

Tips for Collaborations: Getting Started

By Tony Cho

Working with scientists, biologists, and bioengineers poses a difficult but rewarding challenge when you are a designer or design student exploring biodesign. In addition to the task of diplomatically reaching out to these people, there is the ongoing effort of communicating effectively and managing the collaboration. Additionally, working with new biotechnology can be extremely difficult. Unlike other digital or mechanical technologies, most of the developments in synthetic biology are in a nascent stage. Wielding materials that are at once fragile, living, and temperamental makes for great difficulty even for the scientist to produce results. So how can the designer successfully maintain a healthy collaboration with the biologists, bioengineers, and cutting edge researchers? The following is a mix of guidelines and practical advice that should serve the beginner as well as the experienced professional who is comfortable in a lab coat and knows how to steady a pipette.

Outreach: Finding the right institution or expert in a field is one of the more difficult tasks for a designer approaching biodesign. But such outside help is necessary since the designer lacks technical experience and foundational knowledge required to understand life sciences and the various linked fields of research. Therefore, as crucial, early steps towards finding the right researcher and initiating a productive relationship, a designer must A) Make an attempt at understanding the science, and B) Understand the individual who is making the science.

Understanding the science: From tissue engineering, DNA manipulation, gene therapy procedures, to human augmentation, the practice of biodesign can encompass a broad spectrum of the life sciences. The designer is therefore wise to be careful picking a topic of interest that they feel they can invest their time to research. Understanding the science means diving deeper into the subject through scientific research papers. Research publications such as Nature, Science, PNAS, bioRxiv, ACS and many other publications are a great way to understand the science behind biodesign projects. Often times this is the foundational pillar required to move a project forward and establish its legitimacy.

Recognize that we are inundated with popular science posts through Facebook and online publications that give what are often sensationalized glimpses of what is going on in biology. While these can be a great place to start or serve to fan the spark of an idea for a design project, in order to engage with the scientists and experts one must go a step further into the research. This means finding the name of the scientists who have either made a new discovery, or developed a new technique and searching for academic journals that publish papers relevant to the topic. These journals can give a designer insight into how the research has been conducted, or how a certain biotechnology was developed, sometimes just through careful reading of the abstracts, or summaries that are available even if the journal has a pay-wall.

Don't be discouraged if your first try at reading a scientific paper is the same as reading gibberish. It is important to realize that developing scientific literacy in a subject matter is considered difficult even for a scientist, so don't be discouraged if it's hard to understand for a while. As designers, the reason for engaging with these papers is not to understand the whole of the research and field but to formulate questions that a designer can ask a scientist. This will both reassure the scientist they're communicating with someone making a real effort, and will

pave the way toward substantive exchange, of getting to the essence of why the science is important, going beyond the depth of a popular science magazine.

Understanding the individual: While both scientists and designers are born out of creativity the way in which they work are polar opposites. The scientist will dive deep into what is seemingly a narrow path and keep pursuing this direction until finding and confirming new knowledge. Designers love to work with many ideas at once and focus on the breadth of concepts over depth. So when contacting the scientist it is always good to be able to signal that you understand the specificity of what they do or what they've achieved in their work. When messaging the scientists make sure to note that you have read their scientific papers, and that you see a link between interests evident in those papers and your own goals for your project.

Another important conversation a designer will have with a scientist concerns authorship of the collaborative work. Once the scientist has agreed to have a conversation and start working together it is recommended to talk about the crediting and ownership of any output. Be aware, as scientists work for universities and private labs, that these places may have their own rules for intellectual property (IP). Be clear about what your expectations for the collaboration are, including how closely you would like to work together, and what skills you bring to the project. Be aware that often a designer's iterative process may uncover new findings or point to potential applications for research the scientist had not considered. This means that in some cases the authorship of the creative output of the project will need to be shared by the designer and scientist. So, if you are a designer who is heavily relying on the scientist's finding such as making a specific biomaterial or taking their research technique make sure to say that your project is a collaboration between two people when exhibiting, publishing, etc. On the other side, if the designer's iterative process uncovers new directions for research make sure that you are being credited to scientific papers that may be published due to your finding.

It's helpful to remind yourself that the role of a scientist is to produce new scientific results, to propose and then confirm or disprove hypotheses through experimentation. Think about what you as a designer can bring to the scientist. Whether that is a new perspective, connecting the scientific work with societal or cultural trends, or applying their findings to develop new products or services, mutual benefit should be a goal. Whether you are a designer who wants to employ a specific biological process, or understand the research to speculate on a possible future, your journey will likely begin with working to understand the science and forming a healthy collaboration with a scientist who will also be something of a guide.

Understanding Communication in Science: Listen carefully to the way a scientist describes a biological process or a part of biological technology. Words such as genotype, mRNA, germ line, and codon may be completely foreign to you at first. But make sure to find time to learn these words because they will usually be very precise definitions to a specific biological process or mechanism. A designer must learn it and understand it to the level where you can describe these processes on your own employing the same terminology. For example, while the word "protein" is well known, its use in science is specifically to describe a "polymer of amino acids that are composed of two or more polypeptide chains." Likewise, the word "organic" has many meanings outside of the scientific community, but to trained experts is simply means "containing carbon." Just as designers employ their own lexicon to describe a project, scientists also have a specific way of talking which allows them to be precise about their work. It will take

time to get used to, however it is crucial that a designer invests time into practicing and understanding this way of speaking.

When contacting a researcher make sure to include: (1) A clear description of why you're reaching out to them and any affiliation you have, i.e. university. (2) Details that demonstrate you have read an academic paper of theirs. (3) Explain how working together would be beneficial for both parties.

Think about the purpose of the message as a start to a conversation rather than marking a goal of your project. In other words, it is a path to understanding more about the science you are trying to engage with rather than just a means to do a biodesign project. Learning about the science will lead to more and better projects. Finally, it is helpful to remember that in any effort like this collaboration will require more than one conversation with a scientist; apply the iterative approach to your outreach, you may have to contact several people over time to find the right match.

Recommended Resources:

Design and the Elastic Mind – Paola Antonelli

Biology is Technology –Robert Carlson

Synthetic Aesthetics – Alexandra Daisy Ginsbery

BioArt: Altered Realities – William Myers

Synthetic Biology - A Primer – Paul S Freemont

BioBuilder – Natalie Kuldell, et al

Speculative Everything – Tony Dunne, Fiona Raby

Regenesis – George Church

Biopunk: Solving Biotech's Biggest Problems in Kitchens and Garages – Marcus Wohlsen

Material Alchemy – Jenny Lee

ArtScience: Creativity in the Post-Google Generation – David Edwards

Science and Technology coverage of The Economist

Scientific American magazine

BioSocieties journal

Symbiotica eDigest

Biodesign Challenge: see <http://biodesignchallenge.org/>

Bio Art and Design Awards: <http://www.badaward.nl/>

Science Gallery International: <https://international.sciencegallery.com/>

iGEM Competition: <http://igem.org/>

Crediting and thanking: Cultivating longer-term collaborations will involve keeping in touch, thanking, and crediting scientists for their work. Understand that scientists have different agenda's when compared with a designer. They must publish and run their research, and collect results. Think of collaborating as bringing a professional or an expert in to work with you. They are giving their time outside of their normal responsibilities to work with you. Be conscientious of this and make sure that the scientist is aware of your gratitude! Acknowledgement will go a long way in building your project.

FAQs

Where do you find scientists to collaborate with?

If you are a design student at a university, check if your own university has departments dedicated to bioengineering or synthetic biology. Otherwise, check scientist profiles on other university websites, keeping in mind that the lab is often named after the person leading it, i.e. The Murch Lab is headed by Dr. Kater Murch. The head of the lab is usually the busiest and hardest-to-reach person, so you might consider post-doctoral students or associate professors.

What if I don't know anything about biology but what to do a biodesign project? What is the best way to start?

Read a bit more about the subject matter in biology you are interested. If you are interested in DNA editing look at the research related to DNA editing such as CRISPR Cas-9 or search for the term 'central dogma' for an overview of DNA's importance to biology. If you are interested in working with human tissue, try to look for literature about how to culture cells for tissue engineering. Make sure to be clear about the level of knowledge you have in the subject area when talking to a scientist. This will also help them understand how to explain their project to you.

How important is wet lab experience?

This will depend on the type of project you will want to pursue, but it is recommended that if you are using research or even a biomaterial itself for a design project that the designer engages in the wet lab experience even if it is only to be introduced to a process. Whether it'll be a long term or short-term project, the designer must engage with biology at some level. For example, if you want to do a project involving gene editing, it may be good to have some first hand experience with CRISPR Cas-9 techniques.

Where would I be able to get WetLab experience

This can be a difficult thing to find. If you are a student at a university, reach out to researchers in the university to see if they can find some time to train you. Often times this will only be available once you start collaborating and have developed enough knowledge of the research. Also look for DIY-Bio community labs. Places like Genspace(NY), Biocurious (SF), London Biohackspace, EMW StreetBio(Cambridge, MA) offer spaces for enthusiasts to learn more about biology and techniques often used in labs. This is not an exhaustive list of places and usually biohacking spaces can be found or is called open science labs, so try to search for something along those lines when looking in your own community. There are dozens of DIY-Bio labs listed at <https://diybio.org/local/>

Are there non-scientific routes for biodesign?

Harnessing biology for design can take many traditional craft forms. Practices in agriculture, brewing, baking, and even gardening can be tapped for a biodesign project. These are still based in science of course, but it is not strictly necessary to collaborate with a scientist to work with them. They are sometimes easier to approach as well, since there are large amateur communities around these activities.

How do I know if my project is a success?

Evaluation is tricky; take stock of what you have learned. Did this nourish your empathy for other living matter, give you more appreciation of the intricate interdependencies between species? Do you have a firmer grasp of scientific practice and how it benefits from a design approach? Did your project initiate at least one conversation with classmates, professors,

friends, or strangers about the ethics, effectiveness, or possibilities of working with biology? If the answer to any one of these is 'yes' then you've succeeded. Likes on Facebook are nice too, but they do not mark success.

What kind of work do biodesigners do in industry?

Although there is a budding movement academically and in the art and design worlds, it is important to emphasize that working with biology as a designer is a way to build cross-disciplinary skills, which are in increasing demand. The kind of experience required in a biodesign project shows that you're flexible and curious, likely able to work effectively in teams with people who have very different training from you. This in itself is applicable to many kinds of jobs across design and science. However, some people who focus on biodesign find work in biotechnology firms in a creative role, often trying to translate the technology into something useful for everyday life. There is certainly freedom and opportunity for those who want to pursue this type of work, but be aware there is some ambiguity and uncertainty as in any new field.