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The Magazine about Life and Science in Medicon Valley

LifeSciences Insight

THE € 100 MILLION WOMAN

Kirsten Drejer, CEO, Symphogen

"What really drives me is developing new drugs that can make a genuine difference"

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medicon valley alliance
Creating Opportunities

LifeSciences Insight
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We are all biologists

Do-it-yourself biology (DIYBio) wants to liberate biology from academics and biotech. They are bringing biology out of academia and industry and into your home.

By Chris Tachibani

A tool for transparency or destruction? The question could be about Wikileaks or DIYbio—do-it-yourself biology. This loosely connected global network of biology enthusiasts started in 2008 in Cambridge Massachusetts, rooted in the open science movement that calls for free access to publications, materials, and data. While one goal is "to make science fun again," the serious side of DIYbio includes intellectual property issues and bioterrorism.

DIYbio is a community of hip/geek hobby biologists in the tradition of personal computing enthusiasts. Just as they see PCs and code as a playground, DIYbio presents biology as a creative outlet that anyone can do at home. Local groups are found from Chicago to Copenhagen.

Martin Malthe Borch, Biotechnology master's student at Technical University of Denmark (DTU), started a Copenhagen DIYbio group in 2010. He says: "It's a way to 'play around' with science, have fun and socialize. Artists are constantly playing, and form creative collectives where they play. Why shouldn't natural science do the same?" In fact, Seattle artist Elizabeth Buschmann says, "DIYbio has a performance aspect with hopes of engaging the public through creative approaches to science literacy outside of institutional bounds."

DYIbio groups range from large and organized, like Biocurious in California with its own lab space, to medical student Mike Barnkob of Odense, a group of one in 2009 when he put Denmark on the DIYbio map at DIYbio.org. The site has more than 2000 subscribers, and provides protocols for extracting DNA from strawberries using soap and coffee filters, or for a truly hands-on experience, instructions for making a centrifuge from a power drill. Philosophical musings pepper the blog, with entries on whether it is fair use or piracy to isolate bacterial cultures from commercial yogurt, or yeast from unfiltered beer.

DIYbio is compared to computer hacking with the same potential to create viruses—of the biological kind. But DIYbio co-founder Mackenzie Cowell said in a 2009 talk that "biohacking" just means "taking things apart and putting them together in a new way that makes them better." This kind of tinkering is suited to synthetic biology, which mixes and matches genes and cells to create biomachines: Biological systems for tasks like detecting toxins or acting as fuel cells.

Synbio and iGEM

Synthetic biology is the entry for DIYbioers like Barnkob, who founded the University of Southern Denmark's iGEM team. iGEM, for International Genetically Engineered Machine, is an annual biomachine-building contest at the Massachusetts Institute of Technology. "There's some overlap in the people who helped start both iGEM and

Photo: Martin Malthe Borch.

Centrifuge made by Biogaragen in Labitat

Photo: Martin Malthe Borch.

Martin Malthe Borch and Mogens Hvidtfeldt who built the centrifuge and PCR machine

DIYbio, but I'd make a distinction," says Barnkob. "iGEM requires that your team be part of a university". Restrictions are for liability and funding reasons, but for qualified projects, iGEM sends out components from its toolkit of genetic parts and cells. Barnkob's team created a bacterial strain covered with hair-like protein flagella that regulates liquid flow in a microcapillary. They won a gold medal for a safety innovation that gives genetically modified bacteria an identification tag.

"Synthetic biology is a multidisciplinary field, so iGEM teaches teamwork and collaboration," says Barnkob. and adds: "This year's team had students from medicine, chemistry and molecular biology, but this means it kind of falls through the cracks." Faculty advising, and most importantly funding for the University of Southern Denmark's future iGEM teams is uncertain.

Borch was part of the DTU iGEM team, and in Copenhagen, has the DIYbio group Biogaragen, with about six members who meet monthly to swap ideas, build membership and plan their future lab space. They currently hang out at Labitat, a basement in Frederiksberg for biohackers working on projects like building cheap PCR machines for home use.

Genotyping fish

In Seattle, DIYbio doesn't have a lab, but does have ideas, including one with a regional twist. A salmon with a growth hormone gene from another fish might become the first genetically engineered animal allowed as human food in the US, although this is years away. Still, Michal Galdzicki, University of Washington Biomedical and Health Informatics PhD student said Seattle DIYbio wants to develop a home protocol for salmon genotyping. Galdzicki says: "It could be educational, an outreach tool and a cheap method for genotyping fish." Buschmann adds: "It could be something to share with high school students."

Open source

This illustrates what Galdzicki calls the "Seattle school" of DIYbio, which is about "being involved in the local community and encouraging interest in biology". Buschmann

describes their meetings as conceptual and philosophical, with discussions about what DIYbio is and where it's going. This reflects the influence of member Rob Carlson, founder of the technology company Biodesic, author of the book *Biology is Technology, The Promise, Peril and New Business of Engineering Life*, and public advocate of garage biology since the early 2000s. "Rob is an activist promoting innovation through deregulation, and his ideas have been influential for the open source and DIYbio movements," says Buschmann, which is why Seattle DIYbioers tend to discuss topics like how to reconcile open source biology with intellectual property rights.

Awareness and ethics

DIYbio may be opposed to rules and restrictions, but not safety and ethics. About concerns that synthetic biology can be used for bioterrorism, DIYbioers say that making a pathogen like a smallpox virus from scratch isn't easy, even with the chromosomal sequence on the Internet. The costs and technical requirements are too high for home biologists to create new organisms, says a recent US bioethics commission on synthetic biology. And old-fashioned bioterrorism, for example with anthrax, requires no synthetic biology at all. Still, the US Federal Bureau of Investigation is working with the DIYbio community on bioterrorism awareness and ensuring that authorities know of local garage labs in case of accidents. To promote the use of their powers for good instead of evil, DIYbio is creating biosafety guidelines and codes of conduct.

> "While one goal is to make science fun again the serious side of DIYbio includes intellectual property issues and bioterrorism"

This led the journal *Nature* to encourage the movement in a 2010 editorial, saying: "Biohackers are an example of the growing 'citizen science' movement, in which the public takes an active role in scientific experiments. Citizen science can help stimulate public support for science, and can introduce fresh ideas from novel disciplines."

Populism is what DIYbio is all about, says Borch, because life sciences are naturally interesting to everyone. "We are all biologists. DIYbio is about knowledge-sharing, open science, education and lab space for everybody. It's about taking biology down a couple of levels." Barnkob says: "If we want to tackle big problems we need to think differently, and be more efficient in the way we do medicine, for example. The potential for synthetic biology to help with this is so big. And its also cool to play around with." ■

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