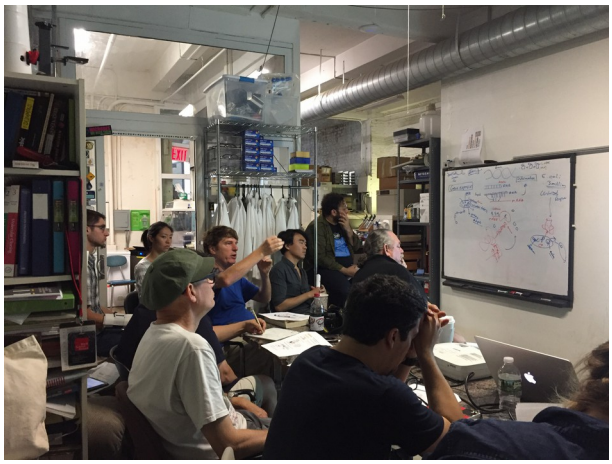
Teaching Life as Creative Medium

By Orkan Telhan*



In the past years, there has been a growing interest within the art and design community to engage with life sciences—from growing biomaterials (i.e., make mycelium furniture) to designing genetic circuits (i.e., explore bacterial photography) or working with the latest gene editing kits (i.e., DIY "CRISPR" kits) for mere curiosity.

Given this interest, a growing number of makerspaces, community biolabs, and informal learning environments become hubs for informal science education. However, teaching biology outside traditional academic environments has its challenges. Here, I will briefly discuss how I approached some of the challenges with a recent workshop series I gave at Genspace Community Biolab[1] in Brooklyn, New York.

Need to inspire further creativity

Artists and designers do not necessarily want to become amateur biologists. Most of them would have to invest too much time and energy into an area, which inherently lie outside their comfort zone. It is often the case that creative practitioners attend a workshop or two to get a first introduction, say to make bacteria glow in green, and then move on, as it becomes hard to translate that knowledge into something more meaningful with respect to their interests. While the principles of gene assembly, bacterial transformation, and safe handling of genetically-transformed organisms can be all captured in a canonical example, making bacteria glow does not necessarily inspire further creative inquiry beyond perhaps painting with bacteria.

Limitations of cookbook workshops

This challenge has often been addressed by "cookbook" workshops in which the learning objectives are clearly defined and attached to some achievable outcomes. A biomaterials workshop, for instance, may black box many complex details on working with biology and focus on sharing pre-existing recipes to grow cellulose, mycelium, or show ways to work with biopolymers such as chitin or sodium alginate. This approach helps more artists and designers instrumentalize biology and bring it closer to their own work. However, after 3-4 activities the designers can still end up reaching to the limits of cookbook solutions. They may end up knowing exactly the same "bag of tricks" and not

1 http://genspace.org/

necessarily have ways to keep learning on their own due to lack of tools, infrastructure, or difficulties to knowledge beyond the jargon of research papers. More importantly, without knowing enough about the underlying biology, it is hard for artists and designers to ask critical questions about what they are working on. Growing genetically modified materials versus melting petroleum-based plastic from the tip of a 3D printer require different sensibilities towards the environment. Artists and designers often need to know more about the ethical, philosophical, and moral implications of what they are doing before treating biology yet another type of fabrication method.

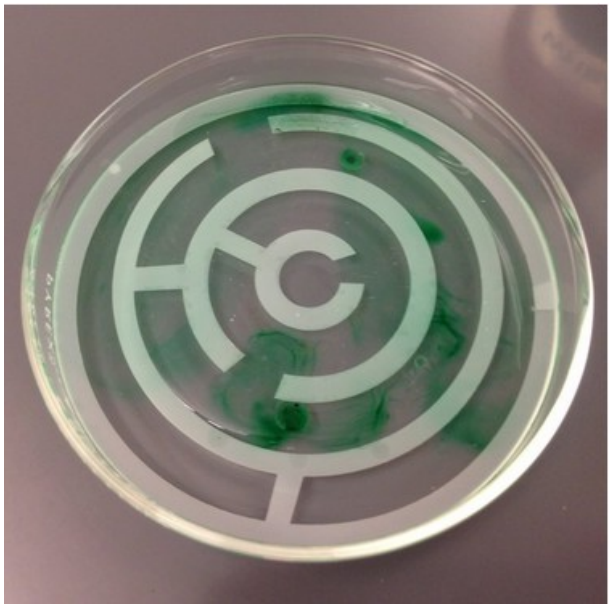
Introducing scale and complexity

Teaching introductory level life sciences and "cookbook" biology have their pros and cons. I have explored them widely in my own teaching; both in college-level design studios and workshops. Here, however, I would like to sketch out a third approach, which I explored in a 3-week workshop series at Genspace in September 2016. This curriculum was developed with an emphasis to scale and complexity in working with organisms. It is designed as an abridged version of a 14-week design studio I teach at University of Pennsylvania[2]. Every week of the workshop involved both a theoretical component and a hands-on activity that could be customized to the interests of the participants. We have started from working individual and less complex elements of the living (i.e., membranes and encapsulations) and ended up with designing microbial scale interactions, and biofilms.

Week 1: Life Before Biology

Designing protocells, droplets, encapsulations.

We started with looking at the first principles of making life. This session provided a brief introduction to protocells and other kinds of semi-living encapsulations with an emphasis on exploring the fundamental motivations behind intention and agency in living systems. The hands on activity focused on animating droplets to solve a maze.



Week 2: Synthetic Biology

Designing living circuits

In the second week, we covered microbial design (gene assembly, bacterial transformation, and growth) by using methods from Synthetic Biology. We drew similarities between engineering approaches to life and parametric and combinatorial

2 For more information regarding the course, please see: http://biologicaldesign.info/

design methods that are frequently utilized in architecture and product design. Our hands on activity were on developing a biosensing circuit using an automated culturing platform that can monitor cell growth in real time.

Week 3: Microbial Interactions

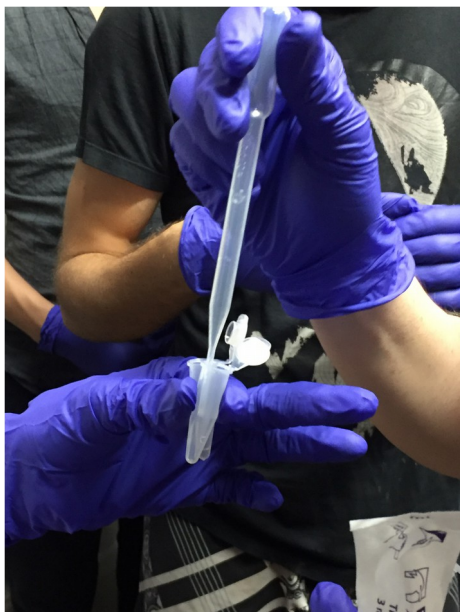
Designing biofilms, synthetic ecologies, microbiome

In the third week, we focused on creating interactions between microbial organisms and explore the design of microbial communities in a range of scales from the human body to the environment. Our particular emphasis was on biofilms for synthesizing energy and environmental remediation. The hands on activity focused on gene sequencing and a discussion concerning genetic identity and surveillance.

These weekly workshops consisted of three 3:30 hour meetings in which the activities were balanced between lectures, discussion and lab activities. Genspace is a bio safety level 2 certified lab that is equipped with consumables and standard lab hardware such as incubators, centrifuge and an autoclave. Most lab activities were designed similar to a cooking show, where some materials were prepared a head of time such that the students could see the outcomes of the lab before doing them.

The sessions were attended with an average of 10-15 participants per week who came from a wide variety of backgrounds ranging from hobbyists, to art students, design faculty and upper-level administrators in local colleges. The interests were also varying. While some participants were really interested in the lab activities, the others cared more about the discussions.

Lessons



For me, an important lesson from this experience was that it is important to design curricula that meet the specific interests and capabilities of the participants. While I believe that this workshop methodology was significantly more successful then the other two approaches, it still needed a more generative environment where participants could explore things on their own and with each other. This is often possible with more free time build into the events.

This is where the community biolabs becomes more and more important. The workshops and informal learning events can only be successful if we can build a culture and community around hubs where learning, discussing and debate can take place collectively. I personally think that the critical and creative advancement of knowledge requires many more diversity of approaches that can drive alternative

audiences to life sciences. Whether these communities will be interested in inquiring into the future of sciences or focus on exploring the practical outcomes of working with living organisms, as educators, we have the responsibility to provide new audiences with the right tools and pedagogical frameworks to fuel curiosity and imagination.

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* Orkan Telhan, Ph.D., is an interdisciplinary designer, whose investigations focus on the design of interrogative objects, interfaces, and media, engaging with critical issues in social, cultural, and environmental responsibility. Telhan is Assistant Professor of Fine Arts - Emerging Design Practices at University of Pennsylvania, School of Design. He holds a PhD in Design and Computation from Massachusetts Institute of Technology with a focus on Synthetic Biology and Biological Design. He was part of the Sociable Media Group at the MIT Media Laboratory and the Mobile Experience Lab at the MIT Design Laboratory.

Orkan Telhan was chosen as the artist in residency for a six-week program at the Center for Fundamental Living Technology (FLinT), University of Southern Denmark. The art program, which was initiated by Vienna based Biofaction and forms part of the SYNENERGENE project's activities, aims at critically exploring bottom-up Synthetic Biology, its societal ramifications and cultural aspects, and at helping envision the potential long-term changes Synthetic Biology might bring to society, through the lens of an artist.