Culture wars threaten synthetic biology's future: Debate on open source versus closed door

Synthetic biology has no problem building bridges between biology and engineering, the natural and unnatural—yet it seems to be struggling with internal divisions.

In particular, the question of whether synthetic biology's future will be best served by an open-source approach or a more guarded, patent-heavy system of managing intellectual property. What pushes the field forward? Broadcasting each advance to the entire synthetic biology community so it can tinker with innovations or relying on patents and other closed door research practices to defend the intellectual property in a highly competitive and potentially very lucarative industry. In essence, this is the tension between the virtues of 'private science' which supporters argue leads to greater innovation because incentives are better aligned and 'public science' which supporters say leads to greater innovation because of crowd-sourced input and ensures the greater good.

This culture war is a theme running through several articles in Nature's excellent collection of special synthetic biology coverage, called "Beyond Divisions."

A collection of tribes

A Nature editorial summarizes the problem, pointing out that "'synbio' is less a coherent discipline than a collection of tribes under the same name." There are computational biologists, geneticists, immunologists; computer scientists and engineers (software, materials, and otherwise); do-it-yourself enthusiasts, start-ups, massive corporations and celebrity scientists-cum-entrepreneurs such as J. Craig Venter.

In each of these research groupings there are sources of tension, and we'll get to each in turn, but for now I want to take a moment to look at synthetic biology as a whole.

A separate editorial in the journal Nature Methods addresses the fact that synbio, as a (ostensibly) discreet discipline has only existed for about a decade, contending that, synthetic biology still has a lot of bricklaying to do. One thing synbio needs, it argues, is a standardized model cell. The Measurement Science and Metrology for Synthetic Biology initiative, a collaboration between Stanford and the US National Institute of Standards and Technology, is working to develop a single, universally accepted cell that all new synthetic biology components and techniques could be tested in. This would make it much easier for the disparate tribes to communicate and collaborate—whether a given lab is testing the effect of a newly synthesized protein or developing software tools to help design new proteins, both would be working from the same experimental cell. Right now, something like this doesn't exist, and the tribes working on synbio problems might each have their own preferred "demo cell" in which to work.

Of course, if your lab develops the best model cell for synthetic biology and you know there are many industry players who are interested in synthetic biology's potential as a manufacturing tool you might want to find a way to make money off of your design.

Profit, progress, or both?

Until recently, the reigning paradigm for making money (and its supporters say incentivizing innovation) has centered on patents and intellectual property law. But with the Internet has come a resurgence in the culture of openness, which came into full bloom among software developers in the 90s with the advent of open-source software. No surprise, then, that as synthetic biology has increasingly incorporated the help of software developers, computer scientists, and others who hail from a culture of openness, their attitudes toward intellectual property have come with them.

Science writer Bryn Nelson summarizes the divide in his Nature feature, "Synthetic biology: Cultural divide":

> On one side sit software design and engineering, which introduced the idea of encoding desired functions in pieces of DNA and joining together a standardized set of biological widgets, much like bricks or Lego pieces. Software engineers also brought with them the philosophy of sharing their work using open, public registries or only lightly restrictive licensing agreements, such as copyrights.
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> On the other side sit molecular biology and biotechnology, which supplied know-how about messy and unpredictable biological systems. They also brought the practice of patenting genes, molecules and technical processes. Half of the papers published in Nature Biotechnology between 1997 and 1999, for example, were linked to a patent.

Nelson focuses on Andrew Hessel's Pink Army Cooperative as a symbol of the open-source tribe in synbio. Hessel's initiative is a challenge to the modus operandi of multibillion dollar pharmaceutical companies; he wagers that a widespread network of volunteers working together from, as Nelson puts it "garages and bedrooms", can find a cure for breast cancer faster than the old guard of biotechnology. Nelson explains:

> Hessel represents an increasingly impatient and outspoken faction of synthetic biology that believes that the patent-heavy intellectual-property model of biotechnology is hopelessly broken.

Meanwhile, the Biotechnology Industry Organization (BIO), the dominant trade organization, insists that strong legal protection of intellectual property is a necessity to ensure that there is enough capital to fund future research.

This particular debate flared up here at the Genetic Literacy Project (and around the Web) as the Myriad Genetics case unfolded last June. In short, the Supreme Court ruled unanimously that genes, as products of nature, cannot be patented—but the ruling leaves a window open for patenting completely novel synthetic genes. Indeed, Nelson uses Myriad, and aforementioned J. Craig Venter as examples of the pro-patent rhetoric:

> In a statement after the ruling against Myriad, Craig Venter, founder and chief executive of Synthetic Genomics in La Jolla, California, applauded the court for making a distinction between naturally occurring and human-derived DNA segments. “These man-made genetic constructs are already being used to create new vaccines, biofuels and nutritional products,” he said. “And the ability to protect this intellectual property is a necessary component of a vital and robust science and biotechnology industry.”

The validity of Venter’s statement is, unfortunately, hard to determine. As Nature’s “Tribal gathering” editorial points out, more research is needed to determine how intellectual property schemes actually influence innovation. The research that does exist, as called out by the GLP’s Sarah Fecht in her post on the Myriad fallout, points against an absolutist view in favor of patent laws. It appears that it is possible for patents to stifle innovation.

One thing that seems under-discussed, even in Nature’s far-ranging coverage, is the influence of economic tribes within synthetic biology as they relate to this culture war. The loudest voices in defense of a patent-heavy system seem to be the industry groups and superstar entrepreneurs. I freely admit to a “Stick it to the Man” bias here, so I won’t speculate, but I think any research that examines the effectiveness of different intellectual property systems should be sure to look at how the effectiveness breaks down along economic and industrial lines.

The potential middle-ground Nelson ends up exploring in his feature involves building a hybrid intellectual property scheme that hinges on complexity. He asks: What if the individual “Lego bricks”—the core components, the cogs and gears of synbio—were openly available, but the sophisticated creations of individual labs—the blueprints for building a car out of Legos—were protected by strong intellectual property laws? It certainly seems like a reasonable compromise.

A united front

The wider world will not remain static while synbio sorts out is differing philosophies. Volker ter Meulen, a virologist and immunologist who is currently co-chair of the Global Network of Science Academies, writes in his own Nature op-ed that synthetic biology is at a turning point.

So far, it has avoided the public relationships disaster that besets genetically modified organisms (GMOs). But, ter Meulen writes:

> The debate over synthetic biology is now entering a critical phase. The Conference of the

> Parties to the Convention on Biological Diversity (CBD) — the global framework that governs the protection of biodiversity — is currently exploring possible restrictions and will clarify its position at meetings next month and in October. But given the precedent of how the issue of genetically modified crops was handled, many scientists are worried that some policy-makers will take unsubstantiated concerns of environmental groups at face value and impose cumbersome and unnecessary rules.

It's this looming threat of regulation that the Nature editors circle back to in their analysis of tribalism within synthetic biology. The time is coming when synthetic biology will begin to enter people's lives in the same pervasive way as genetic modification has entered out food supply; the wider world will become personally, acutely aware of it.

So far synthetic biology's impact on the larger public consciousness has been largely limited to "wow" headlines about synthetic yeast chromosomes or vague promises of revolutions in industry. The story told by Nature's special coverage is one where synbio has not yet begun to tap its full potential. And as it continues to move forward in spite of itself, it will soon be challenged—it should be challenged—in legal and ethical dimensions.

If the burgeoning discipline of synthetic biology is to weather these challenges and mature into the transformative force it wants to be, it needs to get its house in order.

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Selected Sources:

- "Synthetic biology: Cultural divide," Bryn Nelson | Nature
- "Synthetic biology: back to the basics," Nature Methods
- "Time to settle the synthetic controversy," Volker ter Meulen | Nature
- "Synthetic biology: back to the basics," Nature Methods
- "AMP v. Myriad Genetics: Do intellectual property protections really stifle innovation?" Sarah Fecht | Genetic Literacy Project