

SPECIAL REPORT
of the
PROGRAM AND BUDGET AND RESEARCH COUNCILS
concerning an
INSTITUTE FOR CELLULAR ENGINEERING (ICE)

Presented at the
699th Regular Meeting of the Faculty Senate
November 18, 2010

COUNCIL MEMBERSHIP

PROGRAM AND BUDGET COUNCIL

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RESEARCH COUNCIL

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PROGRAM AND BUDGET COUNCIL

Following a review by the Program Subcommittee and based on its recommendation, the Program and Budget Council unanimously approved the Institute for Cellular Engineering by electronic vote on 27 October 2010. The Council was satisfied that projected costs and revenues are realistic and in balance.

RESEARCH COUNCIL

On October 8, 2010, the Research Council reviewed the proposal by the Institute for Cellular Engineering (ICE) and recommends approval. ICE is an interdisciplinary institute that brings together researchers from both engineering and the life sciences, they work together to understand and manipulate the cellular machinery in plants, animals and microorganisms. ICE has been operating under provisional approval by the Provost.

Research and educational benefits of ICE:

- ICE serves to bring together ~ 50 faculty members from more than 10 departments on campus for interdisciplinary research and teaching activities.
- ICE is a unique entity on the UMass campus.
- ICE has secured already significant external funding support, including an NSF IGERT award for graduate education and research training (\$3 million, 2007-2012) and NSF REU awards (~\$650,000, 2007-2013).
- Through the IGERT program, ICE is training graduate students and offers cellular engineering curriculum and seminar opportunities and ICE is preparing a proposal for a *Graduate Certificate in Cellular Engineering* to submit to the Faculty Senate.
- ICE is also active in efforts to attract graduate students to UMass, with addition efforts directed towards attracting underrepresented groups, including underrepresented minorities and women.
- ICE also co-sponsors a high-impact symposium every 2-3 years.
- ICE is ideally positioned to attract support from industry by working to develop an Industrial Partners Network.

The Research Council offers its enthusiastic approval of 'Institute' status to Institute for Cellular Engineering (ICE). The activities and success of ICE are exemplary and are something that well serve the greater goals of UMass. ICE is very well placed to become an Institute of international reputation and will attract outstanding new faculty and students to our University.

MOVED: That the Faculty Senate approve the Institute for Cellular Engineering (ICE),
19-11 as presented in Sen. Doc. No. 11-020.

UNIVERSITY OF MASSACHUSETTS AMHERST
OFFICE OF THE SECRETARY
THE FACULTY SENATE

NEW INSTITUTES AND CENTERS APPROVAL FORM
(50 copies required)

Proposed title of Institute: Institute for Cellular Engineering (ICE)

Organizational Location: College of Engineering, Department of Chemical Engineering

Co-Directors: Prof. Susan Roberts, Director (Chemical Engineering)
Prof. Surita Bhatia, Associate Director (Chemical Engineering)

Mailing Address: 159 Goessmann Laboratory
Phone Number: 545-6140

Proposed starting date: Immediately

I. Description

A. Brief description (60 words or less) of the proposed enterprise: (Name, basic mission, activity scope, clientele)

The mission of ICE, an interdisciplinary institute at the critical interface of engineering and the life sciences, is to coordinate and expand cellular engineering scholarly activities on campus and enable translational research through strategic industry partnerships. ICE serves researchers, students, and industrial partners in their quest to understand and harness the power of cellular “machinery” in plants, animals and microorganisms.

B. Rationale and Justification: (Mission, goals, objectives, relation to campus goals, needs addressed, population served, resources obtained)

Cellular engineering is a rapidly emerging field, which encompasses an estimated 50 faculty investigators from more than 10 departments and two colleges on campus. Increasing research and development activity in cellular engineering is critical for the economic development of UMass Amherst and the Commonwealth of Massachusetts because the applicable markets are large and because Massachusetts has the capacity to create significant products to address needs in these markets. Understanding cellular function and manipulating cells/tissues to perform in a particular manner is the basis for many ventures in the biomedical, biotechnology and pharmaceutical industries, including drug production from cell culture, generation of artificial organs for replacement of diseased tissues, and microbial engineering for biofuel and bioremediation applications. The market opportunities in the fields of medicine, energy, and pollution remediation are all in the multi-billions, and faculty at UMass Amherst are well-positioned to make significant advances in these cellular engineering endeavors.

In 2006, \$145,000 in seed funding from the Science and Technology Initiatives Fund was used to launch the institute. ICE quickly augmented these funds by securing two National Science Foundation (NSF) interdisciplinary training programs:

- i. **Integrative Graduate Education and Research Traineeship (IGERT)** program (\$3 million, 2007-2012). Upwards of 50 graduate students from 12 campus departments and graduate programs will receive interdisciplinary training at the interface of engineering and the life sciences. More than 22 will benefit from ICE IGERT fellowships (\$30,000 annual stipends), which have strengthened recruitment and diversity initiatives for all affiliated departments. The ICE IGERT program has brought novel graduate curriculum, high impact scientific conferences, graduate career day programs, and industrial relationships to the University.
- ii. **Research Experience for Undergraduates (REU)** program (\$320K, 2007-2010; \$330K, 2010-2013). The ICE REU program reveals the field of cellular engineering to undergraduates. The number of applications soared from 41 in 2007 to over 200 by 2009. By 2010, 48 undergraduates had performed summer research in ICE laboratories, including 27 (56%) women, 17 (35%) underrepresented minorities, and 3 (6%) students with disabilities. Additionally, 6 ICE REU associated students are current UMass Amherst chemical engineering doctoral candidates participating in the ICE IGERT program.

The institute has been granted provisional approval by the Provost. We now request full approval to officially establish the Institute for Cellular Engineering and position ourselves to support University initiatives. The goals of the Institute for Cellular Engineering are to:

- Coordinate interdisciplinary research and development activity in cellular engineering.
- Train students (undergraduate and graduate) at the critical interface of engineering and the life sciences and promote K-12 science education outreach.
- Strengthen graduate recruiting, including efforts to attract and retain groups who are typically underrepresented in the field of cellular engineering.
- Foster academic-industrial collaboration in cellular engineering through an *Industrial Partners Network*, which will advise on the translation of proof-of-concept research results into applications and products, connect UMass researchers with industrial collaborators, provide internship and employment opportunities for ICE students, and advocate for Institute success.
- Engage the community in programs and events (ICE Symposium, Fall Graduate Preview, Graduate Career Day, etc.) that promote the field of cellular engineering while increasing visibility for the University at large.

C. Specific Activities planned as an on-going part of the enterprise: (Types, quantities of activities, meetings, publications, seminars, research)

The Institute will implement activities to support training, recruiting, research, and industrial partnership initiatives. The ICE IGERT program brings cellular engineering curriculum and seminar opportunities to campus. In the *Fundamentals of Cellular Engineering* graduate course, 15+ interdisciplinary ICE faculty team-teach 6 topic segments, assigning interdisciplinary, team-based homework assignments that prove to be valuable networking opportunities. The highlight of the program is the *Lab Module*, which is a “Professional Workshop” designed to train students on a particular research technique in a small, hands-on, environment. To date, more than 10 lab modules have been developed and implemented. The *ICE IGERT Graduate Seminar* exposes students to research topics in cellular engineering, and includes two student-invited speakers annually. Students also benefit from a *Professional Seminar*, *Student Research Seminar*, *Journal Club* and *Ethical Conduct of Research* course. To institutionalize these efforts, ICE is currently drafting a proposal for a *Graduate Certificate in Cellular Engineering*, with plans to submit to the faculty senate in 2010.

To support recruiting efforts, ICE and the Northeast Alliance for Graduate Education and the Professoriate (NEAGEP) program spearhead an annual collaboration between various graduate interdisciplinary training programs (CBI, Mass CREST, MassNano, MCB) to host an annual *Fall Graduate Preview* event. The goal is to attract graduate students to UMass, with particular emphasis on groups underrepresented in engineering and the life sciences. For the past two years, a total of 50 recruits have participated in this event, including 36 (72%) underrepresented minorities and 27 (54%) women. Of those 50 recruits, 44 earned bachelor degrees and were eligible for graduate school entrance by fall 2010. Of those 44 potential recruits, 24 (55%) **applied** to UMass, 13 (30%) **were accepted** by UMass, and 12 (27%) **are current** UMass graduate students (9 URM).

In addition to these figures, 6 (14%) underrepresented minority participants accepted federally funded *graduate internship* positions at UMass Amherst, strengthening UMass' opportunity to attract, mentor, and retain these students for affiliated graduate programs. Collectively, for these 44 event participants, UMass has admitted 18 (41%) to campus programs, including 15 underrepresented students.

To support graduate career development, ICE spearheaded *Careers at the Interfaces of Engineering, Physical, and Life Sciences*, a Graduate Career Day event held at UMass Amherst on May 18, 2010. ICE rallied the UMass Graduate School, three federally-funded interdisciplinary training programs (Chemistry – Biology Interface Program, ICE IGERT, and IGERT in Nanotechnology Innovation), one federally funded Nanoscale Science & Engineering Center (Center for Hierarchical Manufacturing, CHM), and the UMass Molecular & Cellular Biology Graduate Program to co-sponsor this event. Six external speakers, including two ACS 2010 National Award Winners and three alumni, came to campus for a day of talks, panel sessions, a sit-down luncheon, and an afternoon reception. Students considered the sit-down luncheon the “highlight of the day.” Six tables (seating one speaker and up to 9 students each) provided 50 graduate students with a unique opportunity to interact with esteemed professionals on a more personal level. This event was a testament to the ICE interdisciplinary mission, attracting over 100 participants from 14 different degree granting programs. Future events will be planned!

To support the research community, ICE organizes and co-sponsors a high-impact research symposium every 2-3 years (time lapse insures that topics and speakers remain “cutting edge”). On May 10, 2006, ICE presented the *First Annual Conference on Cellular Engineering*, with support from industry sponsors and the University of Massachusetts Amherst Research Leadership in Action Program. On May 11, 2009, ICE and the Department of Biochemistry & Molecular Biology (Nordin Lecture) presented the *Frontiers of Cellular Imaging* symposium. Nearly 300 attendees gathered to hear prestigious talks delivered by six imaging pioneers, visit 5 vendor exhibits, and peruse more than 20 posters during the formal poster session.

To support industry initiatives, ICE is in the planning stages of the *Industrial Partners Network (IPN)*. To kick off the IPN, five corporate executives participating in a campus brainstorming session with University administrators, Directors of ICE and the Institute for Massachusetts Biofuels Research (TIMBR), and associated faculty. The IPN will support academic-industrial collaborative research and training in addition to facilitating transfer of technology to the private sector for translation into widely distributed products. A follow up meeting will take place in fall 2010.

- D. How does this enterprise differ from other offices or activities on campus with similar names, missions, interests?

At this time, there is no other campus institute or center that targets the field of cellular engineering. Likewise, no other institute or center was created to specifically address the interface of engineering and the life sciences.

II. Institutional Relationship & Governance

- A. List all University units involved and describe administrative arrangements with them, if any.

ICE will be located within the Department of Chemical Engineering, with directors reporting to the Vice Chancellor for Research and Engagement. Administrative costs are shared by the Department of Chemical Engineering and external funding sources. Departmental support includes minimal use of office and bookkeeping staff for tasks related to human resources, purchase orders, travel reimbursements, and arranging seminar space. The sole ICE professional staff member is (fully) funded by the NSF IGERT grant through 2012, with plans to continue funding through additional training programs and/or center generated funds. Administrative staff will be added, as funds allow. An estimated 50 faculty investigators from more than 10

departments and two colleges on campus are participating in research at the interface of engineering and the life sciences.

- B. Describe any organizational relationships (as distinct from funding sources) with other agencies, public or private, outside the University.

At this time, ICE does not have any official relationships with any outside agencies. Future efforts related to the Industrial Partners Network may establish such relationships. ICE may in the future, as part of a research proposal or collaborative alliance for research funding opportunities, enter into partnerships with other academic institutions, industrial partners, or governmental agencies in order to secure funding.

- C. Describe the organization's advisory board or other governance group.

An Internal Advisory Board (IAB), consisting of campus academic and administrative leaders, will provide guidance to the directors. Meetings of the IAB are planned to take place at least twice per year. IAB members include:

Theodore Djaferis	Dean of the College of Engineering
Steve Goodwin	Dean of the College of Natural Sciences
Craig Martin	Professor and Head, Department of Chemistry
Lakis Mountziaris	Professor and Head, Department of Chemical Engineering
John Mullin	Dean of the Graduate School
Danny Schnell	Professor and Head, Department of Biochemistry

Mike Malone, ex-officio Vice Chancellor of Research and Engagement

To complement internal members, efforts are currently underway to form an External Advisory Board, which will include key members of the *Industrial Partners Network (IPN)*:

John Edwards	President, Adnexus
David Fischhoff	Vice President, Technology Strategy & Development, Monsanto
Michael Raab	Chief Executive Officer, Agrivida
Bob Steininger	Senior Vice President, Manufacturing, Acceleron Pharma

Leadership of ICE will be shared by a Director and an Associate Director, each of whom are faculty specializing in cellular engineering research.

- D. Will this be an institute – an independent organizational unit, acting as a department for purposes of non-faculty personnel actions and appointments, able to solicit its own funds without department head approval?

Yes, due to the interdisciplinary nature of its mission and activities, ICE will be a campus-scale institute rather than a center residing in one particular department. It will exist as a separate organizational unit under the Research and Engagement Area, and will function as a department-level entity in soliciting funding for certain research projects and other activities.

- E. If a center, describe the relationship within the department to which this organization is subordinate.

Not applicable

- F. Describe arrangements for any patent rights, copyrights, or other ownership components of activities, and any restrictions on access to research information.

The institute shall abide by all existing policies for University ownership of intellectual property. Relationships with external IPN members are advisory in nature, and a separate membership agreement will be drafted as companies are solicited for funds. The membership agreement will address the handling of IP in compliance with University policies.

II. Resources

- A. Describe the space available for use by the organization. (If this is not a permanent location, indicate other space arrangements that are to be made in the future).

ICE currently occupies office space (158C Goessmann Laboratory) and utilizes conference rooms within the Department of Chemical Engineering. In the future, ICE will relocate to the New Laboratory Sciences Building (NLSB).

- B. Describe any requests for space that have been made.

Although changes are not required for institute existence, changes have been recommended to improve competitiveness as substantial funding opportunities are pursued.

- C. Describe any repairs, renovations, major equipment needed to make the space you have useful to the organization.

No accommodations are required at this time.

- D. If any non-university employees or students are or will be using space, describe the arrangement.

Space shall only be occupied by university personnel.

- E. Staffing (when operation is fully developed)

1. Non-faculty (Provide rank or grade, student status, working title, FTE, source of funding).
 - a) Program Manager; grade 26; 1.0 FTE: source: grant-funded position, supported by various NSF and/or NIH-sponsored training programs.
 - b) Managing Director; grade 30; 1.0 FTE; hire is conditional upon and funded by a major institutional grant, such as an NSF-sponsored Science & Technology Center (STC).
 - c) Other non-faculty personnel may be considered in the future, based on revenue availability. Anticipated hires include students, as well as clerical and bookkeeping support.
2. Faculty involved (Provide name, department, extent involved, release time arrangement).

The official ICE Faculty members are listed on the next page.

Current ICE Faculty

Kathleen Arcaro	Veterinary and Animal Sciences
Harry Bermudez	Polymer Science & Engineering
Magdalena Bezanilla	Biology
Surita Bhatia	Chemical Engineering
Jeffrey Blanchard	Microbiology
James Chambers	Chemistry
Peter Chien	Biochemistry & Molecular Biology
Paul Dubin	Chemistry
Neil Forbes	Chemical Engineering
Scott Garman	Biochemistry & Molecular Biology
Lila Gierasch	Biochemistry & Molecular Biology
Lori Goldner	Physics
Kevin Griffith	Microbiology
Jeanne Hardy	Chemistry
Samuel Hazen	Biology
Daniel Hebert	Biochemistry & Molecular Biology
Michael Henson	Chemical Engineering
Alejandro Heuck	Biochemistry & Molecular Biology
Wei-Lih Lee	Biology
Susan Leschine	Microbiology
Derek Lovley	Microbiology
Jesse Mager	Veterinary and Animal Sciences
Jennifer Normanly	Biochemistry & Molecular Biology
Om Parkash	Plant, Soil, and Insect Sciences
Sandra Petersen	Biology
Susan Roberts	Chemical Engineering
Jennifer Ross	Physics
Maria Santore	Polymer Science & Engineering
Sallie Smith Schneider	Veterinary and Animal Sciences
Danny Schnell	Biochemistry & Molecular Biology
Larry Schwartz	Biology
Lianhong Sun	Chemical Engineering
Janice Telfer	Veterinary and Animal Sciences
Gregory Tew	Polymer Science & Engineering
Sankaran "Thai" Thayamanavan	Chemistry
Kim Tremblay	Veterinary and Animal Sciences
Patricia Wadsworth	Biology
Elsbeth Walker	Biology

While this list notes "official" members, faculty participation extends far beyond this list through interdisciplinary collaboration and access to cellular engineering facilities.

3. Describe how the Institute may impact existing teaching responsibilities of participating faculty members through "buy-out" arrangements, reduced teaching loads, or other provisions, and how such impacts will be resolved.

To date, no teaching release time has been granted. Any future arrangements for reduced teaching responsibilities would be thoroughly investigated and discussed to be sure that the quality of instruction is not negatively impacted.

- F. Attach a detailed budget showing sources of funding, full year basic operating costs and anticipated expenditures (This should show programmatic expenditure descriptions, kinds of funding accounts and amounts by subsidiary accounts as well as alternative funding arrangements or programmatic adjustments to be made if funding sources fail.)

Please see Attachment A

Attachment A

Budget Information Accompanying Institute Proposal for Institute for Cellular Engineering (ICE)

	2008-2009	2009-2010	2010-2011 (Projected)	2011-2012 (Projected)	NSF STC (annual projection)
Revenue					
NSF ICE IGERT indirect cost return	\$3,810.00	\$3,744.00	\$3,744.00	\$3,744.00	-
NSF ICE IGERT administrative direct costing	\$71,119.00	\$71,744.00	\$73,878.00	\$76,076.00	-
NSF ICE REU indirect cost return	\$928.00	\$1,163.00	\$1,179.00	\$1,012.00	\$1,000.00
NSF STC indirect cost return	-	-	-	-	\$111,500.00
NSF STC administrative direct costing	-	-	-	-	\$522,000.00
Symposium/event income	\$17,275.00	-	\$25,000.00	-	\$20,000.00
Corporate Memberships	-	-	\$10,000.00	\$50,000.00	\$50,000.00
Total	\$93,132.00	\$76,651.00	\$113,801.00	\$130,832.00	\$704,500.00
Expense items					
Personnel	\$55,625.00	\$65,425.00	\$67,387.75	\$69,409.38	\$522,000.00
Administrative and Operational	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00
Equipment Lease and Purchase	\$1,000.00	\$1,000.00	\$1,000.00	\$1,000.00	\$1,000.00
Symposium and events	\$24,250.00	-	\$25,000.00	-	\$25,000.00
Consortium and Advisory Board Meetings	-	\$4,000.00	\$4,000.00	\$4,000.00	\$10,000.00
Total	\$85,875.00	\$75,425.00	\$102,387.75	\$79,409.38	\$563,000.00
Net	\$7,257.00	\$1,226.00	\$11,413.25	\$51,422.62	\$141,500.00

A. Direct Financial Impact of the Institute

A primary objective of the Institute is to better position the University to compete for major NSF center grants and NSF/NIH sponsored training grants that will secure resources, personnel, and facilities vital for research and academic innovation. In 2007, the Institute secured two key NSF training grants: a five year, \$3 million IGERT program and a three year, \$320K REU program that was subsequently renewed in 2010 for an additional \$330K through 2013. In 2009, ICE submitted its first-ever proposal for a five-year, \$25 million NSF Science and Technology Center (STC). The proposal, entitled *Center for Building a Better Cell (CBBC)*, was one of just 43 (out of more than 300 submitted) invited to submit a final proposal. Although the CBBC was not ultimately funded in this round of competition, proposal feedback was positive and will be highly valuable for proposing similar scale grants (~25M) in the next two years.

The above budgetary information presents two operation scenarios: (1) projection through 2012, based upon currently secured funds, and (2) projection contingent upon an NSF STC award. Non-STC projections assume 1 professional staff member (100% direct costing to the IGERT grant) and 100% contribution of PI shares of indirect costs (IGERT and REU) to the Institute. Nominal administrative support (bookkeeping, travel reimbursement) is also contributed by the Chemical Engineering department. Upon center award, the "NSF STC" column applies. This annual budget assumes 4.5 professional staff and 3 core facility technicians at 100% direct costing to the grant, 1 professional staff, 1 administrative assistant and 3 core facility Directors (Ph.D.-level) to be supported by the University and 100% contribution of PI share of STC indirect costs toward institute budget.

Direct financial impact of the Institute resonates through support of personnel and students, creation of new cellular engineering facilities, and organization of events that raise the profile of the University.

	Support for 2007 - 2012		NSF STC (Five Year Award Period)	
	# Supported	Total Funds	# Supported	Total Funds
IGERT Graduate Fellows	>22	1,955,000	32 – 41 per year	7,100,000
REU Undergraduates	63	490,780	70	577,312
ICE Personnel (staff)	1	360,687	7.5	2,770,380
Capital Equipment		191,405		1,800,000

Utilizing secured (grant) resources, ICE is positioned to support one professional staff, at least 63 undergraduate interns and more than 22 graduate students through 2012. IGERT fellows receive competitive \$30,000 annual stipends, health insurance, and support for fees. Creation of an IGERT Associate membership option, pursuit of a graduate certificate in cellular engineering, and internal competitions for graduate student professional development funds have helped to expand programmatic participation to engross nearly 50 graduate students. ICE REU undergraduate interns receive \$4,500 stipends, travel allowance, and full support for UMass meals/housing for the summer. To date, six ICE REU associated students have matriculated into UMass Amherst doctoral programs, exemplifying the strength and synergy of ICE training programs. Through an NSF STC award, ICE will continue (and increase) the number of students and staff supported, as reflected in the above chart. In addition to student and personnel support, ICE has secured and distributed more than \$190,000 in capital equipment funds to procure cutting edge cellular engineering facilities for the University. The NSF STC allocates an additional \$1.8 million for capital equipment. Additionally, ICE organizes high-impact research symposia (attracting nearly 300 attendees to campus), campus-wide *Career Day* events to support graduate students' professional development, and collaborative, inter-program graduate recruiting events (such as the annual *Fall Graduate Preview*, co-organized with the NEAGEP program), aimed at increasing the visibility of our University and recruiting the best graduate talent for our programs.

Several efforts are currently underway to secure additional Institute revenue, including formation of the Industrial Partners Network and establishment of a fee-based membership structure. Encouraged by a deep progression in the first submission and value of feedback provided, the Institute will re-propose an NSF STC in the next two years. In conjunction with center efforts, the institute is aggressively pursuing additional cellular engineering training and education grants. Recent and future submissions include:

- **NSF Graduate STEM Fellows in K-12 Education** (pending): In June 2010, ICE Associate Director, Surita Bhatia submitted a proposal for a five year, \$3 million, NSF-sponsored GK-12 grant entitled *Exploring Cellular Engineering and Life Sciences (ExCELS)*. This collaborative effort involves ICE, the UMass STEM Education Institute, the Boston Museum of Science, and several schools in western Massachusetts serving small towns and rural communities.
- **NSF Research Experiences for Teachers (RET) Program.** This proposed program will provide professional development and research experiences in cellular engineering for 10 in-service and pre-service teachers in Massachusetts. A \$500K proposal, with Associate Director Surita Bhatia as PI and Director Susan Roberts as co-PI, was submitted in fall 2009 and received positive reviews. A resubmission is planned for November 2010.
- **NIH Ruth L. Kirschstein National Research Service Award (NRSA) Institutional Research Training Grants (T32):** This training program supports predoctoral and postdoctoral research training to ensure that a diverse and highly trained workforce is available to assume leadership roles related to the Nation's biomedical, behavioral and clinical research agenda. Institute Directors are currently exploring this synergistic program, with plans to submit a proposal in the next two years.
- **NSF Integrative Graduate Education and Research Traineeship (IGERT) Program.** The ICE IGERT program will end in 2012. A proposal renewal is planned for submission in 2011.

B. Indirect Financial Impact of the Institute

The Institute for Cellular Engineering is a multidisciplinary, interdepartmental research initiative focused on coordinating and expanding cellular engineering educational and scholarly activities on campus and enabling

translational research through strategic industry partnerships. Each facet of our mission represents a revenue opportunity for our members and our University. The institute is needed to pursue these goals and position our members and university to secure external resources beyond those indicated in the financial summary above.

- By coordinating and expanding cellular engineering activities, the institute better positions the university to compete for grants in the \$3-25 million range by strengthening traditional, single investigator submissions. Pooled resources produce stronger proposals, increasing chances for success and the potential to generate new overhead returns for the university.
- By coordinating and expanding cellular engineering educational activities, the institute develops “cutting edge” programs that better position our University to securing federal training grant programs and recruit a talented and diverse student body. To date, the Institute has secured more than \$4 million to implement more than 15 novel curricular courses, support dozens of graduate students, and bring more than 60 undergraduate researchers to campus. Passionate about training, the institute is aggressively pursuing additional training awards to educate undergraduate and graduate students, middle and high school teachers, and the public at large about exciting topics in cellular engineering.
- By funding capital equipment purchases to establish cellular engineering facilities, the institute strengthens interdisciplinary relationships across campus and insures that our researches have access to innovative, cutting-edge technology.
- By enabling translational research through strategic industry partnerships, the Institute aims to position itself as a “gateway” for academic-industry collaboration. In close collaboration with the office of the Vice Chancellor of Research & Engagement, the Institute is establishing the Industrial Partners Network (IPN). The IPN will serve the Institute (and the University) by advising on the translation of proof-of-concept research results into applications and products, connecting ICE associated researchers with industrial collaborators, guiding curricular programs to meet workforce requirements, developing internships and full-time employment opportunities for students, and raising the profile of the University research community. Fee-based membership structures and opportunities for one-on-one sponsored research projects represent additional potential revenue sources for the University.