

Genetic Engineering NOW: An introspective look at synthetic biology in Canada by Team NAIT_Edmonton

Synthetic Biology (SynBio) is a multidisciplinary branch of science that combines biotechnology; evolutionary, molecular and systems biology; biophysics; and electrical engineering. In many ways, it is related to transgenesis; however, unlike transgenesis, which exchanges existing genes from one organism to another, synthetic biology allows scientists to write and synthesize novel genetic codes and insert them into a living organism (The Canadian Biotechnology Action Network, n.d.). Organisms that express the new genetic codes can then be used to create a molecule of human interest. From cleansing our environment to producing novel medications to treat currently incurable diseases, these genetically engineered organisms can potentially help us solve a multitude of pertaining problems in the future.

However, since synthetic biology is a novel field in research, it needs to gain the trust of the public in order to be successful (Bubela, Hagen, & Einsiedel, 2012). Public awareness and involvement in synthetic biology will help facilitate its acceptance into society as well as aid in focusing it in the development of specific products that are necessary for the community (Bubela, Hagen, & Einsiedel, 2012). Synbiota, a young canadian company that began as an iGEM Team, developed DNA design software that helps in the designing, assembling, testing and re-iterating of genetic circuits created by its users (Synbiota, 2015). Their vision is to create an open ecosystem in which synthetic biology parts and protocols can be generated, exchanged, and be made accessible to the public (Synbiota, 2015). The transparency and public involvement in

Synthetic Biology will help to alleviate some of the misconceptions and distrust of the new, emerging science.

In addition to public acceptance, SynBio also needs to be supported in industry. Since the year 2000, Genome Canada, a non-profit organization that applies genomics and genomic-based technologies to create social and economic benefits for Canadians, has invested \$2.3 billion CAD to decipher and understand the mechanism of economically important plant, microbial, and animal genomes (Genome Canada, 2015) (Quirion, Martin, Meulien, LePage, & Bell, 2014). Moreover, a fraction of that money has been used in developing technological toolkits that can improve the study of synthetic biology (Quirion, Martin, Meulien, LePage, & Bell, 2014). With regards to research centres, the Concordia Centre for Applied Synthetic Biology (CASB), in Montréal, is the first dedicated SynBio centre in Canada. Its main goals are to discover and understand the mechanisms of this novel science, and to research and develop tools, protocols, and technologies that allow the scientific community come up with solutions for current environmental and health matters (Concordia University, n.d.). It additionally deals with societal, legal, and ethical concerns with regards to SynBio in order to allow the conscientious development of this scientific field (Concordia University, n.d.). For synthetic biology to become a successful discipline, multiple areas of expertise must synergize (Quirion, Martin, Meulien, LePage, & Bell, 2014). Along with biotechnology, research in law, business, social sciences, and humanities is necessary to resolve the ethical, supply chain management, societal, and cultural adaptation issues that will arise

with the current and future development of synthetic biology (Quirion, Martin, Meulien, LePage, & Bell, 2014).

Nonetheless, the development of this science challenges the present regulatory framework, laws, and public opinion (Bubela, Hagen, & Einsiedel, 2012). In order to constitute relevant regulations pertaining synthetic biology, policy makers must oversee every advancement made in this field and weigh out its risks and benefits (Bubela, Hagen, & Einsiedel, 2012). An analysis on the current regulations must be done to address the gaps in law, and to create new legislations that ensure that the public and scientists will both be protected (Bubela, Hagen, & Einsiedel, 2012). Currently in Canada, any product synthesized by biotechnological means is treated as any other product: regulation is initiated based on the innovative trait of the product (European Commission, 2014). Risk evaluations are done in a scientific and product-based form by Health Canada, the government agency that assesses and manages the risks of health, food, and environmental/industrial products (European Commission, 2014).

With regards to the future of SynBio in Canada, Montréal's Concordia University held a workshop to discuss how synthetic biology can be integrated into Canada's future, creating a rough outline of its plan of action in October 2014. This outline involved cross-sectoral alliances, and the direction of money towards research and development in this particular area. Furthermore, in November 2014, Genome Canada gathered Parliamentary representatives, senior public servants, and representatives of industry, academia, and research agencies to discuss how genomics and synthetic

biology could influence the country's resource sectors and, at the same time, protect and preserve the environment (Quirion, Martin, Meulien, LePage, & Bell, 2014).

Canada is definitely making a conscious effort to advance the new field of SynBio. The *First Research Excellence Fund*, which was recently introduced into the Canadian Budget, aims to empower postsecondary research institutions. By helping researchers develop into a highly qualified workforce with world-leading capabilities, Canada can stay internationally competitive in the research scene while remaining up-to-date with cutting-edge technology - a benefit to all Canadians (Merson, 2014). The proposed budget will deliver \$200 million CAD annually by 2018, meaning that within the next decade, the fund will provide approximately \$1.5 billion CAD to help establish Canadian universities and post-secondary institutions as global leaders in research and innovation. (Merson, 2014).

Like the United Kingdom and America before it, Canada has begun to see the importance of Synthetic Biology and how this new science can revolutionize the future of our societies. From eliminating world hunger to adapting to rapid climate change, Synthetic Biology has the potential to solve many of the present challenges that we face. However, many factors contribute to the success of a science in Canada; such as public opinion and lawful regulation. Although difficult to establish a new, groundbreaking science in Canada, investing in Synthetic Biology has been regarded as a necessary risk and a research priority.

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