Institutionalize the STEM Summer

Provide STEM content professional development for K-12 teachers and institutions providing world-class research labs experiences for a broad group of undergraduate students; discerning the qualities of good mentoring and disseminating our learnings to our peers; providing unique, trans-disciplinary graduate training; using CBiRC know-how to inspire undergraduates in classrooms; and providing entrepreneurial training to graduate students to expand their horizons and to create new economic opportunities.

The project supports the center’s strategic plan by leveraging the CBiRC research infrastructure to produce the next generation of globally-competitive, creative and innovative engineers.

Technology-Led Entrepreneurship for Graduate Students

Approach

- Leverage the talents of the ILO (Peter Keating) and the activities in the Industrial Collaboration and Innovation Ecosystem to produce world-class opportunities for CBiRC graduate students and now a broader audience to learn to be technology-entrepreneurs.
- Learn to think at a systems level – learn to be creative, to seize opportunities, and to understand risks and rewards and the complexity of building a valid foundation for taking a product to market.
- Coursework supports this: ILO offers BR C 507 Entrepreneurship in Biorenewables, which was designed to develop an understanding of discovery research and its relationship to entrepreneurship and innovation in the broad area of biorenewables. Based on early success and interest this course became a required part of the broader ISU Biorenewables Resources and Technology Graduate Program (and title is changing to reflect broader scope: Technology-led Entrepreneurship in Biorenewables).
- Furthermore, a mentoring component (modeled after I-Corps program) was added recently. This in turn is having extremely powerful impacts. For example, multiple other ISU startups mentored through program, and the state of Iowa now using the same mentoring program so that they can mentor startups who have requested state funding.
- Collectively the Course and Mentoring program is referred to as the Biobased Foundry.

Outcomes

- The Entrepreneurship Course, has developed about 50 startup concepts into a first business model. The program has been very well received by the graduate students. The students all gained a deeper understanding of what it takes to build an idea into a value proposition and how this might attract funding. Importantly the concept of technical and business risk becomes part of their vocabulary.
- The Biobased Mentoring Program has incubated 4 CBiRC startups and 6 ISU startups. Of these 10 startup entities, 7 became formally incorporated and are in the process of seeking funding. Four of these startup entities have received phase I SBIR or STTR funding and are now applying for phase II funding. One of them won a SECO award.
- The Foundry is gaining wider acceptance at Iowa State University as a powerful addition to graduate education.

Pre-College Education Programs – Feeding the Pipeline

Program Objectives

- Provide STEM content professional development for K-12 teachers (STEM Summer Institute);
- Offer interdisciplinary research experiences for teachers and high school students centered on CBiRC related projects (Research Experiences for Teachers and Young Engineers and Scientists);
- Directly engage with 9th-12th grade students (GK12);
- Provide STEM learning opportunities to a diverse group of participants.

Vision for Sustainability

- Institutionalize the STEM Summer Institute and Symbi GK12 at Iowa State University;
- Support partner institutions with their K-12 initiatives;
- Collaborate with central Iowa industry to support CBiRC K12 STEM initiatives;
- Establish more long term partnerships between CBiRC and school districts to ensure best practices are maintained.

Bringing CBiRC to the University Classroom

BIOL 313 Genetics Lab
- Dr. Alexis Campbell created a student directed inquiry based experiment module. The module is based upon the science and technology of soybeans. Students worked on part of the soybean lab in conjunction with the Waterloo Leaky acid lipid regulation in seed. Each student group focused on about 30-50 students each year.
- To help with this work the student Campbell implemented "Learning Facilitators" who usually the class size 60 or more the facilitators each semester.
- Students spend about 15 hours - this helps with the student involvement.
- The top students also have the opportunity to present at a CBiRC panel on the final class involving.

BSE 350 Principles of Biological Systems Engineering
- Developed CBiRC based problem in section on modeling microbial growth and enzyme kinetics.
- Exploring use of pyrotron textbook based project in capstone CHE class at ISU.

ENGR 160 Fresh, Problem Solving & Computer Applications
- Used sensor boards to encourage tinkering and hands-on (these were core "hypotheses" we identified at CBiRC outset) – now in several of biorenewables, full generality engineering.
- Refer to global energy and resource use early in class to instill understanding of challenges and context based on ENGR.
- First approach in particular greatly increased student ability and confidence in programming – have continued this approach and have encouraged others to adopt.
- Presented the work at ASEE Frontiers of Engineering (FAE) conference in Irvine, California.

Multi-Institutional Trans-Disciplinary REU

Select partner institutions
- Select project titles and short descriptions
- Advertise REU (applicants indicate top three projects)
- Send each PI two to six applicants after initial review
- Take PI rankings and make cohort
- Interview top selections; make offers
- Sort out logistical

[The CBiRC REU was the first time I really felt that I had independence as a technician. Before CBiRC, I had worked in labs, but I was more of a tech than a researcher.

Having made significant progress in a project I knew very little about 3 months prior gave me a lot of confidence in my abilities as an independent researcher.

I still keep a sample of my soybean plastic as a souvenir.]

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