



From armpit cheese to computer-eating bacteria

Interdisciplinary teams experiment with nature



Odor artist Sissel Tolaas and synthetic biologist Christina Agapakis create cheese in the lab as part of the Synthetic Aesthetics project.

Images courtesy of Alexandra Daisy Ginsberg

As part of a multi-year project, researchers explored the role of design in the field of synthetic biology.

Have you ever wondered what cheese made from bacteria on our toes might smell like; or perhaps what DNA sounds like as it whizzes past you? Would you drink out of a cup made from bacteria that could almost instantly transform water into a probiotic drink?

These and other mind-boggling questions were the product of Synthetic Aesthetics, a multi-year, international project that launched in 2009 and explored the role of design in synthetic biology — broadly defined as the engineering of living things. (Think of bits of DNA code, for example, as programmable, much like computer software.)

As part of the project, synthetic biologists were paired with artists and designers — including a smell artist, an architect, and a composer — to form a total of six teams. Spending an equal amount of time in each other's workspace, the pairs were given the freedom to take their work in any direction they chose. The goal of the project was to explore what it meant to design nature and the participants were interested in how to do this sustainably, by harnessing nature's properties rather than exploiting or manipulating it.

"As a group we said we wanted the project to be like a wedge in the door that stops synthetic biology from closing; that stops synthetic biology from becoming boring," says Jane Calvert, a professor of science and technology

studies at the University of Edinburgh and the UK Principal Investigator on the project. Consider the cheese. As part of their experiment, synthetic biologist Christina Agapakis and odor artist and researcher Sissel Tolaas made cheese out of bacteria found on people's toes, armpits, belly buttons, and tongues — parts of the body that tend to be moist and, therefore, hold bacteria. The range of smells was wide: Calvert described armpit cheese, for instance, as smelling "yogurty and fresh," while toe cheese was "disgusting and strong."

“We didn't know what was going to come out of it.”

The idea behind the experiment was to think about our relationship to our microbiome as well as explore the boundaries between ourselves and the food we eat. In fact, many of the stinkiest cheeses are associated with bacteria that have similar smells to parts of our bodies such as our toes and armpits. That's probably because we have some of the same microorganisms as cheeses — likely the product of artisanal cheese making and the subsequent transfer of bacteria between the cheesemaker's hands and the cheese.

Other projects included creating cyanobacteria that digested computer circuit boards and a look into the future when inanimate machines including cars and computers could potentially be replaced by living machines. "The project reveals ... that professionals in art and creative design can create significant value by leading work to consider what might be wished for, especially when most can't yet imagine," says Drew Endy. Endy is a bioengineering professor at Stanford University who served as the US Principal Investigator on the project.

Because of the strong multidisciplinary nature of the project, individuals had different objectives and takeaways. As a social scientist, Calvert saw the project as a way of challenging the scientific community, seeing it as an "inreach" rather than an outreach project. The synthetic biologists embraced the opportunity to be more imaginative about the science while the artists and designers questioned some commonly held assumptions about synthetic biology.

Other members of Calvert and Endy's team who oversaw the project included Alistair Elfick, a bioengineer at the University of Edinburgh and co-Investigator; Pablo Schyfter, a social scientist, also at Edinburgh; and London-based designer and artist Alexandra Daisy Ginsberg. In 2014, the team published a book, "Synthetic Aesthetics: Investigating Synthetic Biology's Designs on Nature," in which they discussed the project in detail. In addition, teams have presented and exhibited their work at conferences, art exhibits across the world, and festivals as a way to explore the potential reach of synthetic biology in our daily lives.

"We didn't know what was going to come out of it," says Calvert, who had never worked with artists and designers before. But, she says, it was that three-way collaboration between synthetic biologists, artists and designers, and social scientists that allowed each to get something out of it. "Something different from what we expected."

These cheeses made from bacteria found on different parts of the body — including designer Alexandra Daisy Ginsberg's armpit, philosopher and social scientist Pablo Schyfter's toe, synthetic biologist Christina Agapakis' hand, and odor artist Sissel Tolaas' nose — took a few days to make as part of the Synthetic Aesthetics project.



The Synthetic Aesthetics project was supported by UKRI's Engineering and Physical Sciences Research Council and the US National Science Foundation.