



**THE FUTURE IS  
SYNTHETIC  
BIOLOGY**

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## SYNTHETIC BIOLOGY AT CONCORDIA

Concordia has rapidly established itself as a pillar of the synthetic biology revolution in Canada and an important global leader. The university holds the country's only Genome Foundry and Concordia's Centre for Applied Synthetic Biology is the first and only research centre in Canada dedicated to the development of foundational technologies in synthetic biology.

With cutting-edge facilities, Concordia is attracting top researchers and students from around the world to develop solutions for emerging needs in health and drug development, environmental protection, sustainable manufacturing, agriculture and food production.

“Our competition is the big Ivy League schools.  
We're really at the forefront of this research.”

— VINCE MARTIN, co-director of Concordia's Centre for Applied Synthetic Biology  
and Concordia University Research Chair in Microbial Engineering and Synthetic Biology.



## TIMELINE

Emerging in 2012 from a collaboration between the departments of biology and electrical and computer engineering, the Centre for Applied Synthetic Biology (CASB) received university-wide status in 2016 growing its membership to include biochemistry, journalism, communication studies, mechanical, industrial and chemical engineering.

**2012**

Launch of CASB and the centre hosts its first symposium titled “Building Biology”



**2014**

CASB hosts “UK – Canada Synthetic Biology Workshop: New Horizons for Synthetic Biology Research, Public Policy and Industry”



**2016**

Faculty members David Kwan and Steve Shih are recruited to CASB



**2018**

Concordia creates SynBioApps, Canada's first training program for Synthetic Biology



**2020**

Concordia launches new \$62 million Science Hub



**2013**

CASB enters Concordia's first team in the International Genetically Engineered Machine (iGEM) competition



**2015**

CASB secures \$2.4 million to establish Canada's first genome foundry



**2017**

The Genome Foundry is inaugurated



**2019**

Concordia, along with 15 other leading institutions, co-founds the Global Biofoundry Alliance





## WHAT IS SYNTHETIC BIOLOGY?

Synthetic biology is the engineering and programming of biological organisms to harness them for medicinal, industrial or environmental applications. Using modern technology and tools, such as robotics and powerful computers, scientists are able to transform cells and other microorganisms — already highly efficient machines evolved over billions of years — into mass-producing factories or specialized machines.

“Automation takes a lot of the monotonous and repetitive labour away from the research, and frees up researchers and students to come up with new ideas and ways to apply these techniques and approaches.”

— DAVID KWAN, assistant professor in the Department of Biology

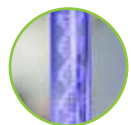
### WHY IS IT IMPORTANT?

Our world is facing unprecedented times. From climate change, food insecurity, drug and medicine shortages, unsustainable energy and manufacturing industries, to global pandemics like the one we are currently experiencing, we need innovative solutions to address these challenges.

Fortunately, few fields of science have as much potential to solve these major issues as synthetic biology. Here are a few ways this emerging field can help solve some of these challenges:



- **Biofuels** can be mass-produced using renewable, cheap and abundant carbon sources such as cellulose and yeast.



- **Vaccines** and other time-sensitive health products can be developed exponentially faster using robots and automation.



- **Rare materials**, often from unreliable sources, used in drugs and medicine can be engineered cheaply in labs using common bacteria.



- **Instead of using harmful insecticides and pesticides**, plants can be designed to be more resistant to attacks from insects and diseases.
- **Genome Foundries**, such as the one at Concordia, help clear bottlenecks in the research cycle and allow scientists to test hundreds of genes simultaneously.
- **By engineering cells, scientists can create macromolecular machines** to perform tasks such as DNA replication or drug delivery.

## HIGH-TECH FACILITIES

For the past several years, we have actively worked and invested heavily to establish Concordia as the center of synthetic biology in Canada. Our modern facilities are set-up with high tech labs and state-of-the-art equipment, allowing our researchers to push the boundaries of what is possible.



### CENTRE FOR APPLIED SYNTHETIC BIOLOGY

- Canada's flagship centre dedicated to synthetic biology.
- State-of-the-art facilities.
- Truly interdisciplinary and multidisciplinary (biology, engineering, chemistry, physics, computer science and communications).
- Well-positioned to tackle the most pressing issues of our time in health and drug development, the environment, sustainable energy and manufacturing, food and agriculture.



### GENOME FOUNDRY

- First and only one of its kind in Canada.
- Cutting-edge robotics and automated systems
- Significantly increases scale and speed of research and allows scientists to tackle challenges that are vastly more complex.
- Eliminates bottlenecks in research cycle.
- Provides unique training opportunities for students and experts.



### CENTRE FOR STRUCTURAL AND FUNCTIONAL GENOMICS

- High-tech genomics facility with powerful computational resources to sequence, process and store the genetic information of various organisms.
- Important on-campus resources for synthetic biology research at Concordia.
- **Coming soon: gene therapy platform.**
- Thanks to a transformational investment from the National Research Council of Canada, Concordia will soon have the infrastructure to quickly and accurately generate donor cells for use in life-saving gene therapies.
- Will make Concordia the go-to place for iterative rounds of gene editing.



## GROUNDBREAKING RESEARCH



- **Using microfluidics** to develop credit card-sized automated labs capable of testing for diseases, engineering microorganisms and cell culturing.



- **Engineering enzymes** — nature's extraordinary biocatalysts — to produce anticancer drugs, therapeutics for infectious diseases and bio-renewable hydrocarbons as alternatives to petroleum products.



- **Researching how lysozymes** — naturally occurring antimicrobial enzymes found in animals' immune systems — can be inexpensively recreated and used in livestock feed to replace sub-therapeutic use of antibiotics.



- **Exploring the potential of microbes** to act as small environmentally-friendly factories that can convert simple carbon sources into bioproducts like fuel and pharmaceuticals.



- **Developing a new method to produce synthetic opium** for use in painkillers and other drugs.



## MOLSON FOUNDATION FUNDING

Thanks to a generous \$5 million gift from the Molson Foundation, Concordia will create an endowment to establish one research chair in synthetic biology and recruit new personnel for the Genome Foundry. This will allow the university to significantly enhance the scope and impact of its groundbreaking research in synthetic biology and increase the foundry's production.

1. **The chair will be open to full professors at Concordia** with significant research experience and demonstrated leadership and capacity building in synthetic biology. The chair will receive \$102,500 per year from the endowment to cover a salary stipend, research allocation and one course release. This chair will have variable year terms and will be eligible for renewal for a second term.
2. **The balance of the yearly funds available (\$72,500)** will be used to help the university recruit a business development officer and two research personnel to increase the Genome's Foundry capacity, visibility and client base.

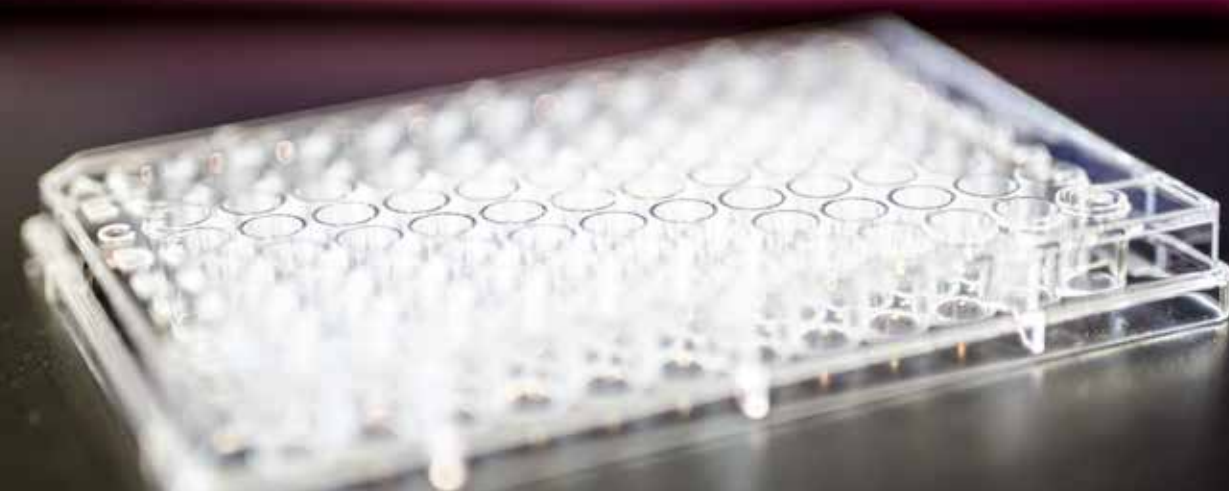
*\*More funds will be available annually as the endowment grows.*

"If my research is successful, we'll be able to program an experiment on a computer that will automate the process on a chip. What takes days or weeks to experiment manually only takes a few hours on a chip."

— STEVE SHIH, head of the Shih Microfluidics Laboratory

## NEXT-GENERATION PROGRAMS AND OPPORTUNITIES FOR STUDENTS

- **Concordia is the number one destination in the country** for students wanting to gain experience and conduct research in the field of synthetic biology.
- **The SynBioApps at Concordia is Canada's first Collaborative Research and Training Experience** (NSERC-CREATE) program focused on synthetic biology and its real-world applications. To cultivate tomorrow's leading synthetic biologists, participating students are immersed in both academic and industrial synthetic biology applications.
- **The university's innovative Individualized Study** (INDI) program encourages students from a broad spectrum of backgrounds to engage in synthetic biology research.





- Learn how you can support the next generation of Concordia students. Contact our development staff at 514-848-2424, ext. 4856.
- Share your **#CUpride** and **#CUalumni** stories via **@ConcordiaAlumni**



**[concordia.ca/campaign](https://concordia.ca/campaign)**

1455 De Maisonneuve Blvd. W., Montreal, Quebec H3G 1M8

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Writer: Joseph Leger Graphic design: Trevor Browne

T20-64866

