

Taking Biofuels From the Lab to the Classroom

By Riya Bhattacharjee

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iCLEM interns Ruty Miyazaki-Smith and Edgar Ulu learn from Laney College student and iCLEM Teaching Assistant Ahmed Akbar (center) how to label cellulase samples at the Joint BioEnergy Institute's Deconstruction lab.

Kate Trimlett is bringing biofuels into Berkeley High School's science curriculum.

Armed with eight weeks of biofuels research experience from the Joint BioEnergy Institute (JBEI) in Emeryville, the Berkeley High science teacher is ready to take this controversial topic from the lab to the classroom.

Trimlett, lead teacher at the School for Social Justice and Ecology, a small school at Berkeley High, won a fellowship from the Synthetic Biology Engineering and Research Center and JBEI to spend the summer with two of her students inside JBEI's Deconstruction Division.

A collaboration between three national labs, public and private universities and industrial and federal agencies, JBEI is engineering bacteria to convert plant waste-material into petroleum products.

As part of the eight-week Introductory College Level Experience in Microbiology (iCLEM) program, the three joined four other East Bay high school students and Oakland Unity High School science department head Rowan Driscoll to study 23 strains of bacteria found in compost piles. The students picked out 12 samples they wanted to inspect further, using them to produce the enzyme cellulase. Cellulase can be used to convert cellulose, or plant material, into glucose, which can then be used to make ethanol.

If it sounds complicated, it's because it is. Enzyme analyses can take weeks, if not months, and even then results are not guaranteed.

Trimlett and her group were still analyzing enzymes at the end of their seventh week in the program, but nobody seemed discouraged. If anything, the students were excited at the prospect of getting a chance to share their discoveries with scientists at JBEI a few days later.

Four days before their final presentation on Aug. 12, the group found some time to break from their intensive lab schedule and have fun during a JBEI barbecue.

Sitting on the campus's plush green lawns, with 15-foot-high fountains dancing in the background, Trimlett laid out her plans for the future.

"We don't teach students about biofuels at Berkeley High," she said. "I didn't learn about it when I was in school. The idea is to develop a curriculum and take it back to the classroom. We have never done any lab work or experiments—this is the first time I'll teach it."

When students return to Berkeley High this week for fall classes, they will collect bacteria from compost heaps and test their ability to break down cellulose. Then they will analyze the bacteria's DNA.

Trimlett is aware of all the debates surrounding biofuels, but is quick to point out that at JBEI, the focus is to produce fuel from food crop "leftovers" instead of the edible parts.

"We have gone on tours of labs where they are getting their fuel from sugar cane and corn, and it definitely came up in the discussion," she said. "It's really easy to get biofuel from corn and sugar cane, but if you take them away from people, then that's really bad. That's why at JBEI they are trying to get glucose from corn husk and corn stalk and all the stuff that you won't eat."

Karla Loaiza, 17, from Unity High, sat chatting with Clem Fortman, a post-doctorate researcher at JBEI who founded iCLEM along with James Carothers, another scientist at the institute.

Karla said that she fell in love with science after watching countless episodes of CSI Las Vegas, and confessed a desire to become a forensic scientist.

Claudia Portillo, a junior from Richmond's Salesian High School, and Dzenifa Velic, a senior from Oakland Tech, joined the discussion on DNA sequencing while nibbling coleslaw and barbecued chicken.

All six iCLEM interns have good grades in science, but they also fulfill another important

criteria for getting an internship at iCLEM: They all have little or no family history of attending college and come from low-income backgrounds.

Ruty Miyazaki-Smith, a junior at Berkeley High, comes from a family of craftsmen who carve stools and tables from cherry wood for a living.

Originally from Japan, Ruty decided to apply for the internship to figure out whether he should take up biological or mechanical engineering in college.

“I wanted to meet actual scientists and do actual labs,” Ruty said as he labeled samples after returning to the lab from lunch. “We didn’t do much labs in school and it wasn’t much fun.”

Ruty’s lab partners for the day were Esteban Bolden, who attends Berkeley Unified School District’s Independent Study program, and Edgar Ulu, who moved to the Bay Area as a high school junior last year.

“It’s my first time working in a lab,” said Edgar. “All the scientists here treat us like co-workers. I feel very grown up.”

Esteban said he applied because of his interest in the local Spare the Air days.

In its second year now, iCLEM hopes to become an annual feature for students from all over the Bay Area.

“iCLEM’s vision is to offer an opportunity to young adults that they would not be able to get in their school or in their community,” Driscoll said. “The students are chosen in part due to their effort and enthusiasm and proactiveness to apply and to chase this opportunity, but also on the basis of how privileged they are. I think there’s a real disconnect between the students that I serve and research jobs like this one.”

A public charter school in East Oakland, Unity High exists in a “no frills, meat and potatoes kind of setting,” and is often unable to offer its students—85 percent of whom take advantage of the school’s free or reduced-cost lunch program—the kind of opportunities they need to succeed.

“I don’t think many of my students can envision that they are completely capable of getting a job working at a lab,” Driscoll said. “As a biology and chemistry teacher, I want to make education as real and as practical as possible. When my students ask me ‘Why do I need to learn this?’ I tell them that five miles down the road, there are jobs, even in this time of economic difficulty. I want to open doors, open their eyes and help them find avenues to use science to make themselves useful to society.”

Besides picking up valuable research skills, iCLEM interns also receive a \$2,500 stipend, help with college applications, personal essays and résumés and a chance to meet the top names in bioscience.

On a recent Friday, the group was paid a visit by JBEI CEO and UC Berkeley bioengineering professor Jay Keasling, who was named Discover magazine's 2006 scientist of the year. Esquire magazine recently included Keasling on its list of the 75 most influential people of the 21st century.

Keasling's lecture, "Life 2.0: From Bugs to Drugs to Fuels," covered everything from U.S. dependence on foreign oil to synthetic biology to his efforts to create a cheap supply of the malarial drug artemisinin through genetic manipulation, and even found time for a few jokes.

Fortman said it was Keasling's enthusiasm that had made iCLEM possible in the first place.

"Training is a big part of JBEI," Fortman said. "It's not a fluke that these kids are here. They are here because they have some capacity and we want them to take advantage of that and of us."

Listening to his students brainstorm ideas of how biofuels might provide an answer to solving global issues like war, starvation, pollution and global warming one day, Driscoll, like Trimlett, admitted that it was impossible to ignore its critics.

"How far do we go, how much do we allow? I don't know," he said. "I can't answer that question right now. What I do know is that the students I have now are going to be making those decisions. They are going to be voting on how much genetically modifiable engineering should be allowed. Should we just let it all come crashing down because we don't want to mess with nature? We have already been messing with nature. We have been messing with nature since humans became agrarians."

Driscoll said that he wanted his students to be stewards who would use their knowledge for the benefit of mankind.

"I would be doing my students a disservice if I didn't expose them to different avenues," he said. "I honestly think that if my students are not informed, they are going to be subject to fear mongering and misconception and misguiding rhetoric that gets tossed around so quickly."