Human Practices from across the globe

From crops to cattle to dogs, humans have always sought to improve their living conditions by adapting plants and animals of their surroundings to their needs [1]. However, these occur over a lengthy selection processes over hundreds, possibly thousands of years. New developments in the field of biology has enabled us to progress much faster, by interfering with an organism's DNA directly.

Synthetic biology is an emerging scientific and biotechnological field that uses these developments at its core. It combines biology and engineering principles, with the aim of designing and building new biological systems and functions.

Synthetic biology has been gaining interest among ambitious science students who are seeking to bring their research outside the lab and be involved in more application-based solutions. The International Genetically Engineered Machine (iGEM) competition brings together thousands of students across the globe to develop synthetic biology solutions and collaborate with one another based on the common passions.

Among hundreds of teams that participated in this year's event, Team Toulouse-INSA-UPS, Team NUSGEM (Singapore Team-A), and Team ULaval came together to exchange ideas about relevant issues regarding synthetic biology. Before writing this report, we discussed different topics ranging from ethics, environmental impact, public engagement, repercussions on public life, and more. We chose three main subjects to discuss: bioethics in synthetic biology; economic aspects; and society's perspective of synthetic biology.

Bioethics in Synthetic Biology (Toulouse)

A lot of factors have to be considered when evaluating the benefits and risks of using synthetic biology. To develop a new production method for example, one must first closely study the available techniques that do not employ synthetic biology. If something can be produced chemically, then a comparison has to be established between this process and the potential new synthetic biology based process. Once this comparison is made, and if synthetic biology can offer an advantage (less costly, quicker, more environmentally friendly, etc), then it is sound to develop a new method based on synthetic biology.

The process of bringing a new product from the lab to the market will often result in the oversimplification of technical knowledge and the associated ethical considerations. People who are involved in this process, be it a businessman or a policymaker, should, in our opinion, be aware of issues that emcompasses the use of synthetic biology in their

products. One area that is especially important to talk about is bioethics. A discussion about bioethics can help society define both possibilities that are welcomed and boundaries in which society should remain.

The advantages brought by modifying living organisms are far from minor [2]. Here, we will take the example of two industries central to this field: the pharmaceutical industry works in the medical sector and aims to improve the daily lives of suffering patients, while the agri-food industry seeks to feed the world, and the optimisation of its yields may seem secondary in comparison to pharmaceutics. However, the human population is ever growing, and feeding billions more mouths may become a more pressing problem than what we may first think.

In these two major areas, the synthetic biology industry is making great leaps forward and enabling innovations that directly affect society. The first is the creation of new medicines and skincare techniques that could improve and enhance the quality of life for everyone. The second is to increase the profitability of certain foodstuffs, which could help reduce hunger in the world.

Take the example of Taxol: it is a cancer chemotherapy agent, acting on spindle stabilisation. Its effects are proven on cancer but remain very inaccessible to many because of its price (about 6000 USD for a full cycle[3]). The reason behind the high cost is the inefficient extraction process from the Pacific yew tree that produces not only low yields of Taxol, but also impure mixtures of compounds. By going through a synthetic biology process, we can simplify the production and purification process. The cost of this drug could then drop dramatically[4] and therefore be much more readily available to those who need it.

Similarly, allowing the creation of plants for continuous food production regardless of the season would result in a significant cost reduction of food which could reduce hunger in the world. This raises the issue of the spread of this technology in the environment, which remains a major problem. Through the spread of artificial products, some ecosystems could become seriously threatened, and maybe even face disappearance. Humans introducing foreign species into different environments has, historically, not gone well, as the Australians can tell you regarding rabbits[5]. Introducing a species which is genetically engineered to be more resistant to harsh temperatures or produce more seeds could therefore lead to even greater problems.

The question to ask ourselves here is no longer “can we achieve this?”, but rather “should we achieve this?”. We have ventured into the technology necessary to modify living beings to our design, creating new subspecies in our free time. We must now study with intense scrutiny the impact of our actions and the moral justifications behind them.

The prospect of developing more efficient antibiotic formulations might seem attractive, yet the reckless and unregulated use of antibiotics will soon spawn new strains of resistant bacteria, harbinging a storm of more drug-resistant infectious diseases. Unfortunately. the current state of matters leads to the very distasteful and unpalatable consequence of breeding drug-resistant pathogens. Effects of these drug-resistant pathogens places undue pressure on the pharmaceutical industry, for the Sisyphean task of developing newer antibiotics to keep up with the development of stronger drug-resistance.

As the saying goes, prevention is better than cure - we strongly believe that judicious usage of the available classes of antibiotics, coupled with vigilant antibiotic stewardship programmes in healthcare settings, should become more commonplace. The fearsome tragedy of having no available antibiotics for treatment, such as in the case of carbapenemase-resistant *Enterobacteriaceae*, harkens back to the Dark Ages before the discovery of antibiotics, and must not be allowed to catch us off guard.

Once we have our priorities settled, even more important questions need to be asked. Is modifying the human genetic code different to modifying that of the plants and animals around us? Again, the risks and benefits require heavy evaluation. Fixing a deleterious mutation causing diabetes or multiple sclerosis could change someone’s life, but deciding what your child’s eye colour will be is probably going too far.

To conclude, it is safe to say that these new developments are not much more different than others before it. Humanity has caused a great deal of damage to the environment through greenhouse gases and deforestation, all for the sake of ease of life and financial profit, to cite only one example. While synthetic biology affects a more profound basis of life, the leaders of any scientific revolution must always reflect on the impact that it will leave on the world before declaring that we are living in a brave new world.

Economic Aspects towards Synthetic Biology (NUS)

For some, genetic engineering is akin to playing God. However, to many synthetic biologists and life science researchers, genetic engineering is a key pathway to exploring a plethora of new applications and technologies. Unfortunately, few of such technologies

have been successfully commercialised. Yet, for these select few, they are largely disruptive in their own fields.

To illustrate this point is the development of the antimalarial drug, artemisinin. Artemisinin was first extracted from *Artemisia annua*, or sweet wormwood, in the 1970s[6]. Since then, global demand for artemisinin has only increased, especially after 2001, when the World Health Organisation identified artemisinin-combination therapies as the recommended first-line treatment for malaria[7]. Yet, the supply of artemisinin remained variable due to the limited cultivation of sweet wormwood, which in turn translated to fluctuating and volatile costs of artemisinin-combination therapies. The vagaries of the artemisinin supply inspired several companies and researchers to set about developing novel alternative methods for the synthetic production of artemisinin to complement plant-derived sources. Sanofi, a Paris-based pharmaceutical company, for example, employed the use of a genetically-engineered yeast that used glucose as a feedstock, to produce artemisinic acid, a precursor of artemisinin[8]. This genetically-engineered yeast was also simultaneously "engineered" by Jay Keasling, a researcher at the University of California (Berkeley), who also developed the chemical pathways necessary for the successful bioproduction of artemisinic acid[9].

The advantage a synthetic biology-approach of artemisinin production provides, such as cheaper and more stable source of artemisinin, is clear. However, the concerns arising over synthetically-produced artemisinin (which manifests as market resistance), such as the monopolistic behaviour of pharmaceutical companies, and the loss of livelihood of the *Artemisia* farmers, must not be ignored. The balance between novel technologies, and its social and ethical implications must be carefully considered - is synthetic artemisinin really cheaper? How can synthetic biology help the farmers whose livelihoods have been disrupted by a decrease in demand for sweet wormwood? How can synthetic artemisinin be responsibly produced and consumed? Without giving due thought and consideration to the existing methods of artemisinin production, it would be a travesty and tragedy to brashly impose synthetic artemisinin on all its consumers.

Drugs aside, there are currently exciting ongoing research involving the food industry. Biotransformation is a multidisciplinary platform within A*STAR focused on developing microbial fermentation processes to produce high value ingredients more sustainably[10]. By using microbial and synthetic biology methods of producing ingredients, food production becomes less land and weather dependent and in higher quantity. A similar case in chemical manufacturing is the story of truffle oil. Truffle oil was previously available only through foraging of truffles, which are also seasonal. However, with artificial truffle oil in production since 1980s, constraints on quantity and seasonality have been greatly removed or eliminated [11]. Synthetic biology is also actively applied to other fields, leading

to the development of potentially transformative applications, such as in therapeutics and biomaterial production. For example, in California, at the startup Bolt Threads, spider silk is produced using genetically engineered yeast [12].

A major obstacle preventing widespread adoption of these novel synthetic biology-based technologies is economic feasibility. Yield is a common problem affecting many new bioreactor fermentation and bio-manufacturing processes. As engineered cells are not naturally inclined to produce the intended products, doing so induce metabolic burden. increasing yield must therefore be achieved by balancing against cell metabolic stress due to production. Furthermore, semi-biologically produced drugs and compounds are larger than chemically produced ones, presenting production challenges and keeping costs high. In large-scale bioreactors, due to the time taken for the diffusion of substrates, heterogeneous conditions between different parts of the bioreactor can create different kinds of reaction conditions and different stresses for different cells. This variability makes bio-manufacturing more expensive and unpredictable. Lastly, for drug production and quality control, the conditions for protein 3D-folding also makes it susceptible for viral contamination[13].

Nonetheless, the global bio-based market remains a growing market with high potential, driven by synthetic biology. [14] It is anticipated to reach US$38.7 billion by 2020, based on predictions by market research company Allied Market Research[15]. Governments all around the world, from the United States to China, are increasingly acknowledging the immense potential of biotechnology, and are increasing investments in an effort to develop biotechnology and its related fields. China, for example, has identified synthetic biology as one of the priority research areas of the country, and its Ministry of Sciences and Technology has invested heavily in funding schemes and initiatives concerning synthetic biology. Perhaps more convincingly the importance the Chinese government places on synthetic biology development, synthetic biology was recently identified as a key industry for China's Five-Year Plan (which was recently published in 2016)[16].

Singapore (a notably different country from China) has similarly invested $25 million (about USD 18.2 million) in its recently-launched "Synthetic Biology Research and Development Programme", which includes groundbreaking projects ranging from exploring uncharted biosynthetic pathways for the production of medical cannabinoids, to engineering microorganisms that are able to convert readily available and renewable substrates into valuable organic compounds. In 2015, Singapore set-up its first research centre dedicated to synthetic biology, SynCTI, at the National University of Singapore with the aim of anchoring Singapore as a leading Synthetic Biology Hub in the world. In 2016, the Singapore Consortium for Synthetic Biology, SINERGY, was launched in order to create a vibrant and globally connected bio-based economy in Singapore [17].

Likewise in Australia, where the Australian Council of Learned Academies recently published a outlook report on the prospects, opportunities, and issues associated with synthetic biology [18]. Synthetic biology was identified as critical to Australian economic development - from complementing and supporting the continuous growth of industries in which Australia has been traditionally strong in, i.e. agriculture, to providing new opportunities for further research and development, in the fields of health and medicine, and the environment. The focus on synthetic biology has been welcomed by the Australian government, whose Research Infrastructure Investment Plan supports research initiatives and studies into synthetic biology.

Compared to chemically synthesized products, bio-manufacturing offers a competitive advantage for producing products that are both economically viable and ecologically sustainable. An appealing option nowadays, as both consumers and governments are changing consumption patterns and policy regulations to take into account the negative externality that is environmental pollution. An example of the competitive advantage in environmental sustainability that synthetic biology can offer is optogenetic regulation. This new tool in synthetic biology provides the potential to eliminate chemical-dependent control, removing the carbon footprint from chemical production and waste treatment and further enhancing its environmental sustainability.

Synthetic biology is an emerging market with many techniques and tools that have yet to mature [19]. Strong governmental support is required to aid in the development of this market, but current signs for its development are promising. Recent start ups such as Zymergen and Ginkgo Bioworks have experienced explosive growth and are making big waves in the synthetic biology industry. Synthetic biology itself has shown potential for high applicability in various different fields. Nonetheless, the development of new technologies, as always, requires acceptance and support from society.

Society's perspective of synthetic biology (ULaval)

Genetic engineering impacts society in many different ways, such as in health and nutrition to name a few. However, most people are unaware that their food or medicine has been produced by mean of synthetic biology. Perhaps, provided with such knowledge, they would reject such products because many people are afraid of what they do not understand. In this section, we attempt to explore and elucidate the following: Is the society knowledgeable enough about biological synthesis? How can they be better informed? How accepting is the general public towards GMOs? Who are the opponents to this technology?

Fear is closely linked to ignorance [20]. Currently, synthetic biology remains an embryonic technology. It is common to think of those novel and unfamiliar technologies as bold science fiction, given the common movie trope of man-made disasters arising from that so very arrogant scientist who tried to "play God". One of the best known is Jurassic Park, in which scientists succeed in bringing dinosaurs back to life from amber-preserved DNA. While scientists are easily able to identify science fiction not grounded in actual science, science fiction can appear convincingly real to the uninitiated, even to the point of believing such science fiction is actually achievable in reality.

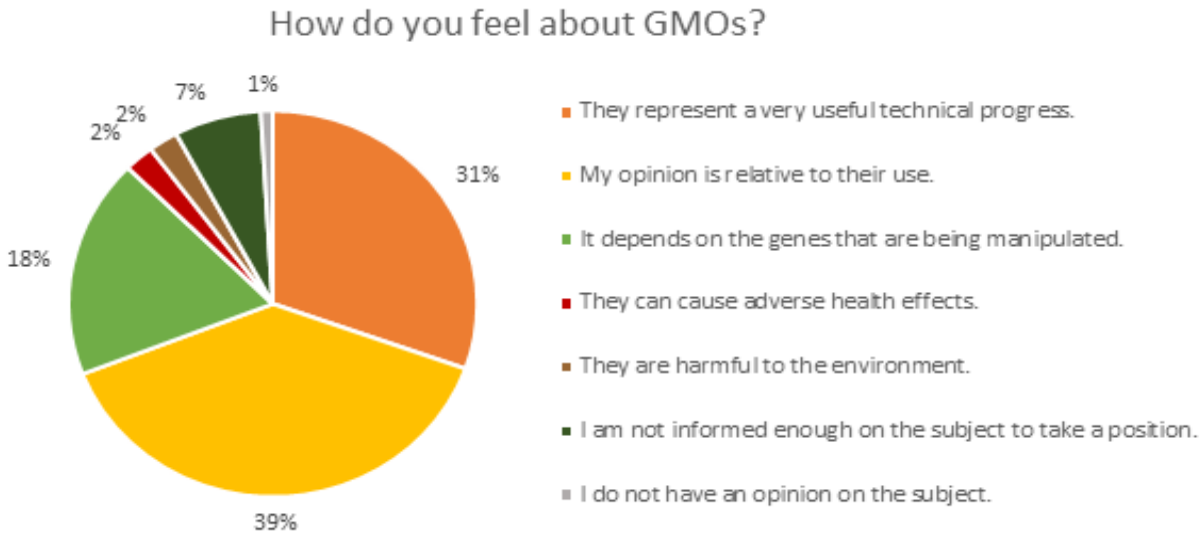
Because of sheer ignorance, synthetic biology is often stereotyped to be "bad", and hence, "dangerous" to health and the environment despite approvals by regulators and scientists, and their benefits recognized to date, like biofuels [21] and increased yields and agricultural growth [22].To prevent these misconceptions, the scientific community requires to invest more time to popularize synthetic biology to educate and inform the public and allow them to better understand how GMOs are designed.

Public scepticism towards new technology is not unfounded. Indeed, scandals in the recent history of the scientific community have put a damper on the credibility that science is supposed to demonstrate[23]. For example, disasters in healthcare like the prescription of tobacco as an anti-stress medicine[24] and the tragedy over the prescription of thalidomide to pregnant women[25]. Other tragedies also happened in the food industry, like the mad cow disease[26]. However, while healthy scepticism is good, anti-intellectualism is developing in some parts of the world, hampering the development of science. In the US, there is an increasing group who mistrust experts [27]. Despite the urgency of global warming and the general unequivocal consensus by the scientific community that global warming is man-made, public scepticism is one of the factors delaying the much needed development of more environmentally sustainable technologies[28].

To counter this slowdown, education of the general public is necessary. In order to communicate with them and debate sensitive topics, scientists need to popularize their work. Popular science is closely linked to the scientific process, and is part of researchers' missions [29]. It represents a bridge between scientific literature and popular knowledge. Meaningful citizen participation in deliberations regarding synthetic biology requires familiarity with general concepts in the science of this particular developing field. In other words, scientists should taken it upon their personal mission to increase the public's "scientific literacy".

A recent study examined perspectives of Millennials regarding GMOs, specifically GM foods[30]. Being a very large generational group, their perspectives are expected to have a

major impact on acceptance of GMOs. Overall, Millennials have somewhat unfavorable views toward GM foods. In an attempt to understand that attitude toward synthetic biology, we made our own survey, which we distributed to a large public. It was answered by 381 persons, whom were mostly Millennials studying at university, from Canada and Europe. We asked respondents how they feel about GMOs and most of them seemed to



feel safe about them, depending of the use that is made of them.
After that, we asked them a few more precise questions about GMOs on the market:

1. Would you trust a product synthesized by a genetically modified organism (GMO)?
2. Did you know that several products (cosmetics, food, drugs, etc.) are already produced by GMOs or are GMOs themselves?
3. If these products were labeled as GMOs, would you still buy them?
4. In your opinion, would it be necessary to specify the origin (chemical or biological) of adrenaline sold in pharmacies?
5. Considering that adrenaline is a drug and not a food product, does the fact that it comes from a GMO make it any different for you?

For each answer given to the previous question, we analysed the answers for the 5 following questions. Charts 1 to 3 (see annex), which represent the majority of respondents (88%), show the same results: these people would trust a product synthesized by a GMO and if these products were labeled as GMOs, they would still by them. However, they do not consider biologically synthesized drugs a different issue than GM food.

On the opposite, the respondents who answered that GMOs are harmful to health and the environment, charts 3 and 4, said they would not trust a product synthesized by a GMO

and if these products were labeled as GMOs, they would not by them. However, they do consider biologically synthesized drugs a different issue than GM food. This means that they consider drugs have more risk towards health and environment thant GM food.

In between, the rest of the respondents who had a neutral attitude towards GMOs, chart 6, have a balanced position on those questions, saying they do not know if they would trust biologically synthesized adrenaline, most of them would buy products labeled as GMOs and they do not consider biologically synthesized drugs a different issue than GM food. Finally, the majority of all respondents considered it would be best to label GMO products and they already knew that several products are produced by GMOs or are GMOs themselves.

From the results of our survey, we can infer that those who do not consider GMOs as harmful also do not fear them. Considering that a majority of respondents in our survey are students who have a medium (37%) or high (44%) level of knowledge in biology, we can also suggest that those who are educated on that matter do not fear the resulting technologies of that field.

Another survey of public attitudes regarding synthetic biology found that nearly two-thirds of respondents supported continued development of the field, including additional research on its possible effects on humans and the environment [31]. There was a strong correlation between self-reported awareness of synthetic biology and support for ongoing research, as 80% of those who had heard a lot about the field believed it should move forward, compared to only 52% of those who had heard nothing about it. Overall, 73% of those surveyed reported having heard “just a little” or “nothing at all” about synthetic biology. These data indicate both the need for broader public engagement regarding synthetic biology and the positive impact of such efforts on public support for novel technologies.

In another vein, there are oppositions to synthetic biology that come from important areas of religions and ethics. Unlike the debate regarding human embryonic stem cell research, the Catholic Church do not oppose to synthetic biology. Following the publication of the Venter Institute’s paper, an official from the Catholic Church praised the development as “a further mark of man’s great intelligence, which is God’s gift enabling man to better know the created world and therefore to better order it.”[32] The statement encouraged continued synthetic biology research, provided that the research proceeded responsibly and did not undercut the sanctity of life.

Faith-based scientists also declared: “absolutely nothing accomplished in synthetic biology by way of synthesizing the genome of a self-replicating bacterial cell from its component parts - which is the most striking and specific technical achievement of the Venter

Institute team - demonstrates that life is without mystery or value that goes beyond the assembly of its parts. The mystery of life is amply great, as both religious and secular minds can appreciate, to survive even the most masterful scientific feats."[33] In other words, we are still far from engineering life *de novo*, therefore it is not urgent to debate on that matter.

Moreover, discussions about synthetic biology and related technologies often raise objections that scientists are "playing God." However, the religious communities find this language to be unhelpful at best, misleading at worst. Skeptics of the field are more likely to use the phrase "playing God" than are religious groups. While religious thinkers suggested caution regarding the human tendency toward hubris, none expressed concern that synthetic biologists were "playing God."[34] The provocative nature of this phrase does more to obscure rather than to illuminate those important moral concerns regarding synthetic biology that deserve serious consideration.

Despite all that, there should be strict regulations in place to regulate synthetic biology research, because responsible science should reject the technological imperative: the mere fact that something new can be done does not mean that it ought to be done. Conversely, how do we ensure regulations do not impede the progress of development? Three principles are prescribed to ensure that : the precautionary principle, the proactionary principle and the prudent vigilance. The first prescribes halting or substantially slowing the progress of scientific research until risks can be identified and mitigated. The second assumes that an emerging biotechnology should be considered "safe, economically desirable and intrinsically good unless and until shown to be otherwise"[35]. The last is a middle ground of those extremes, it prescribes to carefully monitor, identify, and mitigate potential harms over time.

In conclusion, biotechnology has the potential to affect everyone, and opportunities for the public to participate in discussion and deliberation about emerging technologies such as synthetic biology are critical. Robust public participation is essential in both the development and implementation of specific policies as well as in a broader, ongoing national conversation about science, technology, society, and values.

Conclusion

Each team had an interesting experience doing this collaboration. We had the chance to exchange different points of view from our different countries and we managed to write a great report out of those discussions. Unfortunately, we barely covered three areas of the issues concerning synthetic biology, therefore there are still many other things we could still discuss about.

A word from each team concerning their experience on that collaboration:
Toulouse-INSA-UPS: “We are so very lucky to have been able to collaborate all together on this subject. As we discussed above, the ethics behind biological research have become more important than ever, and in the context of our growing and changing world, we need to focus on just that: we are a part of the world, not just our country or our iGEM project. This humans practices-oriented collaboration has shown us all the diversity in this competition, and we hope that next year’s projects can unite even more different cultural backgrounds in a common goal.”

NUSGEM (Singapore Team-A): “NUSGEM is happy to have worked with Team Toulouse-INSA-IPS and Team ULaval on this piece about the bioethical, economic and cultural considerations of Synthetic Biology, its businesses and its technology. The human practices based research conducted by each of our teams has been instrumental in helping us understand the different facets of synthetic biology. Learning aside, this collaboration also served to illustrate how collaboration between different teams is important not merely a transactional relationship, but a synergistic one. We learned more than the sum of our individual sections combined, as we have gained a more holistic understanding of the field of synthetic biology.”

ULaval: “It was an enriching experience to work with people from other countries on that project. It made us have a new perspective on the matter. As it was also our first year participating at the iGEM competition we were glad we could exchange with people having different points of view on these issues. We learned a lot about the importance of collaboration, not just with other labs but with people around the world.”

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Annex

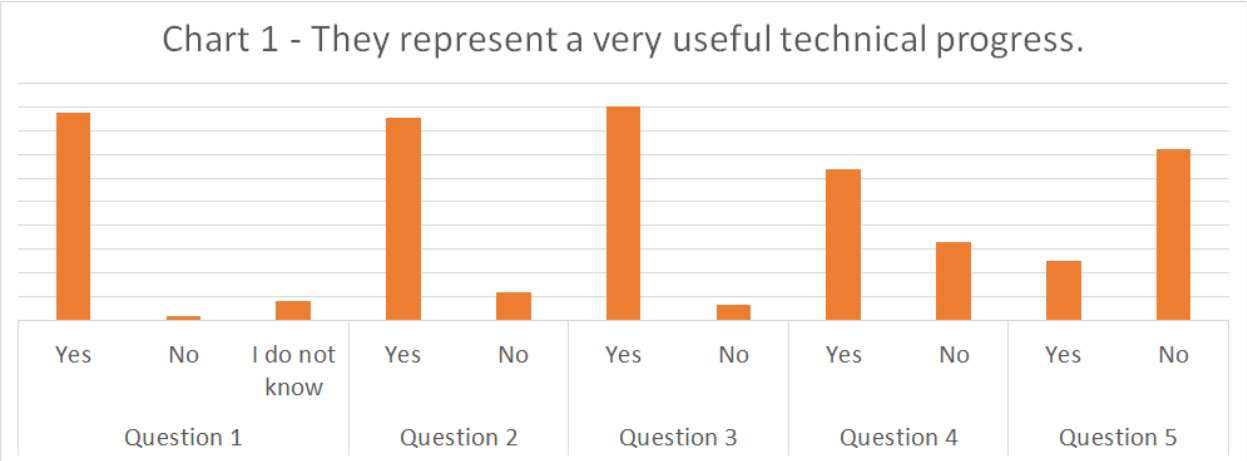
Chart 1 - They represent a very useful technical progress.
Yes
No
I do not know
Yes
No
Yes
No
Yes
No
Yes
No
Question 1
Question 2
Question 3
Question 4
Question 5

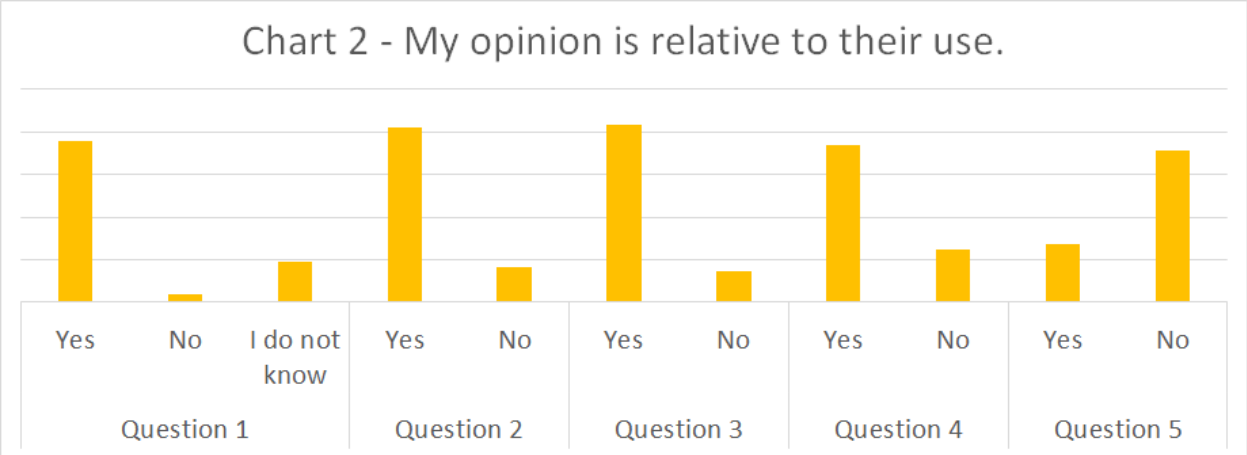
Chart 2 - My opinion is relative to their use.
Yes
No
I do not know
Yes
No
Yes
No
Yes
No
Yes
No
Question 1
Question 2
Question 3
Question 4
Question 5

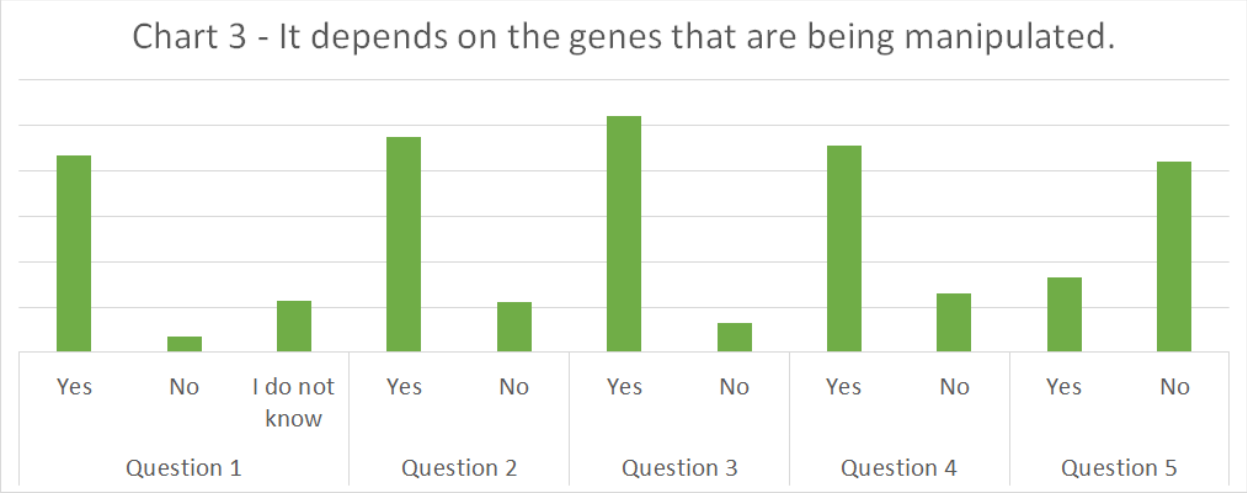
Chart 3 - It depends on the genes that are being manipulated.
Yes
No
I do not know
Yes
No
Yes
No
Yes
No
Yes
No
Question 1
Question 2
Question 3
Question 4
Question 5

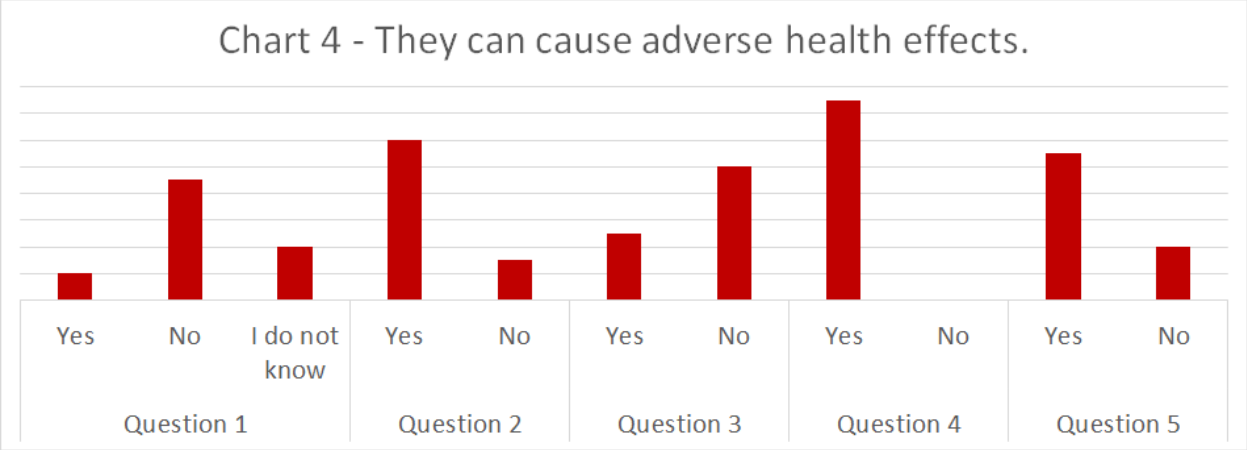
Chart 4 - They can cause adverse health effects.
Yes
No
I do not know
Yes
No
Yes
No
Yes
No
Yes
No
Question 1
Question 2
Question 3
Question 4
Question 5

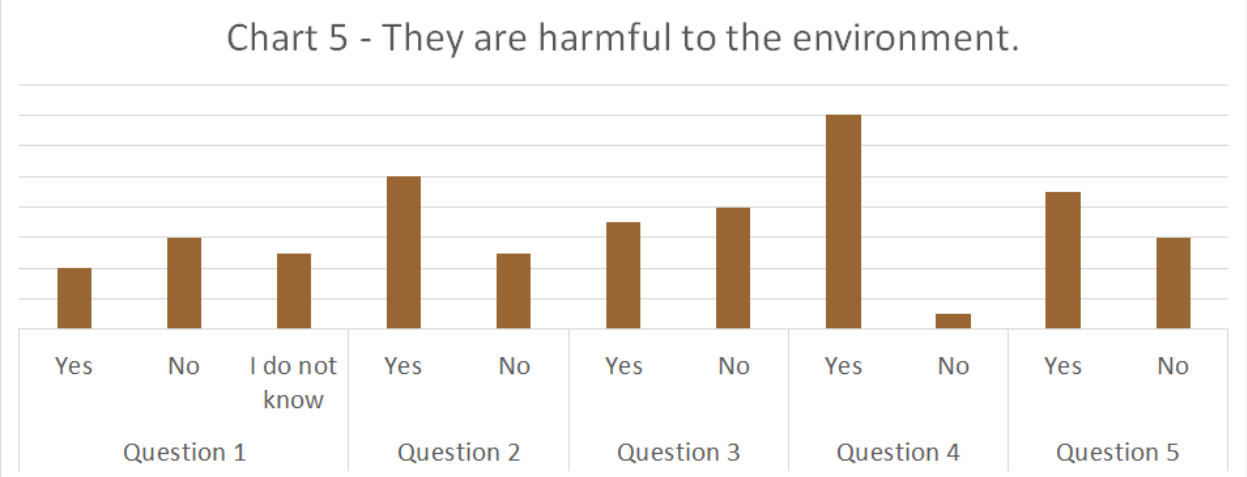
Chart 5 - They are harmful to the environment.
Yes
No
I do not know
Yes
No
Yes
No
Yes
No
Yes
No
Question 1
Question 2
Question 3
Question 4
Question 5

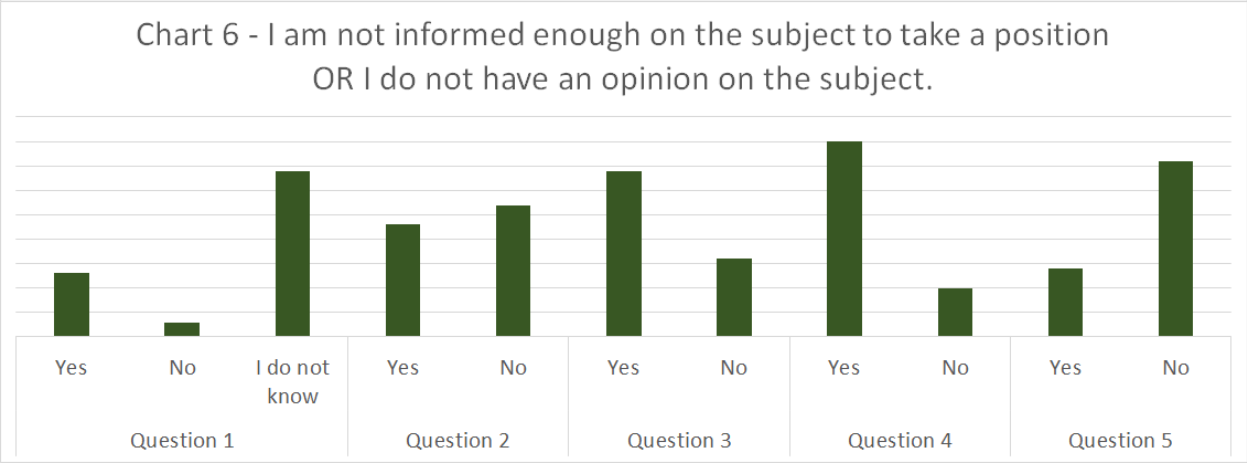
Chart 6 - I am not informed enough on the subject to take a position
OR I do not have an opinion on the subject.
Yes
No
I do not know
Yes
No
Yes
No
Yes
No
Yes
No
Question 1
Question 2
Question 3
Question 4
Question 5

Themes to discuss

- Philosophy
- **Ethics (bioethics)**
- Safety
- Security
- Risk Assessment
- Environmental Impact
- Public Engagement / Dialogue
- Product Design
- Scale-Up and Deployment
- Public Policy
- Law and Regulation
- **Economy (repercussions on public life and how competitive biological synthesis is compared to other processes)**
- **Cultural perspective**

Theme	Quebec	France	Singapore
Society (which aspects of society are impacted by biological synthesis and how are they impacted)	Biological synthesis impacts on society in many different ways, for example health and nutrition. However, most people don't even know that their food or medicine has been produced by biological synthesis and if they knew maybe they wouldn't by those things. Most people are afraid of what they don't understand.	Is the society knowledgeable enough on biological synthesis? How to increase this level of knowledge? What are people's apprehensions?	Integration of the synbio technology into society- how accepting are the general public towards the idea of synbio? Who are the people who would oppose of this technology and who would advocate for it? How can we introduce the technology in such a way that people will be more open towards this?
Economy (same as society)	Can local economies (small enterprises for example) be developed with synthetic biology in order to replace those big chemical enterprises?	Are synthetic biology techniques much more expensive than others (chemistry ...)? Why? How to make it more accessible?	
Ecology (same as society)	Compared to chemical synthesis, biological synthesis is surely eco-friendlier, but by itself is it sustainable development?	Positive and negative points of synthetic biology on the environment? What are the ecological advances that this technique could generate?	How disruptive can synbio be for the environment? Can we really introduce synthetically designed organisms into the environment without major disruption?
Brake from society	We should talk about the	Does big scientific	What are some

(how the lack of knowledge from society impacts on the advancement of science)	importance of vulgarisation to counteract the brake on progress from society.	advances scare the uninitiated? Are people aware of synthetic biology techniques already in use?	suggestions we can give to extend the bridge between the consumer and the scientists?
Innovation of synthetic biology (how synthetic biology is important for the future and the fields which it impacts, e.g. health, food industry, etc.)		Distinction between essential innovations (treatment of deadly diseases) and those more abstract (increase food production) Must we directly touch people's daily to get their approval?	It would be interesting if we could postulate which industry would benefit most from synbio and why maybe in terms of regulation? How can synbio provide a benefit/advantage over already existing industries? What makes it unique and thus more valuable?
What are the biggest obstacles that this field has to overcome before it truly flourishes? Is it actually possible for us to engineer biology when biological systems are so diverse?	Is there a point in terms of scientific improvement which we shouldn't reach in order to respect ethics?	Are this obstacles different from one continent to another?	Who are usually the skeptics of this field? What are the common criticisms of synthetic biology?
Ethics- can we mess with life? Does it go against religion or the belief that only a higher power has the power to create life? If we can create life, then does life become less precious and meaningful?		Does man's well-being have to come before everything else?	Is a synthetically made living organism a living organism or is it man-made? If we can successfully create life, then the creator is given power. What would happen if this power is abused? How can this technology be used for the good? Can the benefits outweigh the risks? Should there be strict regulations in place to regulate synthetic biology research? Conversely, how to we ensure regulations does not impede the progress of development?

What are the common misconceptions about synbio and its products?			
How are our individual countries supporting synbio?		What are the differences between our continents? Positive, negative?	