Proposal to Change the Chemical Engineering Department Name to
Department of Chemical and Biological Engineering

**Summary**

- Accurately reflects what we are doing – using biology and chemistry to do our engineering.
- Aids in recruitment of undergraduate and graduate students to Iowa State that are interested in bioengineering.
- Promotes collaboration for the introduction of biology into other engineering majors.
- Gives advantages in grant competition – particularly with NIH.

**Rationale for Change**

The Chemical Engineering Department at Iowa State University has long had interests in the biological applications of chemical engineering. O. R. Sweeney (1931 establishment of Agricultural Byproducts Laboratory) was looking to add value to agricultural years ago and the building now known as Nuclear Engineering Lab was originally built with USDA funding to support this effort. Richard Seagrave brought in biomedical engineering (1966), George Tsao (1965) and Peter Reilly (1974) added enzyme engineering, Charles Glatz brought in bioseparations (1976), Carol Heath (1993) and Surya Mallapragada (1996) debuted tissue engineering, Jackie Shanks (1999) brought in metabolic engineering and plant biotechnology and has been joined by Ramon Gonzalez (2002) in the former, and Balaji Narasimhan (2001) is doing drug delivery. Brent Shanks, Glenn Schader, Derrick Rollins, and Dennis Vigil both bring their core expertise to problems in biology or processing of biological feedstocks.

Many of these faculty members are using knowledge from the biological sciences to solve chemical engineering problems. In other words biology has become as much of an enabling science for us as Math, Physics, and Chemistry. We have offered a variety of courses in these areas for years and the recent flexibility of the curriculum permits interested students to graduate with a transcript that is quite comparable to a degree in Biochemical Engineering as offered at some institutions. So the added name is an accurate reflection of what we offer. And unlike some other “appendage” names (Petrochemical, Materials, Environmental) it does reflect the use of a core science – biology.

Furthermore, students – both graduate and undergraduate – are drawn to biologically-linked engineering in looking for a place to study. Hence, there is a need to make this aspect of what we are doing evident to those who don’t have a full appreciation of the breadth of chemical engineering or our activities here. Competition for students with such interest has become more intense with the establishment of numerous Biomedical Engineering departments. We feel the narrower focus of these

programs may well not be best for most students. While we are aware of full range of the chemical engineering discipline, most guidance counselors and high school seniors are not, and college seniors looking for a graduate program may infer that we have less activity in this area than programs including “bio” in the name. Since Iowa State has no biomedical engineering or bioengineering department or degree, our visibility is poor and very talented high school seniors will be lost to other campuses without having a chance to investigate the opportunities in our department and others in the College of Engineering.

There are two reasons that we feel a chemical engineering degree with an elective package emphasizing “bio” is more appropriate for many students. First, the education will be built on fundamental principles that apply to more than biological systems. That provides the student the flexibility to work in non-biological fields also. Second, “bio”-related companies have become the major employers of ISU Chemical Engineering graduates. Figure 1 shows that in recent years food, pharmaceutical, agricultural and biotechnology firms have employed 42% or our graduates.

There is also a need to support discipline-wide efforts to secure the future place of Chemical Engineering during a time in which many disciplines will be impacted by biology. We are currently seeing a proliferation of biomedical, bioengineering and biosystems engineering programs. Each of those programs has its place and there are advantages in having some accepted meaning emerge to avoid confusion. Chemical Engineering departments are changing their names to include “bio” in various forms (Table 3), but two options are favored. “Biochemical” is the older term but currently seems too narrow. “Biological” nicely reflects biology in the same way that “Chemical” reflects chemistry and the AIChE is introducing the Society for Biological Engineering. “Biomolecular” has been favored by some because it accents our focus on molecular transformations and also because it was defined by an NIH study group some years ago as appropriate. We raised the question with our industrial advisory group two meetings ago and they endorsed a name change while favoring “biological” with “biomolecular” second. The initial round of recent changes favored biomolecular but more recently biological has emerged as the favorite and now is the most frequently taken.

Chemical engineering as a discipline cannot do all of bioengineering. However, chemical engineering is well positioned to have a major impact on: reactors and analytical systems at a variety of scales, metabolic engineering, biomolecular/protein engineering, cell and tissue engineering, use of renewable feedstocks and “green” processing to create a sustainable chemical economy, bioinformatics, and drug delivery. Currently half of our faculty members have research efforts with components in these fields and, over the next few years, our involvement will grow. In pursuing these issues, there is ample opportunity to collaborate, not only with life scientists, but also our colleagues in other engineering departments. Collaborations can be promoted in research, course offerings, a biology for engineers offering, and interdisciplinary minors and majors. We have had numerous discussions with ABE regarding their proposal for

a degree in Biosystems Engineering and believe that has led to an understanding of a logical division of our two emphases for incorporation of biology.

We do not feel the need for either a new degree or new resources, because we are not asking to change our activity. We are proposing a name change for the department to more accurately reflect what we and our students are doing.

Table 1. Current faculty with "bio" engineering as their **major** research focus. (B. Shanks, R. D. Vigil, D. Rollins, and G. Schrader also have projects with this focus as do our two courtesy appointments – R. Brown and M. Porter).

| **Name** | **Rank** | **Research** | **Teaching** |
|---|---|---|---|
| P. Reilly | Dist. Prof. | Protein engineering | ChE 415, 515L |
| C. Glatz | Prof. | Bioseparations | ChE 415, 562, 562L |
| S. Mallapragada | Assoc. Prof. | Tissue engineering | ChE 543, 543L |
| J. Shanks | Prof. | Metabolic engr (plants) | ChE 525, 525L |
| B. Narasimhan | Assoc. Prof. | Biomaterials | ChE 543 |
| R. Gonzalez | Asst. Prof. | Metabolic engr (microbial) | ChE 525, 525L |

Table 2. Current Bioengineering Coursework (all are every two year offerings except 415 which is offered annually). All 500-level courses are taken by both seniors and graduate students.

| ChE Course No. | Title | Description |
|---|---|---|
| 415 | Biochemical Engineering | Survey of enzyme technology and fermentation |
| 525 | Metabolic Engineering | Analysis of biochemical reaction Pathways. |
| 543 | Biomaterials | Biomedical applications of materials |
| 562 | Bioseparations | Purification and recovery in bioprocessing |
| 515L, 525L 543L, 562L | Laboratory modules for 415, 525, 543, and 562 resp. | Labs developed with NSF funding |
| 426 | Unit Operations Lab | Includes experiments in ultrafiltration,fermentor mass transfer, enzymatic hydrolysis. |

Table 3. Sampling (what we were aware of supplemented with those found in a web search) of Chemical Engineering departments with “bio” added to name and the specific choice of name. Parentheses indicates in process.

| **Biological** | **Biomolecular** | **Biochemical** | **Other** |
|---|---|---|---|
| Wisconsin | Illinois | Rutgers | Colorado St. |
| Tufts | Penn | Iowa | Dartmouth |
| Colorado | Cornell | Christian Br. U | Nebraska |
| RPI | Ga Tech | Ariz St U | |
| Missouri Rolla | John Hopkins | UC Irvine | |
| Maryland BC | Notre Dame | Univ Coll London | |
| Poly U | Melbourne | Swansea | |
| British Columbia | | | |
| Maine | | | |
| Montana State | | | |
| SUNY Buffalo | | | |
| Northwestern | | | |
| (MIT) | | | |

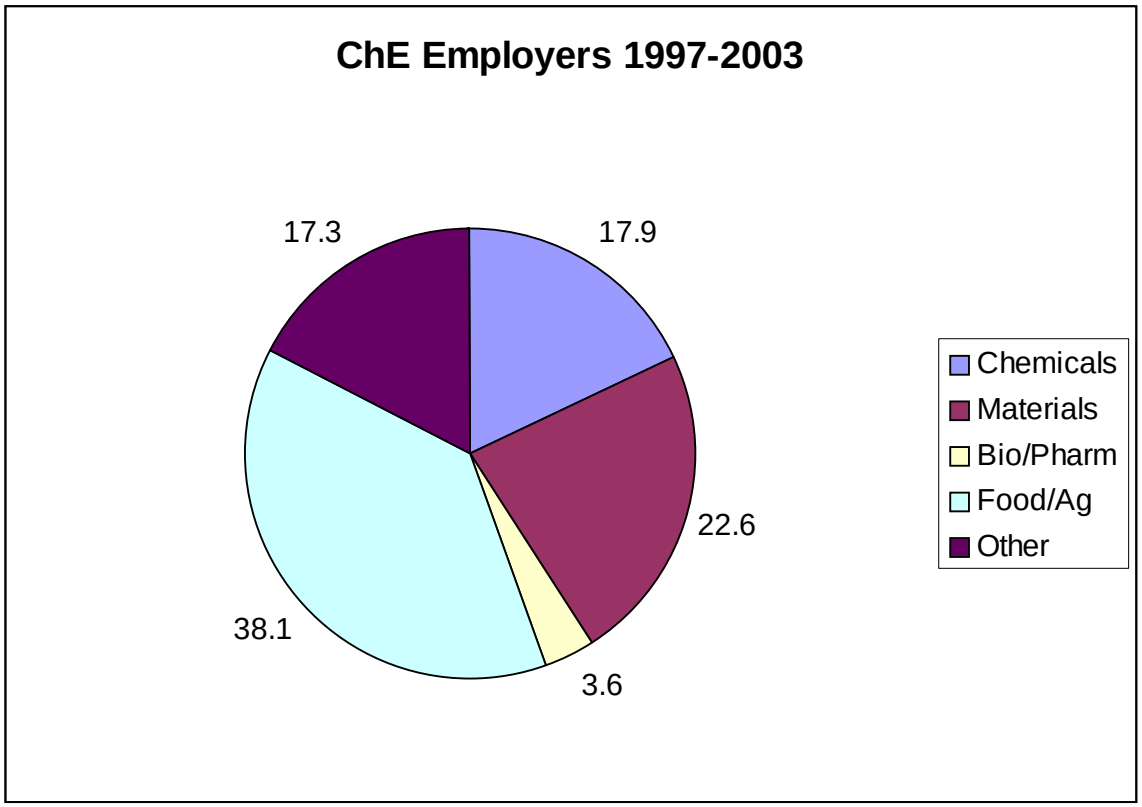


Figure 1. Employment field (by percentage) of ISU Chemical Engineering B. S. graduates 1997 – 2003 showing that 42% of our students have been employed in industries making significant use of biology. Data from Career Services listing of companies employing 3 or more graduates over this time period.