



Synthetic Biology

Broad Definition

An area of biotechnology that specifically involves redesigning organisms, typically microbes such as *E. coli* and yeast, to have new, useful abilities. This is an interdisciplinary field that combines genetic engineering, computational genetics, and laboratory automation to design new molecules OR put pathways for generating known molecules in organisms that don't naturally create them.

Behaviors

- Big players focus on platform vs product
 - Two giants dominate the field -- Zymergen and Gingko, West Coast and East Coast -- and they take on a variety of projects in different areas, enabled by their unique platforms for strain engineering. Some projects include fragrance production, COVID diagnostic testing, and breaking down plastics
 - Other successful SynBio companies have mass molecule-producing, cell-searching or DNA-producing platforms that they market to companies to make profit (B2B Biology)
 - Only small startups that have emerged recently are product-focused companies
 - Language of "genetic circuits" or logic circuits for gene "computation"
- Companies tend to stay private/start-up for a long time, but are well-funded Most companies are small, and responsive if you email them directly/through their website
 - Although they are startups, they're often looking to hire if you display passion for the field
 - Highly contract-driven: companies put the most effort into developing their own platforms, only implementing them for projects with product-based companies (typically small to mid-sized startups)
 - Must display role flexibility and interdisciplinary background if you want to work in this field, because large overlap of fields within the company
- Large focus on futuristic technology, even as platform-based companies succeed Often contract with government departments such as IARPA/DARPA to tackle future issues in biotech
 - Must be aware of current issues beyond biological sciences (i.e. climate change) if you want to work in this field
 - Some companies have creative departments that specifically create

non-useful cool projects (i.e. bringing back ancient flower smells)

Gingko releases a magazine every couple of months with SynBio projects

Highly engaged marketing: often work on educating the public on what microbe engineering does + engaging the public with these cool art projects to enhance public acceptance levels for what they're doing (i.e. people protest about GMOs without knowing what GMOs are)

Example foci: generating palm oil using microbes, generating antibody-laden breastmilk with microbes, engineered yeast as medicine or probiotics

- Heavily concentrated around San Fran and Cambridge, as Stanford/Berkeley and Harvard are the strongholds of the industry
SynBio departments are nonexistent outside of these communities, whereas other biotech industries are better distributed

Types of Roles Available

- *Software engineering/Data Science*: many of these companies incorporate large technology platforms and need people to develop their data analytics platform as well as perform scientific computation. Most valued in the field. Strong computational skills required, base level of biology knowledge
- *Strain/Fermentation Engineer*: Works to engineer the microbes to produce desired molecules at a large scale. Molecular Bio experience required (i.e. engineering microbes)
- *Bioinformatics/Genomics Scientist*: Proposes how to perform genetic engineering experiments on large scales, analyzes output. Second most valued in field.
- *Other chemical/biological positions*: Laboratory research for product development, varies by company but may include materials engineers, synthetic chemists, etc
- *Automation, Manufacturing Engineer*: Many companies are working on automation platforms and need mechanical engineers to contribute
- *Process Engineer*: For chemical engineers, how to manufacture molecules from microbes at a large scale
- *Business Development/Corporate*: Finance, marketing, and management needed for business-side operations and sales
- *Science Writing/Marketing/Social Media/Creative Roles*: Companies like to engage public to encourage widespread acceptance of their platforms, so often have strong media/creative departments
- Gingko and Zymergen may have *postgraduate internship programs* for 1 to 2 years based on the time of year/funding success they're having

Valued Skills

- Knowledge of the field + relevant players
- Laboratory experience in a synthetic biology setting
- Creative, problem-solving mindset
- Attention to the outside world, desire to tackle global issues
- Good collaborative skills, as work in teams
- Interdisciplinary background, as startup mindset + bridging different areas

Relevant Companies

<i>Gingko BioWorks</i>	Synlogic
<i>Zymergen</i>	Twist Biosciences
Beam Therapeutics	Asimov
Berkeley Lights	ZBiotics
Distributed Bio	Sherlock Biosciences
Conagen	Coral Genomics
Codexis	Mammoth Biosciences
C16 Biosciences	

To Follow/Join:

- SynBioBeta: synthetic biology newsletter
- IndieBio: biotech accelerator, often has a variety of synthetic biology companies
- Y-Combinator Bio: also often has good synbio companies
- iGEM at Yale: performs synbio experiments in competition, big thing for SynBio
- Y-BioIncubate: SynBio speakers, companies, and events
- Wyss Institute: birthplace of synthetic biology (Church and Silver)

Relevant Majors: BME, MCDB, MB&B, MechE, CS

