



A squeeze. A dozen GenSpace members, including (left to right) Sung won Lim, Russell Durrett, and Ellen Jorgensen, share two tiny labs.

NEWS

A Lab of Their Own

Do-it-yourself biologists in New York follow their dreams, setting up a community lab that combines synthetic biology with art, fun, and perhaps profit

NEW YORK—It's 4 p.m. on a summery Wednesday afternoon, and four members of GenSpace—two former biotech scientists, an undergrad on hiatus from school, and a person who runs next-generation DNA sequencers at a local medical school—are sitting around on mismatched chairs on the seventh floor of this former Flatbush bank, sipping Magic Hat beer and reflecting on the oddity of becoming minor scientific celebrities. *GQ France* did a photo spread recently on the writers, artists, and biologists who practice biology at GenSpace, and the Guggenheim Museum approached them about collaborating on an exhibit to teach synthetic biology. Low-brow TV producers even pitched the idea of a reality show based at this “community lab,” a place where professionals and amateurs alike tinker with life forms and engineer DNA. GenSpace turned the producers down, and things soured with the Guggenheim, but amid any disappointment, members marvel at the continued, and sometimes lurid, fascination they've dredged up. “I've been really surprised at all the attention,” says president Ellen Jorgensen.

Eventually, talk turns back to biology,

and other GenSpace members start drifting in. Indeed, says GenSpace vice president Daniel Grushkin, a science writer, “GenSpace is like a gym membership” in that people come and go 24 hours a day. Grushkin spends the afternoon sketching out plans to use a bacterium to genetically transform the worm *Caenorhabditis elegans* and make it fluoresce. “It's a few steps above a pet rock,” he suggests. And amid these discussions of organisms and experiments, all the other distractions fall away. That's why this crew had founded GenSpace, after all—to do their own biology, on their own agenda.

With the lab's debut in December 2010, GenSpace opened a new chapter for the do-it-yourself (DIY) biology movement, which some say parallels the garage computer culture in the 1970s that helped usher in the personal computing revolution. (Some DIY biologists even call themselves “biohackers.”) But although the New York crew was the first to commit to a formal lab space for community biology, they're not alone. BioCurious, a DIY biology team near San Francisco, California, founded in 2009, has recently signed a lease for a 220-square-

meter office in the Bay Area that will be turned into lab space.

Whether many more GenSpaces will arise is tough to predict. It's hard to quantify the number of active DIY synthetic biologists. Thousands of people trade tips (and jobs) in online forums, and the Web site DIYbio.org has seen its membership grow by orders of magnitude since starting in April 2008. But the number of people doing “wetwork” is significantly smaller, acknowledges Jason Bobe, who co-founded DIYbio.org.

Although not a biologist herself, BioCurious co-founder Eri Gentry says she hunted down lab space to rent because biology students she knew through BioCurious had grown weary of pursuing narrow Ph.D. research topics and wanted to tackle side projects they were passionate about. The setup in most science labs today “doesn't breed creativity,” she argues.

That's a common sentiment in DIY bio, and it motivates much of the passion. Scientists are born tinkerers, says Jorgensen, also an assistant professor of pathology at New York Medical College. “This place is made for spare-time tinkering.”

Indeed, as James Collins, a synthetic biology pioneer at Boston University, points out, “when we started synthetic biology, most of us were amateurs. We came from engineering, physics, computer science, and other fields.” Still, “amateurs” like Collins, although biology neophytes, worked at universities and had access to expensive research equipment. Almost by definition, DIY biologists lack that access, and Collins argues that they will thus have a tough time making significant contributions.

Building communities

GenSpace started in 2009 after several like-minded New Yorkers met online through the Google group [DIYbio](http://DIYbio.org). For months they puttered around with experiments in Grushkin's living room, but late last year they graduated to their new space: two boxcar-sized labs, each about 10 square meters, and a lounge on the top floor of a building that is primarily an artists' collective. The move to a permanent place was important for doing better science, Jorgensen says: “We kept hitting obstacles easily solved with the creation of a community lab. Suppliers of reagents often won't

ship to residential addresses, and you need a separate fridge for storage so [microbes] won't contaminate food."

Like a clubhouse, the labs are cobbled together, in part from the impressive piles of junk lying around the building. "A lot of sweat equity went into this place," says Oliver Medvedik, who earned a Ph.D. from Harvard University in biomedical science and has taught there in the past few years but focuses on being GenSpace's director of scientific development. Many of GenSpace's lab benches are countertops salvaged from restaurants. Centrifuges, a PCR machine, and other equipment were donated by Jorgensen's previous employer, a biotech company that laid her off and had to unload things as it downsized. Medvedik even scouted eBay, finding an incubator that he ultimately bought off a truck in Jersey City, New Jersey, for \$659.

The research equipment is integral to Medvedik's plans to genetically engineer bacteria to turn colors (perhaps from blue to yellow) in the presence of arsenic, to test groundwater in places like Bangladesh.

Even with a dedicated lab, though, the work Medvedik and others are doing is not easy. All DIY biologists have access to the international Registry of Standard Biological Parts, snippets of genetic code that can be popped into cells and microorganisms, much as resistors or capacitors can be popped into electrical circuits, and that should produce certain molecules or effects each time. But at a "synbio" meeting in July 2010, participants reported that of the registry's 13,413 parts listed then, 11,084 didn't work. As one presenter noted, "Lots of parts are junk." Wary of this, Medvedik and others say they must carefully test each registry part before relying on it.

GenSpace members also pay close mind to biosafety. Medvedik or Jorgensen gives all new recruits a 90-minute safety briefing and lab tour, similar, Jorgensen says, to what typical graduate students get. GenSpace has government and university safety officers on its advisory board, and it stays in contact with FBI agents as well. It even invited agents to one of its "strawberry mayhem" events, at which participants (usually children) mash fruit and extract DNA. The group also screens new members' projects carefully, having recently rejected a proposal

involving human pathogens that cause acne.

Besides accepting donations and scrounging for hardware, GenSpace helps make ends meet by offering biology classes to the public. The 12 GenSpace members pay just \$100 per month for lab access, but the group charges \$300 per student for a 4-week course that includes learning lab techniques such as gel electrophoresis and splicing DNA with restriction enzymes. Jorgensen and Medvedik have taught more than 60 students since January, with more classes planned.

Students range in age from their 20s to their 60s, and most have no real science background. Alumni include a winemaker, biotech investors, and New Yorkers curious about personal genomics. In one class, Medvedik had students engineer *Escherichia coli* to produce pungent banana oil. "Some people want to do real MacGyver stuff" like



Citizen science. The classes for the public that GenSpace teaches have brought in most of the lab's revenue so far.

the TV secret agent, Jorgensen says, whereas others "are fascinated just by running a gel."

Different strokes

Likewise, GenSpace members have different motivations for pursuing DIY biology. One of Medvedik's projects involves cultivating a fungus that can digest wood chips or sawdust. It converts those loose materials into a Styrofoam-like matrix, which could find use as an ecofriendly packing material or as insulation. Medvedik is also applying for Bill and Melinda Gates Foundation grants to expand his arsenic-detecting microbe project.

GenSpace executive secretary Russell Durrett, who graduated with degrees in biochemistry and anthropology from New York University in May 2010 and now has a job running DNA sequencers at Weill-Cornell

Medical College, joined GenSpace largely to develop ideas to spin off into a company or sell as inventions. Toward that end, GenSpace announced early on that its members would retain all intellectual property rights. Some biohackers were aghast at this, arguing that it runs counter to the open-source ethos of the computer culture that helped spawn DIY bio, and GenSpace was flamed online.

But what makes sense financially in computing doesn't necessarily work in biotech, Durrett says, because organic parts take far longer to test and develop. His projects right now include designing fluorescent moss. He's also interested in producing cheap PCR machines: At a weekend-long "synbio binge" at GenSpace (an event inspired by "hack-a-thons" where amateur computer programmers gather and work together for days), he built a homemade PCR machine

from plastic piping and a light bulb.

Jan Mun, who took Medvedik's class in May after hearing about it on a digital media listserve, recently joined GenSpace for the sake of her art. She had been culturing mushrooms at her home for an environmental sculpture, but they died; most homes are not antiseptic enough for finicky 'shrooms. GenSpace was her solution, as she could grow them under sterile conditions. "It's very unusual to have access to a molecular biology lab," Mun says, "and it's wonderful that they're open to artists."

Traditionally, there are certain scientific fields, such as high-energy physics, to which only professionals can significantly contribute. In other fields, such as astronomy or ornithology, committed amateurs can do important work.

Synthetic biology is currently the first kind of science, but by teaching classes and opening community labs, groups such as GenSpace and BioCurious strive to make it the second: to welcome Mun's artistic mushrooms alongside Medvedik's humanitarian bacteria or Durrett's entrepreneurial mosses. It's ambitious for such small groups, but Jorgensen welcomes the eclectic mix. DIY bio, she says, "is called a movement because it's just that. It's not organized and means different things to different people." Despite recruits like Mun and spreads in *GG*, GenSpace isn't quite mainstream yet, but Jorgensen predicts it will be: "We feel the future is community labs." **-SAM KEAN**