Evaluating the Benefit of Community Laboratories

Ellen D. Jorgensen, Ph.D., Executive Director and Co-Founder, Genspace NYC

Synthetic biology aims to make living organisms easier to engineer through the use of standardized DNA "parts". Hiding biological complexity behind abstraction is key, since it allows the practitioner to design new biological circuits quickly and facilitates automation of the process. In computer software, the ones and zeros of the most basic code are hidden behind operating systems and programming languages. Synthetic biology aims to make coding life similarly user-friendly.

One of the unintended consequences of making biology easier to engineer was to facilitate a new class of practitioners known as the DIYbio movement. These citizen scientists practice synthetic biology in unconventional surroundings, outside of traditional venues such as university campuses and biotech startups. Since reading and writing (synthesizing) DNA code has become faster and cheaper, it is now within the reach of the hobbyist or inventor or artist to build biological circuits. The specifications and other information contained within registries such as the iGEM Registry of Standard Biological Parts plus the availability of free software such as that provided by DNA 2.0 has allowed almost anyone to be the designer of DNA code which can then built by a fee-for-service synthesis company. The price of DNA has dropped precipitously in the past few years as companies compete for business; the cost of 1000 basepairss of double-stranded DNA (a modest bacterial gene) is now under $200. These factors, coupled with the popularity of the Maker movement, fueled the rise of DIYbio.

Early voices in the movement were often strident and inflammatory. In her "Biopunk Manifesto", Meredith Patterson argued that that we all have the right to explore the world through biological experimentation, and implied that established institutions block this process by withholding information. The anti-authority stance that many early practitioners adopted garnered a lot of publicity (much of it negative) as the perception that practitioners were less concerned with safety than with personal freedom was perpetuated by the press.

The founding of the DIYbio Google Group by Mackenzie Cowell and Jason Bobe, both former iGEM participants, was the key step in establishing the DIYbio movement. It is still vibrant with nearly 4,000 members. The group quickly became a worldwide forum for discussions about community-building and practice by local groups of citizen scientists. By 2009 there were enough local DIYbio groups to meet at iGEM, where coincidentally the FBI was pursuing its mandate to reach out to synthetic biologists both professional and amateur and make them aware of the dual-use potential of their science. This began a relationship between DIYbio and Homeland Security which continues to this day.

In 2010-2011 the first community labs opened to the general public: Genspace in New York and Biocurious in the San Francisco Bay area. The idea was to create a welcoming informal space with a fully-equipped molecular biology lab facility that complied with all biosafety guidelines but was welcoming to the novice. Personal and group projects could be pursued

at a relatively low cost. The spaces would provide safety training and mentorship (both individual and in the form of hands-on classes and workshops), as well as a place for community gathering and discussion around synthetic biology and its implications. Both organizations decided to incorporate as nonprofits pursuing a mission of public benefit. Science literacy in both adults and students, particularly in the new area of synthetic biology, is woefully low. The DIYers felt that hands-on experience in the technology of synthetic biology would help to both educate and demystify it. The mission also helped to allay fears that the citizen scientists were selfishly tinkering with DNA code without thought to the greater community good.

In 2011 Genspace hosted a bridge-building meeting where heads of local DIYbio groups were introduced to the FBI personnel in their home city. A similar event was held at Biocurious the following year, with international participation. This strengthened the relationship between DIYbio and Homeland Security forces, which consider citizen science groups allies in vigilance against bioterrorism.

In the same time period, the Wilson Center in Washington DC received a grant from the Sloan Foundation to study the biosecurity implications of DIYbio. Led by Jason Bobe of DIYbio and Todd Kuiken of the Wilson Center, two meetings (one in the US and one in Europe) were convened to help DIY practitioners develop a formal code of ethics to guide their practice. Both successfully resulted in codes that all participants agreed upon as guiding principles. Thus the DIYbio community showed that they were wholeheartedly committed to safe and secure practice of synthetic biology.

Biocurious and Genspace continue to be models for community labs, and advise people worldwide who want to start one in their area. DIYbio has introduced hundreds of people to the concepts and practices of synthetic biology, and is unique in that we directly interact with the general public on a daily basis to inform and inspire. Our thesis is that the spread of community labs should be encouraged because it communicates synthetic biology to the public in a way that established institutions cannot. Our spaces are informal and make use of recycled and DIY equipment and materials. Many of the volunteer mentors in these labs have advanced degrees in biological sciences, yet they are not in the formal environment of a large laboratory complex or an office. This facilitates a more open and honest dialogue around the social and ethical implications of the technology. In 2012 a poster describing Genspace's groundbreaking program that teaches synthetic biology to the public in a community lab space was awarded the prize for Best Social Study in Synthetic Biology at the International Synthetic Biology meeting SB5.0.

Unfortunately, there is little data that quantify the benefit of community labs, particularly in their ability to communicate synthetic biology to the public. I propose that further research evaluating the impact of community labs will help guide their evolution and help them become even more useful to both the general community and the synthetic biology community in particular.