


What's in my closet? A biology lab

By Gayathri Vaidyanathan

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A geneticist, a graduate biology student, a writer and an undergraduate physics student recently gathered around a wooden kitchen countertop in New York City, as shown in a video captured by the group.

Daniel Grushkin, the writer, ran a slimy pink liquid through a coffee filter, and the smell of strawberries filled the air. He inhaled and said, “Hmmm.”

“In this juice is--what?” Grushkin asked the others.

Sung Won Lim, 22, the physics undergrad, replied, “In the juice is DNA along with strawberry essence.”

By the end of the night, the motley crew of biology aficionados had used common kitchen items—shot glasses, alcohol, salt, coffee filters, dish soap, meat tenderizer, wooden skewers—to isolate DNA from strawberries.

They all belong to DIYbio, a biology movement that places experimentation in the hands of amateurs. The idea is to infiltrate basic science, a field that has become increasingly clublike over the years because of specialization of knowledge. Some see it as a return to the era of scientists making important discoveries in their home labs.

“There is a resurgence in ‘make’ culture,



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Kay Aull tries to see if she has DNA at the end of an experiment using a handheld UV flashlight. (Photo courtesy of Mac Cowell)



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Members of DIYbio assemble homemade equipment to separate DNA: batteries, an iPhone and a voltmeter. (Photo courtesy of Mac Cowell)



and the newest, hottest cool thing in DIY culture is biology,” says Mac Cowell, 25, a biologist who helped launch the movement. “DIYbio is making the technology of biotech better. It is making the tools cheaper and easier.”

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A homemade camera stand to see DNA, named "Senor Gel Box" by Kay Aull. It was made using UV filters from a military-surplus store. (Photo courtesy of Mac Cowell)

Cowell, who attended Davidson College, launched DIYbio in Cambridge, Mass., with help from Jason Bobe, 35, the community director for the Personal Genome Project at Harvard Medical School. Chapters have formed in Boston, Chicago, Seattle, London, New York and San Francisco, with a new one starting up in Toronto.

“We are on our way to becoming a biotech society, where people’s understanding of biotechnology will become ubiquitous,” Cowell says.

The members get together to experiment in an informal setting with research goals, such as the pilot BioWeatherMap project that the Boston-based group is considering. The map is designed to document the ebb and flow of microorganisms that thrive in different regions of the United States, an endeavor that will be highly useful, especially during flu season.

For the project, volunteers armed with \$2 cotton swabs will collect samples of organisms from sidewalks in their cities, a basic experiment in microbiology.

They will then send the samples to Bobe, who will get the DNA sequence of all organisms on the swab from a professional laboratory. Analyzing the sequence—an exercise in bioinformatics—will reveal all species of bacteria that were living on the sidewalk.

Visualizing the results on a map and incorporating environmental trends will get into the fields of ecology, public health and biodiversity.

“It inspires a whole new generation of young people to get engaged with biology,” says Bobe. “With a \$2 swab, a 15-year-old can get exposed to five really exciting disciplines.”

Other at-home projects are more complicated but possible. Kay Aull of Cambridge, Mass., is in the process of sequencing her own genome in a laboratory set up in her bedroom closet.

She wants to find out if she has a genetic disorder that runs in her family, but more than that, she wants to show that scientific procedures are not hands-off to laypeople who have an interest in biology.

For the United States, which is struggling with science education in its ailing public school system, DIYbio’s can-do approach may be a boon.

Lim, a sophomore at New York University, had not performed a single science

experiment in the New York City public school system—no dissections and certainly no DNA extraction from strawberries. So he was excited to learn the basics of life at DIYbio New York through the strawberry experiment.

“That was the first time I’ve seen and touched DNA,” says Lim. “It was exciting. It got my hopes up. I thought, If I can do this, maybe someday I might be able to do something that’s actually close to genetic engineering or synthetic biology.”

To ultimately be able to generate synthetic organisms from basic parts is the holy grail of most of the DIYbio groups, as it is of researchers in academia and industry.

Ellen Jorgensen, a geneticist at a pharmaceutical company in New York, describes the quest: “To break the simplest of nature—bacteria—down to component parts that you can reassemble into useful machines.”

Synthetic biology aims to make the assembly of cells simple by standardizing the parts that make up the cell. It may eventually become as simple as assembling a living organism from a catalog of ready-made parts.

This brings up issues of safety and regulation and prompts questions about the possibility of bioterrorism. How safe can it be for an amateur to grow and engineer bacteria in a basement lab?

“A lot of people have a knee-jerk reaction, that it sounds too dangerous and too futuristic and let us just ban it,” says Bobe. “But I think being able to build frameworks for making this safe and effective for people is our best option.”

The frameworks include regulation and oversight by experienced biologists like Jorgensen for the New York group. She and others say the worries are often overblown. Bacteria used in scientific research are crippled to ensure that they do not thrive outside the laboratory setting.

It is also not possible for an amateur to have bacteria cultures or even advanced chemicals shipped to a home address by supply companies. In the cases where authorities have found private laboratories, they have immediately dismantled them. In 2005, Steve Kurtz, an art professor in upstate New York was arrested by the FBI for keeping bacterial cultures in a home lab in a false bioterrorism scare (he was later acquitted).

“But what’s really clear is we can’t try to prohibit DIYbio,” says Cowell. “The only thing that happens when you try to prohibit people from doing the basic stuff is, they’ll do it without telling you.”

The advantages of DIYbio outweigh the risks, according to Jorgensen because it allows entry into a field that has unfortunately become difficult to access. For the layperson, understanding a published scientific article with its own specialized lingo may be a herculean task. The way out of this predicament may be by educating the public.

“There is an ivory-tower effect with science,” says Cowell. “The most beautiful thing about DIYbio is that it breaks down that wall. The fact that we are not scientists and we are evangelizing it makes it a lot more approachable to people.”

President Barack Obama has announced billions of dollars in his stimulus package to help with various facets of science education and research at the school and university level.

“Now we have a president that is willing to appoint Nobel laureates to Cabinet positions, we are looking to the future,” says Jorgensen. “Science is part of the future.”

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