenure is primarily determined by their research productivity, but still have strong teaching commitments. This is essential for sustainability as we strive to attract and retain the best students to attend USU, especially as we may start to feel more competition from Utah Valley State College which is selling itself as a "teaching institution". And finally, this addresses the decline in graduate student admissions from foreign countries due to tightened security measures and bureaucracy; by fostering an undergraduate research culture in our department, we are seeing more undergraduate students remain at USU for their graduate degrees. This is especially true for the five year BS - MS concurrent degree program.

Recent BIE participation in regional and national education conferences:

1. Britt, D., M. McConkie, T. Taylor, *Redefining a Biological Engineering undergraduate curriculum: Profits, Pitfalls, and Practicality.* Oral Presentation, 113th annual ASEE conference, Chicago, IL

2. Taylor, T., D. Britt, M. McConkie, P. Schreuders, and R. Sims, *One Model of Biological Engineering Education at a Land Grant University Based on Directed Evolution,* **Invited** oral presentation at Annual Meeting of Institute of Biological Engineering, Tucson, AZ, March 10-12, **2006**

3. Taylor, T., K. Nguyen, M. McConkie, D. Britt, *Redefining Biological Engineering*. American Society of Engineering Education: Advances in Engineering and Technology Education, Rocky Mountain Section, Utah State University, Logan, Utah. April 15-16, **2005**.

Section 4. Provision of resources for students

The department curriculum committee works with the College of Engineering advising center to ensure that the sequence and times courses are taught will be the best for the students. Proposed changes to the curriculum are jointly evaluated with the advisors to address potential conflicts in schedules and course prerequisites.

One of the outstanding features of the BIE department has always been the interaction of students with faculty. Most of the faculty have an open door policy with students to discuss courses, research, or advising issues. In addition, because of the emphasis on undergraduate research in the department the faculty interact on a personal level with all of the students. The department has an open lounge area that provides space for students, staff and faculty to interact, study or relax.

The departmental undergraduate coordinator, Dr. Timothy Taylor, serves as advisor for technical electives, mentor for academic issues and career counselor. In this role he strives to identify at-risk students and provide appropriate guidance for resources on campus to help students.

The department provides several methods for students to voice concerns and suggestions about the program. Both Dr. Taylor and Dr. Ron Sims, Department Chairman, are available to meet with students when they have concerns. The appropriate steps are then followed depending on the issue, with the goal to resolve the concern. If it is an academic issue the College of Engineering policies are followed. Often the concern is more about teaching quality or curriculum. These issues are addressed to the department curriculum committee.

The department philosophy emphasizes that research is central to learning, which extends the education process beyond the classroom. All students are encouraged to become involved in research during freshman orientation. Most begin by attending research group meetings of faculty with research emphasis related to their interest. This is then extended by shadowing more advanced students in the laboratory and assisting with literature reviews. This mentor-apprentice model allows each student to gain skills each year as they progress from the apprentice role to that of mentor.

Beyond departmental research, the department encourages internships with companies and research institutions. In recent years, students have had internships with HyClone Laboratories, Watson Pharmaceuticals, Pacific Northwest National Laboratory, Spendlove Research Foundation, Fresenius Medical Care, Facet Solutions, Amgen, and Wescore Medical Devices. Additionally, many of our students have participated in American Heart Association summer internships as well as REU summer programs. The BIE Club also arranges tours of local companies each year to allow students to explore real world opportunities.

The department has supported professional society membership for all students and works to maintain a student club. The department provides a 50% match on dues to the Institute of Biological Engineering and has supported student travel to the national meeting. In 2006, fourteen undergraduate students attended the IBE meeting in Tucson, Arizona with supporting funds from the department to aid in travel and hotel costs. In March 2007, eight undergraduate students will be attending the national meeting in St. Louis, Missouri. Further, the department provides a study room with key code access so that students have a place to study and interact. The study room has four computers, a white board and seating for up to 16 students to work together. Combined with the lounge area and undergraduate laboratory, we have developed a biological engineering environment that engages an undergraduate research culture by providing a sense of identity and belonging to a larger research team.

Student feedback is an important part of the department continuous improvement process. Course evaluations, student feedback to faculty, exit interviews and comments from graduates in industry all are factored into course and curriculum changes.

Section 5. Linking discovery, creative activity, and engagement with teaching and learning for the benefit of students

The department continues to integrate undergraduate research into the curriculum. All students are required to participate in a three-semester capstone design and research experience. They are encouraged to present findings at national meetings and to publish the results in peer reviewed scientific publications. Since 2003, over thirty-eight poster/papers have been presented at national meetings that included undergraduate authors. Since the fall of 2005, the BIE department has obtained ten Undergraduate Research and Creative Opportunities (URCO) Grants. This was nearly one-third of the grants awarded to the entire university. The students' research interests cover a wide range of research areas from biomedical, bioprocess, and bioenvironmental engineering (Table 3.), illustrating the diversity in our student interests and underscoring the need and motivation for our NSF-DLR activities to "redefine" Biological engineering to benefit students and faculty alike.

In the spring of 2007, Dr. Britt has added a new course, *Introduction to Undergraduate Research*, to help better prepare students for research activities in the department. This elective course is designed to engage first and second year students in research in the realm of biological engineering and biotechnology. In particular, these students are provided a formal means to gain firsthand access to research facilities and faculty research programs at USU. It is anticipated that students will learn specific skills in searching scientific literature, design of controlled experiments, basic lab techniques, data analysis, and data presentation. Early involvement in research will empower the students, better preparing them for future laboratory based courses as well as their capstone research projects (senior thesis). In addition, this course should benefit the faculty who supervise the capstone projects by providing faculty with competent undergraduate researchers. We have high expectations for undergraduates to perform high caliber research suitable for publication in peer-reviewed journals. As an incentive, students are given the option

of preparing their capstone projects in the format of a journal publication. Several examples of journal publications centered primarily on undergraduate efforts are given below (undergraduates are indicated by *):

1. Beck*, J., R. Angus*, B Madsen, D. Britt, B. Vernon, K.T. Nguyen, *Islet Encapsulation – Strategies to enhance islet cell functions.* Tissue Engineering Journal. In press, **2006**.

2. Anderson, A.J., D. W. Britt, J. Johnson*, G. Narasimhan, A. Rodriguez*. *Physicochemical parameters influencing the formation of biofilms compared in mutant and wild type cells of Pseudomonas chlororaphis O6*. Water Science and Technology, 52(7), 21-25, **2005**.

3. Goodman*, T., E. Bussmann, C. Williams, M. Taveras*, D. Britt, *Miscibility analysis of two-component lipid monolayers using electrostatic force microscopy*, Langmuir, 20, 3684-3689, **2004**.

4. Britt, D.W., T. Goodman*, C. Selle, *The Influence of Lipid Dipole Moment and Interfacial Water Structure on Protein Adsorption to Mixed Lipid Monolayers*, Materialwissenschaft & Werkstofftechnik, 34, 1133-1137, **2003**.

Table 3. URCO Grants from Fall 2005 through Fall 2006

Students		Research Topic
Heather Warren and Dolly Creger	F 05	EGF Conjugated Nanoparticles for Targeted Chemotherapy.
Gerald Dustin McEwen	F 05	Electrochemical detection of pathogenic DNA by signal amplification with intercalating agents.
Robert Gardner and Nephi Zufelt	F 05	Development of a Multi-element Microelectrode Array Sensor and Application of Water Quality Measurements.
Bryant White and Sterling Fife	F 05	Effect of 3D environment on growth and differentiation of bone marrow derived stem cells.
Jeremy Rasband	F 05	High-level GFP expression from immobilization of the methlothropic yeast Pichia pastoris.
Ryan Angus and Dustin Olsen	S 06	Strategies to enhance the adhesion of insulin secreting cell lines to polysulfone.
Reese Thompson and Shaun Cornia	F 06	Removal of hydrogen sulfide from biogas using biological methods.
Dusti McEwen, Erick Griffiths and Greg Olsen	F 06	Bio-impedance multi-sensor array, quartz crystal microbalance, and microelectrode array to measure relative volume changes in HEK293 cells.
Ross Booth, Gary Brimley and Sara Parker	F 06	Treatability studies for the bioremediation of PCP contaminated soils by use of prepared bed bioreactor models.
Steve Broby, Jason Brown, and Tayna Butt	F 06	A comparison of green fluorescent protein secretion in suspended cell and immobilized reactors.

Beyond the formal capstone research projects, students are encouraged to participate in research with faculty members as early in their careers as possible. Recently, one student started research in the summer before her freshman year. This student, Elisabeth Linton, has spent the last three years conducting research with Dr. Ron Sims and was recently selected as the Outstanding Junior in the department. All faculty have noticed an increase in the number of second year students attending their research group meetings.

Summary

The BIE Department is committed to developing a culture of teaching excellence as a core value for the overall success of the department and the students who graduate from our program. It is our belief that experiential learning combined with an integrated research and teaching program provides the best possible learning environment. Our department is committed to a process of continuous improvement to develop a modern, applied learning environment as we redefine biological engineering. The proposed changes are aligned with departmental goals and driven by student, faculty, and ABET recommendations to our program.

The BIE department is not as large as some other departments on campus, but our methods of integrated research and culture of teaching excellence can serve as a model to other departments by providing the best possible experience for students at USU. The interdisciplinary nature of Biological Engineering keeps us in continual contact with multiple other departments on campus.

In summary, we would like to highlight several key points of our program:

1. We have a commitment to *sustained excellence in teaching and learning*. This is evidenced by high student evaluations of our courses and instructors, extramural funding to improve our educational efforts, and continual improvement of courses with expertise from the Instructional Technology Department. Similarly, multidisciplinary courses such as Biophotonics have been developed in collaboration with other departments, extending our efforts to a greater number of students on campus.

2. Through ABET, student exit interviews, and our industrial advisory board, we have an *ongoing assessment and improvement of teaching and learning quality*. This is a continual process that provides us with critical feedback on our program.

3. Our faculty have numerous resources to assist in their *development for teaching*. This includes mentoring by more senior faculty, co-teaching of first offerings of courses to facilitate the transition, access to standardized course templates and training from the Instructional Technology Department, as well as opportunities to participate in regional and national engineering education conferences.

4. Finally, our *resources* and ability to *link discovery, creative activity, and engagement with teaching and learning for the benefit of students* is excellent both on and off campus. Students have a dedicated study room and lounge area adjacent to faculty offices. They have access to faculty research facilities through their undergraduate research projects (capstone projects). Through our new course, *Introduction to Undergraduate Research*, they have a formal means to participate in research starting from their first year on campus. Off campus, we encourage conference participation, provide industry tours, and facilitate industry and government laboratory internships for our students. Student involvement and response is excellent, as evidenced by our high number of URCO recipients, undergraduate co-authors on peer-reviewed journal papers, and undergraduate participation in conferences.