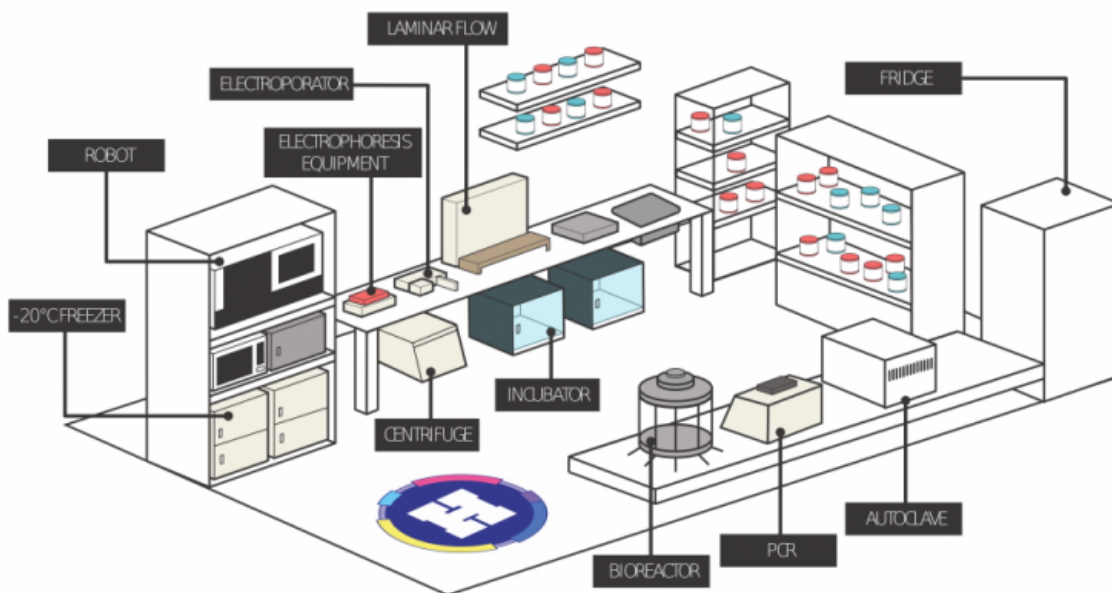


SynBio—democratizing biotechnology?

May 9 2016, by Steven Burgess



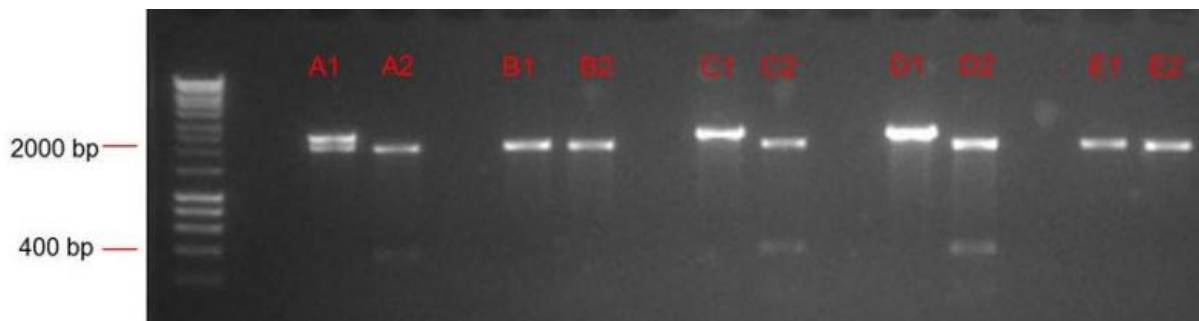
A schematic of the LBHS. Credit: Lena Asai

In the 1970s a group of enthusiasts met at the Homebrew Computer Club in Silicon Valley to share information about DIY construction of computing devices. Members complained that computers would never become commonplace if they had to be built up from individual parts.

Taking up the challenge, Steve Wozniak got out his soldering iron and constructed the Apple I computer, and the rest is history.

Likewise, it is suggested that synthetic biology will kick start a new [wave of innovation](#) by creating [standardized components](#) and [hiding the technical details](#) of genetic modification – theoretically allowing anyone with a good idea to make something. But for biotechnology to be truly accessible, it must be possible for non-experts to design and build using organic materials. To get some insight on the issue, I contacted members of the [London biohackspace](#) (LBHS) to find out about the realities of practicing [DIYBio](#).

In 2012 Philipp Boeing became excited about biohacking because it promised to allow anyone to dabble in bioengineering. Along with fellow members of the 2012 UCL iGEM team, Philipp envisaged working with the LBHS to create the first 'public biobrick' – a shareable, standardized biological part made by biohackers. To achieve this aim, the iGEM team visited the cramped conditions of the LBHS of the time (or 'cupboard' featured in a [BBC news clip](#)). "We did actually build equipment in the hackspace, amplify DNA, run a gel to confirm and make competent cells" says Philipp. "What we didn't do was transform those cells, as per recombinant DNA regulation. This was then carried out by the group in the [UCL] teaching labs. In the end, the Public Biobrick was probably a much more interesting project because of the obstacles, than if we had just succeeded in recruiting a "pipetting army".. [it] became very much an exploration of how far we would be able to go until we had to turn to the university."



Analytical digest of the Public Biobrick

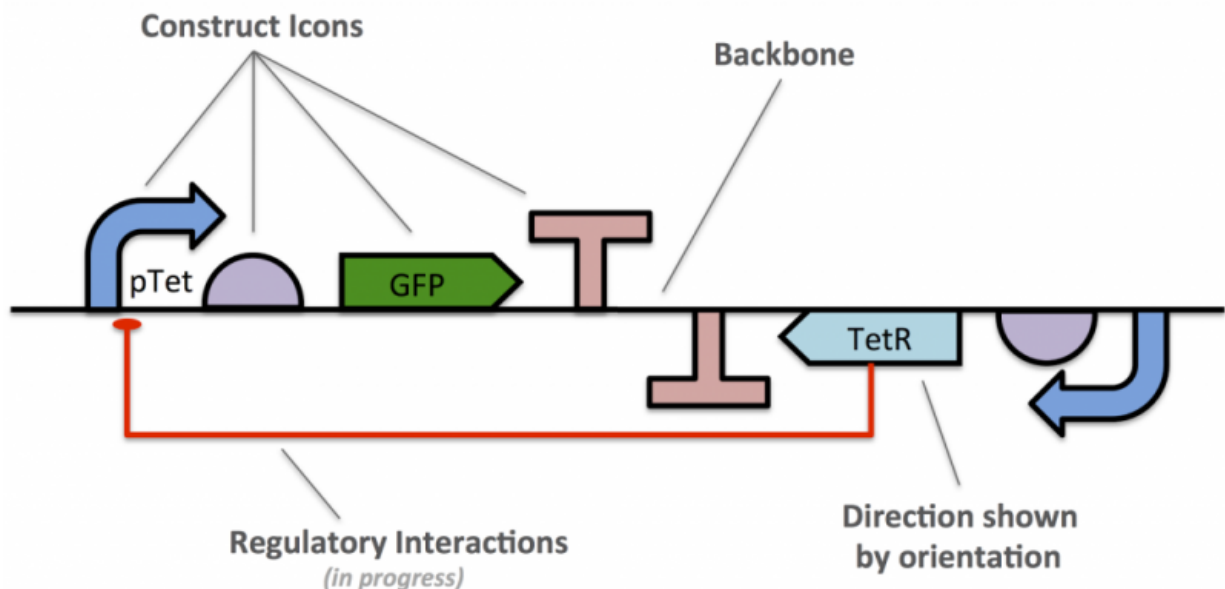
"Getting into a [[Containment Level 1](#)] lab has been particularly difficult," explains Catherine Disney. This is a requirement for anyone wishing to perform genetic modification and something that was lacking in 2012. Since then, LBHS has moved to a new lab on Hackney Road with permission to do GM research. This has vastly expanded what it is possible for members to do, which is demonstrated in recent projects including 3D printing bacterial cellulose ([JuicyPrint](#)), and a "[SynBio DIY Brew Kit](#)". So is biohacking finally beginning to live up to the hype?

To answer this question, I wanted to find out how realistic it is that 'anyone' can biohack. For starters, doing lab work can be expensive ([£50 for a few plastic combs anyone?](#)), so I wondered if this might be prohibitive to entry. Tom Hodder, who helps run the LBHS, disagrees, "I think the cost is over emphasized. As a hobby, DIYbio is no more expensive than say owning a motorbike, or any equipment intensive sport, or photography etc."

So are there other challenges to entry? "The main constraint on making progress is the time, effort and persistence required to gain the skills and experience in order to do anything interesting" says Tom. This is also the view of Catherine, "people do their PhDs in synbio – it's not like a craft

skill you can just learn and apply to everything."

The the technical challenge of DIYBio is an experience shared by Lena Asai, a design student at Goldsmiths, University of London who was involved in the SynBio DIY brew kit, "from personal experience, I know [genetic modification](#) can be quite complex for beginners and without formal training. Citizen science is not as accessible as portrayed in the media and scientific journals. As a result ... the participants of DIY biology are not necessarily a representation of the general public."



Making molecular biology easier. Credit: Jake Beal's Next Step

So who are the members of LBHS? "A year or so ago I would have said that the biohackers who were regularly involved fell into either being IT technologists (sysadmins/developers) and biologists" says Tom. "Since then, several more recent regular contributors are designers, artists and

photographers... [additionally there are] pure engineers with little interest in biology, other than the technology that is being used. (Lab robots, lasers and microscopes have wide appeal!)."

Is it difficult for non-experts to get into biohacking? For Catherine, a textiles graduate, the answer is "Yes and no – easy if you know what you want to do or try out – like basic DNA extraction and reading it. But actual synbio; this is much more difficult as without the help of a trained specialist. It's not something I personally would face the confidence to just rock up at the lab and do – you really do need to have quite a thorough grasp on biology and the sciences in order to really 'hack'."

This is perhaps the key issue – technological developments such as cheap, portable (aesthetically pleasing) equipment can help make technical aspects of biology accessible, but knowing what is achievable may always require some degree of expert knowledge. So in order to connect science with people from different disciplines Lena has set up interdisciplinary workshops known as Co-Lab (derived from the Japanese word コラボ (collaboration)).

But more can be done. [Standardization of components](#), and DNA repositories such as Addgene and the [Registry of Standard Biological Parts](#) are great for sharing DNA between academic labs, but even ignoring the problems of product characterization, a quick scan through the websites reveals a lot of scientific knowledge is still required to build anything. To create something like a heat monitor, one must know what the terms promoter, ribosome binding site, terminator and coding sequence mean, along with all the background science that goes with it. A situation where you can order 'a heat detector with xx temperature range' and 'a summary display of xx colour' which can be clicked together to make a detector is still a way off.

So at the moment, what can biohackers achieve? Lena points to Counter

Culture Lab's [Open-Insulin](#) project, explaining "[they are] aiming 'to make and refine synthetic insulin from E. coli' and hope that a generic pharmaceutical company will use that protocol to make insulin that's affordable for diabetes patients all over the world." This is a great demonstration that with a willing pool of volunteers and sponsors, DIYBio can drive important projects which would normally struggle to be funded due to lack of 'scientific' or commercial interest.

Perhaps as importantly, Lena says "DIY biology not only helps the development of open research, but spreads ideas for new ways to approach science by enabling scientific experiments to be conducted just for the sake of curiosity." Science fulfills the human need to explore the world in which we live, and does not have to be restricted to a lab environment controlled by PhD holders (a point forcefully made by the biohacker Josiah Zayner in a great piece by Kristen V. Brown).

Clearly more needs to be done to make biological engineering accessible. But whether or not biohacking results in a new Microsoft, Google or Apple, biohackers are helping foster the spirit of open, interdisciplinary research, whilst keeping the joy of science alive. Lena summed it up best: "at the end, this is a place for hobbyists – which is still wonderful place to be!"

More information: Tom Baden et al. Open Labware: 3-D Printing Your Own Lab Equipment, *PLOS Biology* (2015). [DOI: 10.1371/journal.pbio.1002086](#)

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