LAB TOUR

In the field of synthetic biology, where biological systems are engineered to serve new and useful purposes, advancing ideas from imagination to reality requires building, testing, and iterating quickly.

THE BIOFOUNDRY AT THE CENTER FOR SYNTHETIC BIOLOGY

OPENED IN OCTOBER 2024, the BioFoundry at Northwestern's Center for Synthetic Biology provides tools to rapidly assemble DNA, engineer microbes, and run large numbers of experiments in parallel. Combining automated laboratory instruments with specialized software for data analysis, the BioFoundry helps scientists test more ideas, generate larger datasets, and move discovery forward faster.

The lab is led by director Josh Leonard, professor of chemical and biological engineering and (by courtesy) biomedical engineering, and codirector Arthur Prindle, associate professor of chemical and biological engineering, (by courtesy) biomedical engineering, and biochemistry and molecular genetics in the Feinberg School of Medicine. It is managed by scientist Lauren Clark.

1. Opentrons Flex Robotic Liquid Handler

This system automates one of the most common laboratory tasks: moving small amounts of liquid between containers. Researchers can program the system to perform these repetitive procedures with speed and precision, reducing human error while improving efficiency, consistency, and reproducibility across a broad range of experiments.

2. Echo 655 and Echo 525 Acoustic Liquid Handler

Rather than using pipette tips, this instrument uses sound waves to move tiny droplets between wells without physical contact. Operating at the nanoliter scale, it can transfer volumes as small as a few thousandths the size of a raindrop, enabling researchers to run hundreds or even thousands of experiments simultaneously using far less material. This increase in experimental throughput enables scientists to explore combinations of conditions, variables, and designs that would be impractical with conventional laboratory methods.

Explore the BioFoundry's technologies, capabilities, projects, and offerings on the facility's website.

3. Sony Cell Sorter

Also called a flow cytometer, the cell sorter helps researchers find and isolate rare cells from large populations. The instrument analyzes one cell at a time as it passes through lasers that detect properties such as fluorescence. Based on those signals, the sorter separates cells into different groups, helping researchers identify the few among millions that can successfully perform a desired function. The system supports everything from bacterial to human-cell experiments and uses interchangeable components that reduce the risk of cross-contamination.

4. MiSeq i100 High-Throughput DNA Sequencer

This sequencer can read thousands of DNA sequences simultaneously, enabling researchers to quickly identify and measure the biological components present in complex samples. Scientists can determine which organisms, genes, or genetic changes are present and how abundant they are, providing a detailed snapshot of what is happening inside a biological system.

5. AMBR 250 Eight-Way Parallel Bioreactor

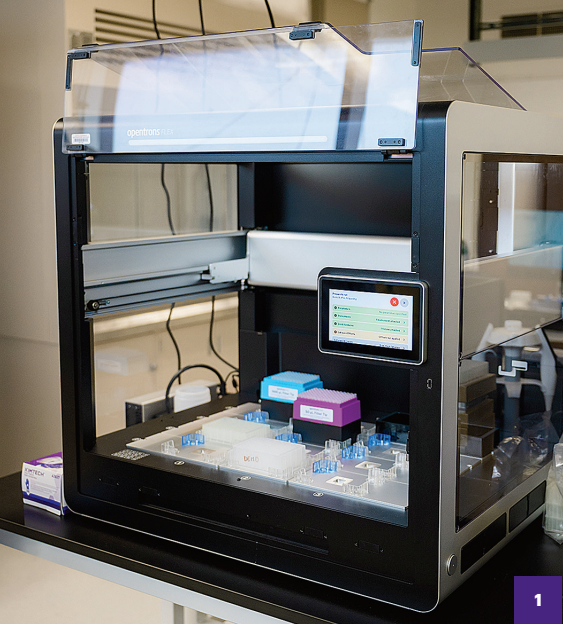
Researchers can grow and monitor up to eight cell cultures simultaneously under tightly controlled conditions in this parallel bioreactor. The system automatically regulates factors such as oxygen levels, pH, and temperature, allowing researchers to compare different cell or microbial designs side by side and identify top performers or most advantageous growth conditions. The instrument also helps bridge the gap between laboratory discovery and larger-scale production.

6. Two MP Auto Mass Photometer

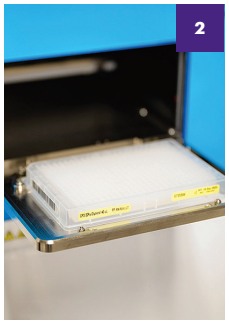
One of the lab's newest technologies, this instrument uses light to measure the mass of individual molecules and molecular complexes. Researchers can determine what subpopulations are present in different forms and assess the quality of advanced therapeutics, including antibodies, nanoparticles, and gene-delivery vectors by identifying which particles are fully assembled and which are not.

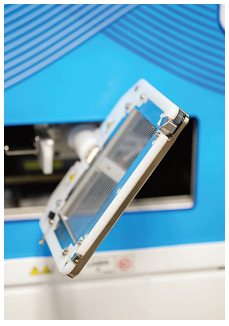
BRIAN SANDALOW

Photos by Jason Brown

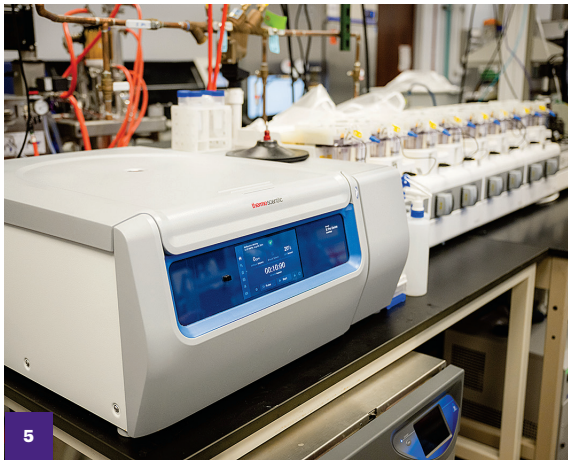
















LEADING THE NATION IN ACCELERATING BIOTECHNOLOGY DISCOVERY

Currently, the resources of the Center for Synthetic Biology's BioFoundry are available only to Northwestern, its collaborators, and local startups and biotech companies. However, the National Science Foundation recently awarded the University $20 million over four years to expand the lab's experimental throughput capability and open access to the lab's protein engineering expertise for researchers across the country.

Housed within the BioFoundry, the AI-Driven, Rapid, Experimental Automation Machine (DREAM) Cloud Lab for Protein Engineering will serve as the first national resource for accelerating the development of new medicines, sustainable materials, agricultural technologies, and other biotechnology innovations. Researchers will be able to design and run experiments remotely, access advanced scientific instruments, and leverage shared data and AI models to speed discovery.

Julius Lucks, Margery Claire Carlson Professor of Chemical and Biological Engineering, will serve as principal investigator. Coprincipal investigators include Danielle Tullman-Ercek, James N. and Nancy J. Farley Professor in Manufacturing and Entrepreneurship, chair and professor of chemical and biological engineering; and Han Liu, Orrington Lunt Professor of Computer Science at the McCormick School of Engineering and professor of statistics at the Weinberg College of Arts and Sciences.