



Update on Synthetic Biology 2014

At Canadian Yearly Meeting in August, 2014, a minute on synthetic biology was passed. It recommends that Friends work on this concern in the following ways:

1. That CYM affirm the seven principles identified in [Principles for the Oversight of Synthetic Biology](#), a document that makes many important recommendations, and continue to work with the [Biotechnology Reference Group of the Canadian Council of Churches \(BRG\)](#) on discerning ways to implement the seven principles:
 - i. Employ the Precautionary Principle;
 - ii. Require mandatory synthetic biology-specific regulations;
 - iii. Protect public health and worker safety;
 - iv. Protect the environment;
 - v. Guarantee the right-to-know and democratic participation;
 - vi. Require corporate accountability and manufacturer liability; and
 - vii. Protect economic and environmental justice.
2. That CYM request that Canadian Friends Service Committee (CFSC), with the help of concerned groups such as the [ETC Group](#) and the [BRG](#), provide Canadian Quakers with an annual, easily understandable update on synthetic biology;
3. That CYM request CFSC, and encourage Monthly Meetings, to find opportunities to link with other faith and community groups, and with Indigenous peoples, to share insights and discernment about synthetic biology; and
4. That CYM encourage CFSC and Quaker Meetings in Canada to engage with other faith groups and interested parties, including organizations involved in research and/or manufacture in synthetic biology, to hold and/or participate in conferences that address ethical, spiritual, social, and economic aspects of synthetic biology.

This minute builds from [Monthly Meeting responses](#) to a [background information kit](#) and a [background report brought to CYM](#). CFSC has begun monitoring developments in synthetic biology (SB) and seeking ways forward with other faith and community groups, with Indigenous peoples, and with respect to the ethical, spiritual, social and economic dimensions of SB. Responding to recommendation #2 from the CYM minute, the following is a brief update on some of the SB developments making headlines in 2014:

"Synthetic biology companies raised more than \$500 million in 2014, and at least 20 start-ups were launched."¹ Investment news sites have been advising that SB is poised to be the next major money maker as the industry explodes into more and more realms of everyday use.

¹ http://www.mercurynews.com/science/ci_26940445/synthetic-biologist-aims-create-pig-human-lungs#disqus_thread

Trends necessary for the success of the SB industry have continued this year. These include decreasing costs of genetic sequencing, increasing speed of computers, and improvements in the field of "machine learning" (computers' increasing abilities to meaningfully work with vast amounts of data).

A Silicon Valley newspaper reports² that using computer coding, scientists are rewriting a pig's genome with the hope that it will grow lungs usable by humans who need them. Critics warn that this type of SB is building on many years of failed genetic engineering experiments into "xenotransplantation", particularly from pigs. Among other problems, there is a high risk of unintentionally introducing pig viruses into humans.³ There remain significant barriers to these transplants being accepted by the human recipient, who would at a minimum need a powerful immunosuppressant for the rest of their life.

A major contribution on fundamental issues raised by SB comes from Craig Holdrege in the Nature Institute's current newsletter <http://www.natureinstitute.org/pub/ic/ic32/synbio.pdf>. The article offers specific biological evidence that synthetic biology's oversimplified, "building-blocks" approach to life is inadequate. In addressing living beings' capacities to grow, heal and adapt, Holdrege cites research that shows the flexible functions of cells and molecules (platelets in blood, connective tissue growth factor) and the ways organisms adapt to different environments (a fascinating example is given, the spadefoot toad). Holdrege also offers quotes from leaders in synthetic biology that describe organisms as "machines which can be rewired" and genes and proteins as "Lego blocks". Holdrege states,

One reason we cannot explain the organism through the relations between parts, is that those parts tend not to remain the same parts from moment to moment. For example, as most molecular biologists now acknowledge, there is no fixed, easily definable thing we can call a gene. Whatever we do designate a gene is so thoroughly bound up with cellular processes as a whole that its identity and function depend on whatever else is happening. The larger context determines what constitutes a significant part, and in what sense, at any particular moment. Where, then, is any sort of definable mechanism?

and concludes, "Whether and how these questions are addressed should not be left up to the community of synthetic biologists and its funders, given their mission-driven zeal and power."

In November it was announced that Google has hired a top SB expert from Stanford University to work at its Google X project, which develops new technologies like a driverless car. It appears that Google may be interested in selling "made-to-order organisms" at some point in the not too distant future.⁴

A [new animated video](#) was released by the ETC Group which, in just 10 minutes, covers a staggering array of concerns with SB. For a very different perspective you can see [this older more optimistic video](#).

An example from a SB company's press release illustrates how the industry speaks to the public about what it does. The ingredient in question, hemisqualane manufactured by synthetic biology (though the press release never uses that term), is sold in hair and skin care products and in makeup. Amyris says they are, "a global renewable products company providing sustainable alternatives to a variety of non-

² [ibid.](#)

³ For details see <http://www.crt-online.org/wrong.html>

⁴ http://www.mercurynews.com/science/ci_26940445/synthetic-biologist-aims-create-pig-human-lungs#disqus_thread

renewable resources. Amyris uses its innovative bioscience technology to convert plant sugars into hydrocarbon molecules."⁵ Incredibly, due to the lack of regulation on the labelling of SB, hemisqualane is still legally classed as an ECOCERT-approved "natural ingredient".

The annual International Genetically Engineered Machines (iGEM) Competition in 2014 brought nearly 2,200 students from 32 countries, and as one of the organizers, Drew Endy, noted, "No one outside this room understands what they're doing." The competition challenges students to work in teams using DNA sequences, "available from the Registry of Standard Biological Parts, fit together like Lego pieces [distributed under the trademarked name 'BioBricks'] to create synthetic circuits that can be incorporated into living cells."⁶

Harvard Genetics professor George Church says he is working to revive the extinct mammoth by altering the DNA of its closest living relative, the Asian elephant.⁷ Questions raised by this work are many, including why not seek to save the many species currently at risk of extinction rather than to revive already extinct species? Would an extinct species still be able to live within a different world and fit into ecosystems which have changed since the time of its extinction? What are the ethical and spiritual implications of seeking to revive extinct species?

A San Francisco start-up (which previously raised money via the crowd-funding site Kickstarter to make glow-in-the-dark plants and ship their seeds to funders) claimed it was using SB to create new strains of microbes with the goal of making women's vaginas smell like ripe peaches. The company (run by men), said this use of SB would provide "personal empowerment" to women. "We think it's a fundamental human right to not only know your [genetic] code and the code of the things that live on you, but also to rewrite that code and personalize it." The company's founders said Cambrian Genomics is "interested in the probiotics market because it sidesteps the standard biotech regulatory process." However the story became even stranger when it turned out that the SB product they were speaking of was actually owned by another company and being designed with a different goal (to prevent yeast infections).^{8,9}

Multiple SB companies are working to increase its use in food. Synthetic biologists have worked out how to manufacture scents, flavours and fragrances "on an industrial scale in big fermentation tanks by inserting synthesized genes into the DNA of baker's yeast that enables it to convert sugars into these compounds more efficiently than a plant can." Said one company's CEO, "All genes are just sequences of data and these sequences change all the time in nature anyway."¹⁰

Find out more, including background of how this concern of Quakers has developed and what Meetings from across Canada have said: <http://www.quakerservice.ca/syntheticbiology>

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⁵ <http://www.amyris.com/News/424/Amyris-Launches-Second-Innovative-and-Renewable-Ingredient-for-Cosmetics-Industry>

⁶ <http://teconomy.com/2014/11/synthetic-biologys-future-assembled-boston-last-weekend/>

⁷ <http://news.harvard.edu/gazette/story/2014/10/behold-the-mammoth-maybe/>

⁸ <http://medcitynews.com/2014/11/startup-purports-make-vaginas-smell-like-peaches-just-got-10m-gsk-customer/>

⁹ <http://www.theguardian.com/technology/2014/nov/24/sweet-peach-vagina-smell-like-fruit-taste-diet-coke-probiotic>

¹⁰ <http://www.foodnavigator-usa.com/Ingredients/Health-and-nutritional-ingredients/synthetic-biology-firm-Evolva-to-buy-Allylix-for-stevia-flavors>