

## Hacking Life? The Politics and Poetics of DIY Biology

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Biohacking, or do-it-yourself (DIY) biology, has rapidly established itself as a distinctive movement over the past 6 years. Numerous media articles have reported on biohacking, and it has even entered the museum world, in an exhibition called *Biohacking: Do-It-Yourself* at the Medical Museion in Copenhagen. Last year, a dedicated web series of documentaries and a quarterly journal called *BioCoder* have been launched. DIY biology is today a rather fashionable phenomenon, attracting an increasing number of practitioners, journalists, academics, scientists, students, citizens, hackers, artists, and potential entrepreneurs. The average DIY biologist is male, educated and young, works 7 hours per week on DIY projects, and values transparency [1]. Out of the long list of activities that DIY biologists do, let us mention the following ones: extracting DNA; “hacking” yoghurt (to alter its taste or produce fluorescent proteins, vitamin C or Prozac); DNA barcoding of plants or sushi; producing bioreactors; developing home-brewing kits for the public; genetic testing; bio-art projects; molecular gastronomy; producing biosensors to detect pollutants in food and the environment; educational activities, courses and workshops.

### History

The history of DIY biology is both a recent and an old one. Its recent history can be roughly outlined as follows: in 2005, biologist Rob Carlson predicts that “garage biology is at hand” [2] and stories about home laboratories of people like Carlson, Kay Aull and others gain increasing attention. The association DIYbio is created in Boston in 2008 and among the first community labs established there is *GenSpace* in New York (2010), *BiologiGaragen* in Copenhagen (2010), *BioCurious* in Sunnyvale, California (2011) and *La Paillasse* near Paris (2011). A European DIY biology network, DIY Bio Europe, is launched in 2012. At the time of writing, there are around 50 DIY biology labs across the world. But the history of DIY biology is also much older and more complex. The involvement of amateurs and citizens in science, in particular in biology, has a long tradition. Be it in natural history (ornithology, botany, zoology), in epidemiology, or in astronomy, non-professionals have actively contributed to science for centuries. Thus, DIY biology can be seen as a continuation of this longer tradition of amateurs and professionals co-producing scientific knowledge. At the same time, it also represents a rupture. The amateurization and domestication of molecular biology is also a novel phenomenon and while amateurs in natural history have been observing and describing the natural world, DIY biologists aim at experimenting with, and (re)engineering, the biological world [3].

In addition, the history of DIY biology cannot be told without mentioning at least four related movements. First, do-it-yourself has emerged in the 1950s and 1960s and usually refers to home-improvement and fashion (however, while DIY biologists now also use the expression, the term “do-it-with-others” seems more appropriate). Second, DIY biology can be situated within the broader open science movement, a movement itself inspired by the open source movement that has developed since the 1990s [4]. Third, the proximity between the hacker movement and DIY biology is noteworthy - a proximity that is technical and spatial (the tools and physical spaces of hackerspaces and DIY labs are often shared), semantic (through terms such as “biohacker” or “biohackerspace”) and ethical (i.e. favoring access, sharing, collaboration). Fourth, the

development of synthetic biology over the past decade has also played an important role: its engineering vision has been influential, and many founders of DIY biology labs have met each other at a student competition in synthetic biology called iGEM and collaborations between iGEM teams and DIY biology are on the rise [5].

DIY biology cannot and should not be reduced to either one of these histories. Neither a radically new phenomenon, nor a simple continuation of amateur or DIY practices, nor an extension of hacker and open source ethics to a new domain: DIY biology is best understood as an entanglement of all of these.

### **The politics and fabric of openness**

Increasing “openness”, “accessibility”, or “availability”: these are some of the words commonly used to describe how DIY biology aims to transform science. Biology should not be an activity confined to university researchers, but the broader public – whether called “amateurs”, “citizens” or “everyone” – should also be involved. In a nutshell, the idea is to “democratize” science. As much as such terms sound reasonable, they are also problematic: words such as “openness” and “democratic” are too vague and too widely used to provide a thorough description of DIY biology.

In fact, DIY biology aims at “democratizing” biology in various ways: spatially, technically, socially and economically. In terms of the spaces of biological experimentation, a two fold effort is visible: some people’s homes are transformed into laboratories (biology is “domesticated”) and new community laboratories are established (like the ones mentioned above). The redesign of scientific and technical equipment is another way in which biology is made more accessible. There are now many examples of alternative equipment: using a webcam instead of a microscope, the *OpenPCR* instead of a conventional PCR machine, the *DremelFuge* instead of a centrifuge, or building one’s own electrophoresis gels, magnetic stirrers, autoclaves, etc. [6]. People from all socio cultural backgrounds can join DIY laboratories and their mailing lists. Neither diplomas, nor previous expertise is required to become a member (unlike institutional science). Finally, DIY biology aims at making biology more affordable economically: DIY biology labs usually ask for no membership fees, or only modest ones, and one of the motives behind the creation of alternative equipment is to decrease their cost (often 10 to 100 times).

Hence, rather than arguing that DIY biology “opens up” and “democratizes” biology, the concrete processes of this democratization need to be unpacked. Various processes are visible: DIY biology builds new, and reconfigures existing, spaces; develops creative workarounds around technical equipment and protocols; renders the sites and techniques for scientific experimentation more affordable; creates networks and laboratories accessible to various people, motivations, and interests; portrays itself as an alternative to established and “closed” science and a way to “demystify” science. DIY biology not only seeks to foster a “politics” of openness, it also aims to produce the very fabric of this openness. We might even talk of a “cosmopolitical” form of public participation and experimentation, involving “various powers, actors and communities across scales and ontologies” [7].

DIY biology aims to constitute a distinct and political form of self by providing people with access, by enabling them to transform themselves into active producers of science, by making their bodies and ailments more knowable, and by demonstrating that one *can* do it oneself. The “yourself” in DIY is not a passive, individual person, but someone who engages with biology and does things (with others), a self that is active and juxtaposed to other sites and scales of science production: the university, the institution, the enterprise, etc.

### **The ethics and economics of DIY biology**

The politics of openness of DIY biology is at once celebrated and dreaded. On the one hand, it is praised for empowering citizens, for fostering open innovation, for providing new means for education, and for being inclusive. Optimist accounts often compare DIY biology to the Home Brew Computer Club and Steve Jobs’ a promissory comparison that brings side by side a familiar success story and a story of innovation, and offers a narrative of change, innovation and revolution. On the other hand, DIY biology also raises concerns about security, safety and regulation. The most negative accounts even refer to bioterrorism – with the figure of the terrorist being used to crystallise the unpredictable danger of biohacking and to represent evilness. It should come as no surprise that this anxiety is mostly voiced in the US.

There have been three kinds of responses from the DIY biology community to such concerns about safety and security. The first response is argumentative: responses by practitioners highlight that DIY biologists do not work with dangerous material and that potential terrorists do not need DIY biology to meet their aims. The second response has been ethical, by collectively establishing a code of ethics. The European code of ethics, first drafted in 2011, states that practitioners should “emphasize transparency”, “adopt safe practices”, “promote citizen science and decentralized access to biotechnology”, “respect humans and all living systems”, etc. The third response has been practical: on DIYbio.org, a portal has been set up through which people can ask questions about safety to a panel of biosafety experts and members of a professional association of biosafety; and DIY Bio Europe has developed “Community Biolab Guidelines”.

Discussions not only concern the ethics of DIY biology, but economics and funding as well. We see both non-market and market rationales at work [8]. In its purest form, there is a logic of “do-it-without”: DIY biology is often portrayed as a reaction against big pharma, standard/expensive equipment, patents and, in general, against everything that keeps knowledge from being freely shared. Yet, DIY biology relies – at least partially – on markets and industries: by buying used equipment from commercial websites, tools and products from supermarkets, or seeking and accepting donations from companies. Also, various sources for funding DIY biology projects have been sought, be it via membership fees, crowdfunding, grant funding, funding from the European Union or from local municipalities [9]. And, there are even entrepreneurial projects that have developed out of DIY biology (like *OpenPCR*, *Pearl Biotech*, *LavaAmp*, *Ginkgo Bioworks*). The potential relationships and co-existence - or, conversely, tensions and ruptures - between non-market and market rationales and projects will be interesting to follow as the movement develops.

DIY biology is an interesting phenomenon and merits academic analysis. Its history and genealogy, its politics of openness, and its ethics and economic logics all need to be carefully

analysed and defy neat categories and simple narratives. The politics of life are complex and multifaceted - and the politics of hacking life are no exception.

### References and Notes

1. Woodrow Wilson International Center for Scholars, *Seven Myths & Realities about Do-It-Yourself Biology*, Washington (2013). Of the respondents of this survey 75% are male, and 63% are between 25 and 45 years old.
2. R. Carlson, "Splice it yourself: Who needs a geneticist? Build your own DNA lab," *Wired Magazine* **13**, No. 5 (2005).
3. M. Meyer, "Domesticating and democratizing science: a geography of do-it-yourself biology," *Journal of Material Culture* **18**, No. 2 (2013), pp. 117-134.
4. H. Ledford, "Life hackers," *Nature* **467** (2010), pp. 650-652.
5. Yet, in the past, DIY biology teams have not been allowed to take part in the iGEM competition. From 2014 onwards, this is changing via a new "community labs" track at the competition.
6. T. Landrain, M. Meyer, A. M. Perez, and R. Sussan, "Do-it-yourself biology: Challenges and Promises for an Open Science and Technology Movement," *Systems and Synthetic Biology* **7**, No. 3 (2013), pp. 115-126.
7. D. Kera, "Innovation regimes based on collaborative and global tinkering: Synthetic biology and nanotechnology in the hackerspaces," *Technology in Society* (in press).
8. A. Delfanti, *Biohackers: The Politics of Open Science* (Pluto Books, 2013).
9. Examples include: crowdfunding campaigns on Kickstarter to fund the development of *OpenPCR* and the setting up of *BioCurious*; Wellcome Trust funding for *MadLab* (Manchester) to develop a "citizen science" partnership; the EU COST initiative being tapped into by DIY Bio Europe.

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