

Synthetic Biology Survey Report (Hong Kong)

Abstract

Despite the fact that active discussions about the wonders and potentials of synthetic biology are growing increasingly prevalent in the world, few systematic surveys regarding in this field has been conducted, especially in Asia. Hence the iGEM2011 HKUST Team, collaborating their Austrian partners Markus Schmidt and Lei Pei of IDC and Biofaction, launched this survey, hoping to take advantage of Hong Kong's status as an international city to establish a starting point for meaningful data collection in Asia regarding synthetic biology. The survey tries to obtain public perception of synthetic biology, with particular emphasis on people living in Asia, as well as the key factors influencing their impression. Due to the scale and on-going nature of the survey, this report should be treated as a snapshot of the responses gathered so far, and as a reference to the effectiveness of using online survey formats to gather data.

The results show that this online survey system is quite adaptable, but should be better spread on the Internet and complemented with more distributed hard copies to make the data more reflective and reliable. Two major findings have been obtained from this snapshot analysis. The first is that the public in HK tend to have a neutral to slightly positive perception of synthetic biology, showing a relatively conservative attitude. Second, the general public knows very little about synthetic biology, which likely has a positive correlation with their overall impression about this new technology. However, notwithstanding this lack of knowledge, the general awareness of the possible risks and benefit is nearly at the same level, without specific bias against or favoring future development of this technology. In addition, the public is more inclined to accept synthetic biology products when the technology can lead to a major reduction in product price, echoing the focus on financial benefit as the major driving force of the development of this technology.

Introduction

Synthetic Biology is a newly developed field of biological research recently, bringing together biology, genetics, chemistry and engineering. It aims to use an engineering/biological approach to assemble genetic material of diverse sources, the combination of which creates new biological functions or systems, which facilitate production of novel and useful products not possible in the natural world, including material, fuel, food and pharmaceuticals. In the process, re-engineering of living cells as a platform takes place.

Since this concept was brought to the public, it has aroused great concerns, not only among the professionals but also within the general public. Several nationwide surveys and public dialogues have been conducted in the United States¹, the United Kingdom² and other countries. However, few systematical surveys have been done, especially in Asian areas. In this case, the iGEM2011 HKUST Team cooperating with their Austrian partners, Markus Schmidt and Lei Pei, of IDC <<http://www.idialog.eu/>> and Biofaction <http://www.biofaction.com/?page_id=10>, launched this survey, treating Hong Kong as a starting point, trying to get the public perception of synthetic biology, especially in Asia, and the key factors influencing this impression.

The online version of the survey was started on August 30th, 2011 and several invitation letters was sent to the social public groups like the Hong Kong Institute of Engineers, etc. So far, 647 responses have been collected, and a snapshot analysis was started at 570 responses, to see if the survey system worked well, also getting some sample data. The survey will be spread more widely after this snapshot and a final report will be released after the data collection.

The following analysis is based on the 570 responses got online from August 30th to October 1st.

¹ US survey 2009

[Syst Synth Biol](#). 2009 Dec;3(1-4):37-46. Epub 2009 Oct 10.

Review of quantitative and qualitative studies on U.S. public perceptions of synthetic biology. Pauwels E.

² UK survey 2010

The survey 'Synthetic Biology Public Dialogue' - was commissioned by the Biotechnology and Biological Sciences Research Council and the Engineering and Physical Sciences Research Council with the aim of aiding the research councils on how to proceed with funding research in the field of synthetic biology.

<http://www.bbsrc.ac.uk/society/dialogue/activities/synthetic-biology/findings-recommendations.aspx>

Survey Design

This survey is separated into two parts. This first part aims to know people's general understanding about synthetic biology, including their attitudes towards the potential benefits and risks, and the tradeoff between them. Also, their general perception of the newly developed technology (e.g. stem cell technology, nanotechnology, etc.) was tested as a referenced parameter. The second part is designed to get some demographic information of the respondents and use as the parameters to analyze their influence on the responses of the target group.

More Details about the Survey Design

- The Potential Targets of the questions in Part One

| | |
|--------------|--|
| Q1 | respondent's general attitudes towards newly developed technology, or in other words, his acceptance of new technology |
| Q2 & Q3 | Respondent has ever heard of or got some information about synthetic biology or not |
| Q4 | Respondent's major concern or worry about synthetic biology |
| Q5 | Respondent's confidence in the potential benefits brought by synthetic biology (or in other words, when he/she is told a possible benefit (like producing medicine in a more efficient way) of synthetic biology, whether he/she will believe it will actually be useful) |
| Q6 | Respondent's attitudes towards the potential risks caused by synthetic biology |
| Q7 | Respondent's tradeoff between the ordinary products and synthetic biology products under/without the price press |
| Q8, Q9 & Q10 | Respondent's opinions on the future development and the regulation of synthetic biology |
| Q11 | Respondent's overall scores/impression about synthetic biology |
| Q12 | Respondent's knowledge about synthetic biology (a series of True or False Test are given to the participant to test whether he gets a correct idea of synthetic biology or misunderstand the range of synthetic biology, relating something bad but irrelevant to synthetic biology) |

- The Parameters Tested in Part Two
 - Gender
 - Age
 - Local Residents or not
 - Residential Time in Hong Kong
 - Religious Belief

- Income
- Family Background
- Education Background & Level

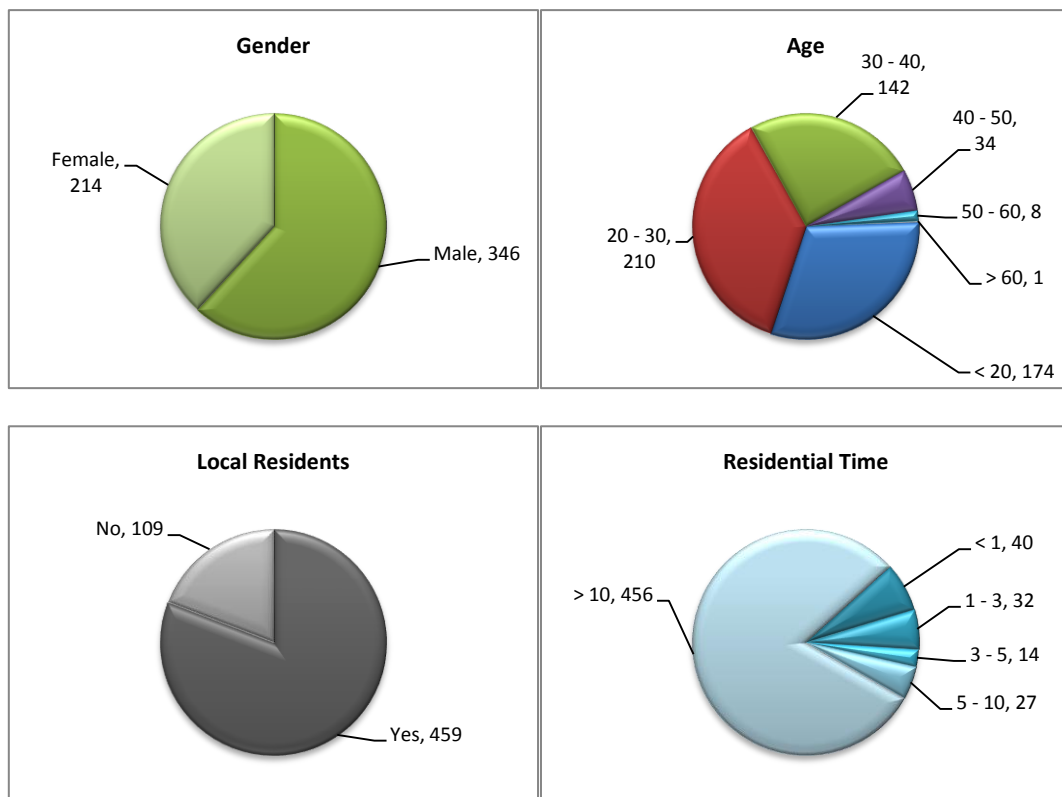
Data Analysis and Results

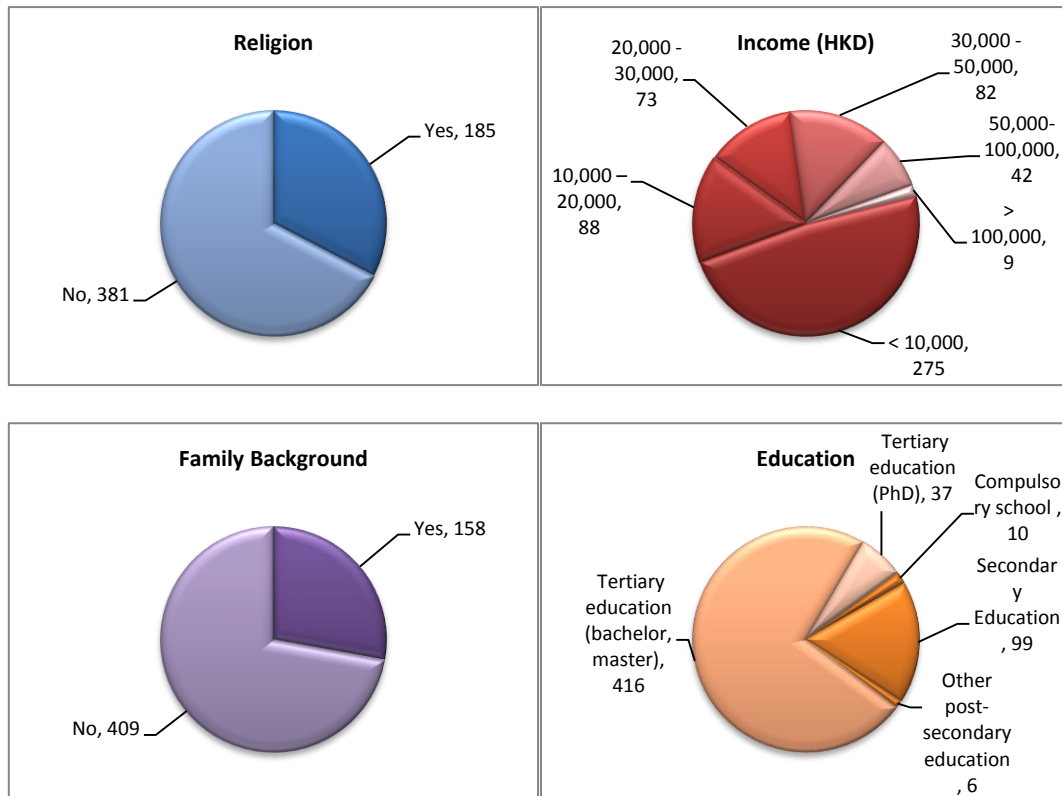
• Parameters in Part Two

The variance of each parameter we targeted in this survey is shown in the following charts (**Figure1**)

Obviously, it has some clear biases in the targeted parameters, especially strong in the field of age and education background. This may be due to the form of the survey. Since it is conducted online, it tends to attract people of higher education level and younger age. Also, the invitation letter we sent to certain social public group (e.g. HK Institute of Engineers) may further increase the bias. The relative small range of distributing the survey link may also have impact.

Figure 1: Variance of Each Parameter in Part Two



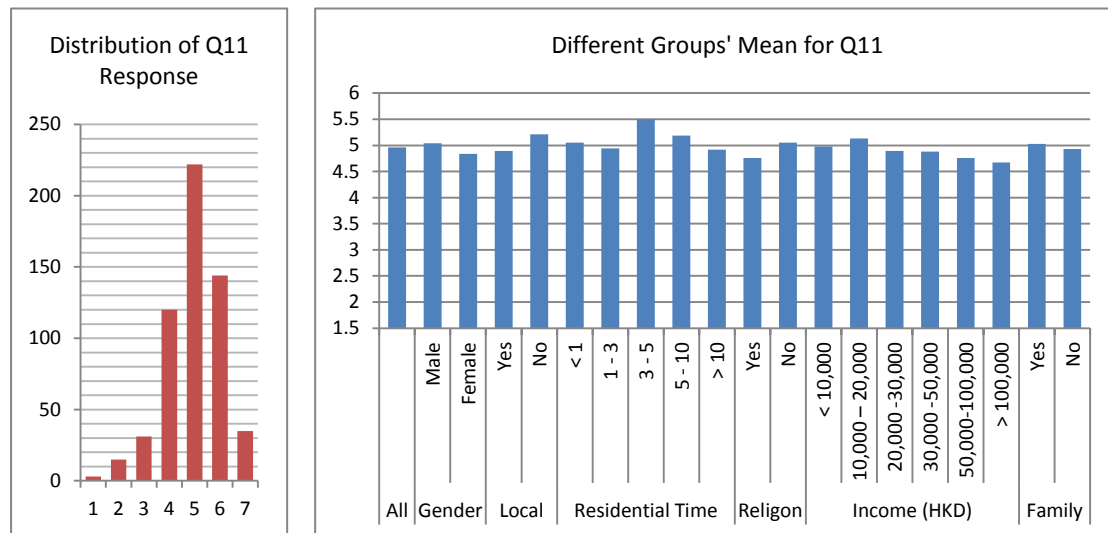


• General Trend of the Responses in Part One

□ Q11

Q11 is the most important question in this survey since it aims to directly get the respondent's overall impression about synthetic biology by using a grading system from 1 to 7 (1 for very negative, 7 for very positive). The score distribution is shown in **Figure 2** and the overall mean of this question is 4.99, showing that the overall public's impression is more likely to be positive, but close to neutral. This may be an evidence to support that people tend to hold a relatively conservative attitudes towards this newly developed technology.

Further comparing the results with the parameters in Part Two, the mean of Q11 do not show significant difference (**Figure2**, already deleting the mean for the age and education category) and even though some slight difference may exist, it doesn't pass the significance test, not having at least 95% confidence to show the difference is due to the variable (discrepancy in a certain parameter).

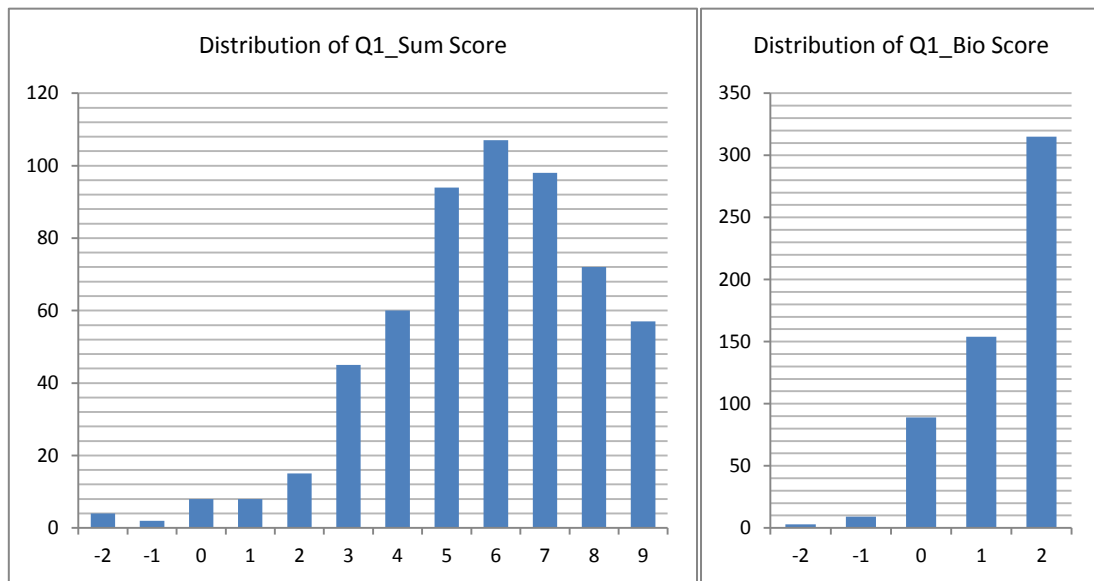
Figure 2: Q11's Response Distribution and Relation with Parameters in Part Two

□ Q1

For the easiness of the quantitative comparison in Q1, +1 is given to each choice of “positive effect”, -1 to that of “negative effect”, 0 to that of “no effect”, “hard to say”, “I don’t know this technology”. Then the quantitative result is obtained by computing the sum of the choice of each respondent (maximum 9, minimum -9) – named as Q1_Sum. Also, each respondent’s total score for the two biology related technology (Biotechnology and genetic engineering, stem cell technology) are calculated for further comparison – named as Q1_Bio.

All the respondents’ mean of Q1_Sum is 5.77 ($5/9=64.11\%$) and Q1_Bio is 1.34 ($1.34/2=67\%$). The score distribution is shown below **(Figure 3)** It can be obtained that the respondents’ overall impression about all the newly developed technologies and the focused biological technologies are both more likely to be positive, which may have an influence on the scores of their overall impression about synthetic biology in Q11

Also, the parameters do not have significant influence on the final score of Q1_Sum and Q1_Bio

Figure 3: Distribution of Q1_Sum and Q1_Bio

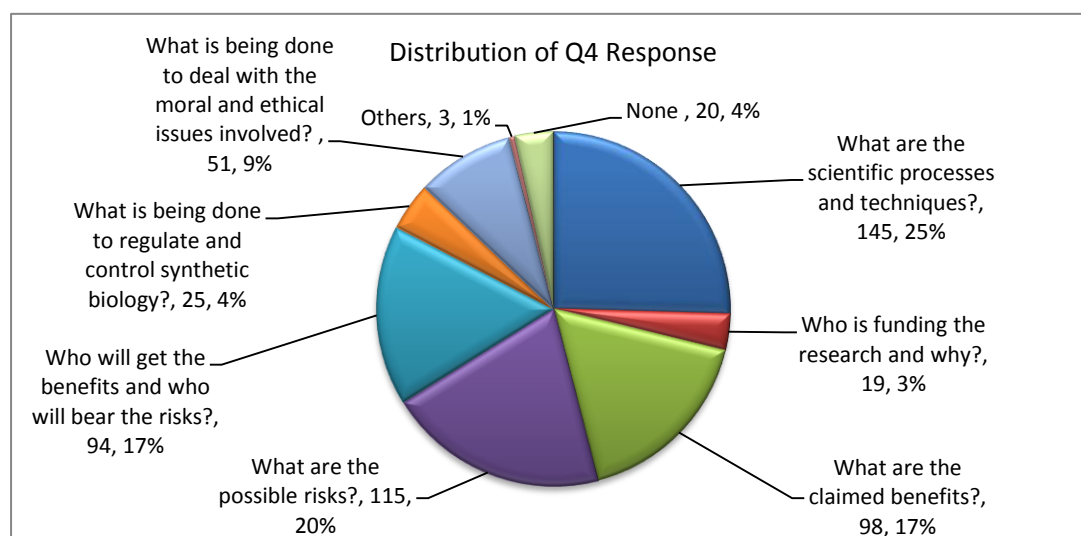
□ Q2 and Q3

Among all the 570 response, 254 (44.48%) reported to have heard of the term “synthetic biology” before confronting the survey. But if further asking about the frequency they talked or searched about the information relevant to synthetic biology, the score is a bit low, only 1.22 (3 for “frequently”, 2 for “occasionally”, 1 for “only once or twice”, 0 for “never” or “I don’t know”). This can be interpreted into that the public actually lacks the knowledge of synthetic biology.

Still, the variance in parameters does not cause great difference in the response pattern.

□ Q4

Among the seven listed potential concerns caused by synthetic biology, the top questions about synthetic biology people hold in mind is “what are the scientific processes and techniques”, followed by the “what are the possible risks” , “ what are the claimed benefits” and “who will get the benefits and who will bear the risk. The overall distribution of the responses is show as following (**Figure 4**)

Figure 4: Distribution of Q4 Response

This result is actually a bit out of the expectation. People show more curiosity about the process of synthetic biology than expected, but this can be considered as a support for the results getting from Q2 and Q3 that the public are lack of the knowledge of synthetic biology in general. The second and third runner-up is understandable. The tradeoff between the potential benefits and risks is always a heated concern. However, the fall behind of the concerns for the “moral and ethical issues” should also bring some attention here. It may indicate that nowadays people may worry more about the practical benefits and risks faced with them rather than some spiritual issues.

Still, the deviation in parameters do not values a lot in the pattern of the responses in this question.

□ Q5

For interpreting the data in Q5, a scale of -2 to 2 (-2 for very useless, 2 for very useful) is applied to obtain the score of the respondent’s confidence of the potential benefits brought by synthetic biology. The overall mean is 0.92. This figure shows that the public generally believe that synthetic biology can have some beneficial applications for humans’ daily life despite their little knowledge in this newly applied science. And this may have some relationship with the respondents’ general positive overall perception of the synthetic biology in Q11

For the parameter, only the family background factor shows a valid mean difference for the confidence in synthetic biology. The mean for the respondents who have family members ever worked or studied in synthetic biology related areas (like biology, engineering, etc.) is 0.99 comparing with 0.89 obtained by the other side of

group, thus showing they have more possibilities to get a more positive attitude towards the potential benefits of synthetic biology.

□ Q6

To get a quantitative result and easier for comparison, a scale of 1-4 (1 for “low priority”, 4 for “highest priority, and the choice “I don’t know” is left blank and uncounted) is designated to the responses of Q6. Then the total mean score of each item (each possible risk listed) is calculated (Table 1).

Table 1: Total Mean Score of Q6

| Q6 | mean |
|--|--------|
| man-made organisms might behave in unpredictable ways | 3.0583 |
| creating artificial life forms raises moral and ethical questions | 2.7695 |
| the technology might be misused, for example by terrorists | 3.0036 |
| the technology will benefit industry but normal people will bear the risks | 2.5571 |
| synthetic biology might clash with people’s religious or ethical convictions | 2.0657 |

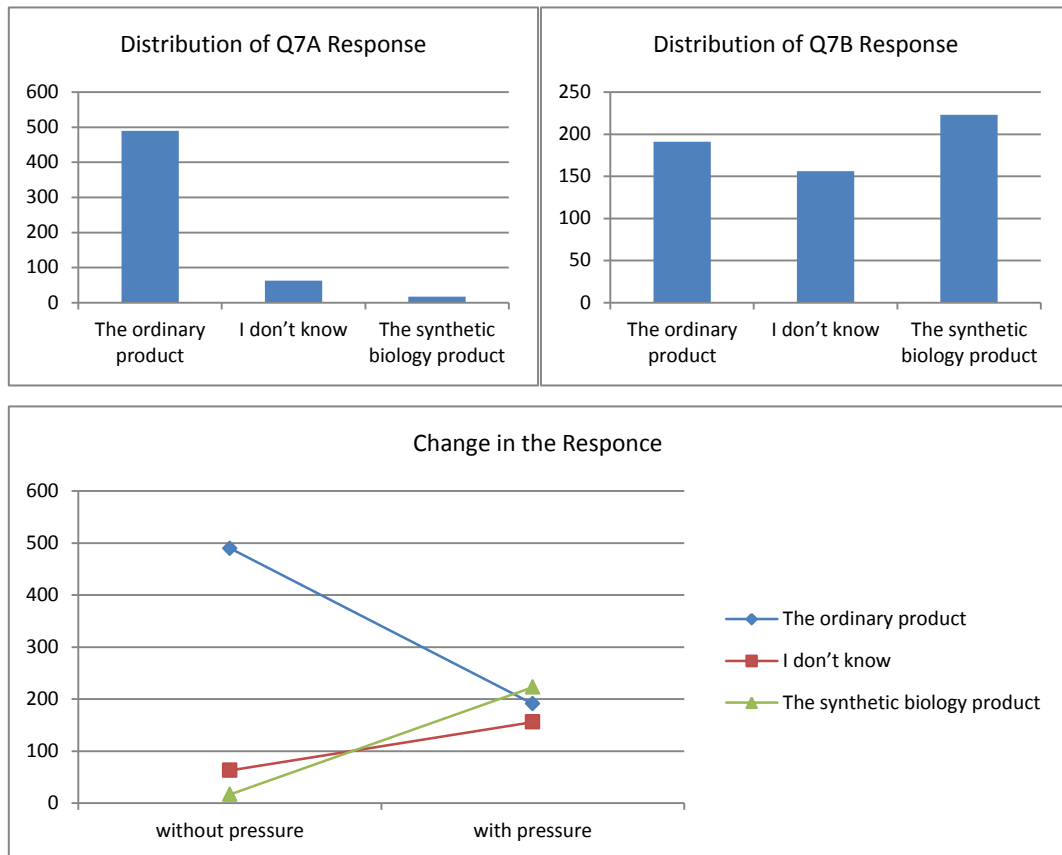
The results are similar to that of Q4. The “uncontrollable results may be generated” and “the abuse of the technology by the terrorists” are the highest two and the concerns related to ethical issues and religious conviction are still kind of ignored.

Also, the sum of one respondent’s scores for the 5 listed potential risks is computed and the total average is 2.68, showing that the public is a bit more worried about the application of synthetic biology and may tend to have more regulation (related to Q10) and pay more attention to its development.

Still, the influence of the parameters on this question is tiny.

□ Q7A & Q7B

The pattern of respondents’ choices for synthetic biology product and the ordinary product without price pressure and under the price pressure is show below (Figure 5).

Figure 5: Distribution and Change in Q7A and Q7B

This figure is a good support for the price impact on perception of synthetic biology. An interesting phenomenon here is that although the respondents' total mean score for their impression about synthetic biology is inclined to be positive, most of them (82.46%) still prefer to choose the ordinary product when the two products are of equal price. And further investigation into the change of their choice when the price of the ordinary product raises a lot, turns out that more than two-thirds changed their mind, half to uncertainty and half to synthetic biology product. This result shows that if synthetic biology can show the public definite benefits (e.g. great price advantage) may make the public more acceptable to it.

As for the parameters, this trend is more obvious in the female group comparing with the male group.

□ Q8 & Q9

Using the quantitative method to simplify the response for Q8 and Q9 (in Q8, positive values are put on the side of scientific evidence and negative values on social concerns; in Q9, +1 for "the advice of experts", -1 for "the thoughts of the majority"), it is shown that the respondents tend to trust the experts and scientific

evidence when deciding the future development of synthetic biology. This may have some connection with their relatively low background in this new field.

Still, the differences in the parameter are not reliable and useful.

□ Q10

The distribution of the choices for Q10 is shown in **Figure 6**. From this, a clear finding is that the tight regulation is more favored in terms with synthetic biology. The lack of related knowledge in this new technology may have something to do with this pattern.

Still, the impact of the parameters on the choice pattern is small.

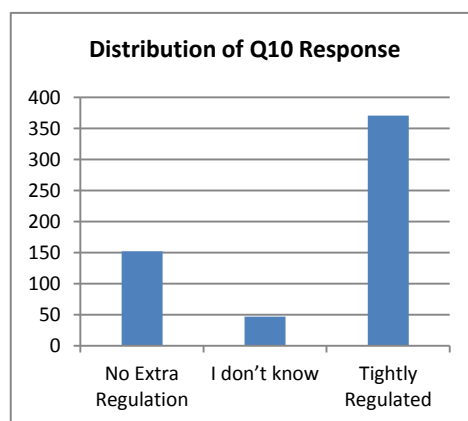


Figure 6: Distribution of Q10 Response

□ Q12

The full mark of the True/False Test in Q12 test is 5 (+1 pts for each correct choice, -1pts for wrong one, 0 for “I don’t know”). The mean of this test is 1.66. This result is a bit low, but acceptable considering nearly 50% respondents never heard of synthetic biology. And the deduction of the marks in this test is mainly caused by choosing “I don’t know”, which may show that the rate of misunderstanding of the range of synthetic biology (e.g. mismatch something bad, but irrelevant to the synthetic biology) is low.

Still, the role of the differences in the parameters is of little importance in its group mean scores.

• Relationships between the Questions in Part One

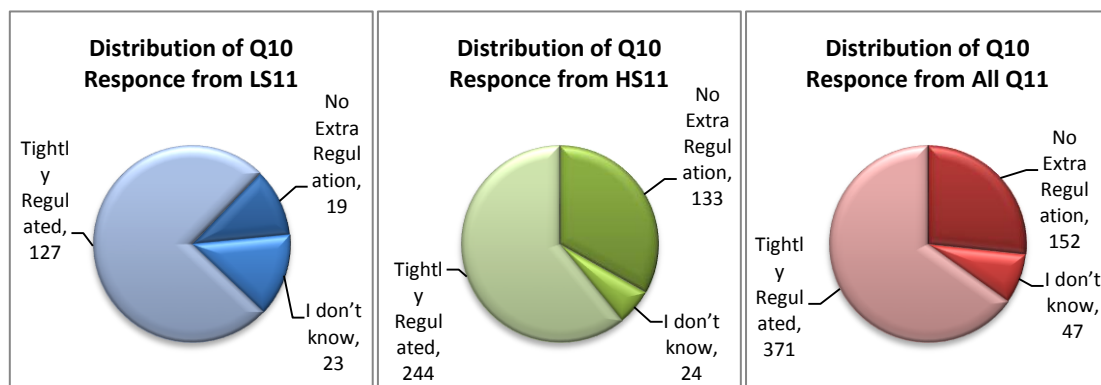
As mentioned above, the means of Q11 do not show significant difference among the variables in the parameter. However, if comparing back with the results in the previous question in Part One, a relative strong relationship between Q11 and Q5 & Q8 is found.

The mean score of Q5 for all the respondents, the respondents with higher scores (above mean) in Q11 (HS11), and the respondents with lower scores (below mean) in Q11(LS11) is shown in **Table 2**.

Table 2: Relations of Mean Score of Q5 with Q11

| Q11 | mean |
|-----|------|
| ALL | 0.92 |
| LS | 0.50 |
| HS | 1.10 |

Also, all the respondents', the HS11 respondents', and the LS11 respondents' choice pattern in Q10 for "tight regulation" (like that for nuclear technology) or "no extra special regulation" towards synthetic biology is shown in **Figure 7**

Figure 7: Differences in Distribution of Q10 Response

Through the charts above, one possible assumption is that the respondents who give relative low scores in Q11 is more inclined to give tight regulation to synthetic biology and trust less about the usefulness of synthetic biology, and vice versa. The quantitative interpreting of the data also supports this conclusion and gives at least 95% confidence towards this.

Exploring more about the data in Q5 and Q10, the influence of the Q1 can be found. The average score of O1_Sum and Q1_Bio for the corresponding choice of Q5 and Q10 (**Table 3**, the abnormal figure obtained for "useless" items in Q5 due to little sample number is marked in dashed lines and ignored) states that the respondents choosing to have tight regulation towards synthetic biology and having less confidence in the usefulness of synthetic biology get lower scores in Q1_Sum and Q1_Bio, especially Q1_Bio, whose T-test shows a higher confidence towards that.

Table 3: Relations of Mean Score of Q1_Sum and Q1_Bio with Q5 and Q10

| | Q5 | | | | Q10 | | All |
|--------|--------------|---------------|--------------|-------------|---------------------|-------------------|------|
| | I don't know | Little useful | Quite useful | Very useful | No extra regulation | tightly regulated | |
| Q1_Sum | 5.26 | 5.31 | 5.56 | 6.63 | 6.13 | 5.72 | 5.77 |
| Q1_Bio | 1.05 | 1.08 | 1.33 | 1.68 | 1.67 | 1.25 | 1.35 |

However, if using the data in Q1_Sum and Q1_Bio as the parameters (divide the data into three categories: above mean, mean-0, below 0) to further analyze the data in other questions. A series of obvious and valid differences are found in Q5, Q8, Q9, Q10 and Q11 (**Table 4.1, Table 4.2**).

Table 4.1: The Quantitative Modeling of Response

| | | | | | |
|-----|------------------------------|---------------------------------|--------------|-----------------------------|------------------------------|
| Q5 | Very useful | Quite useful | I don't know | Little useful | Not useful at all |
| | 2 | 1 | 0 | -1 | -2 |
| Q8 | based on scientific evidence | emphasis on scientific criteria | I don't know | emphasis on social criteria | based on the social criteria |
| | 2 | 1 | 0 | -1 | -2 |
| Q9 | the advice of experts | I don't know | | | thoughts of the majority |
| | 1 | 0 | | | -1 |
| Q10 | tightly regulated | I don't know | | | No extra regulation |
| | 1 | 0 | | | -1 |
| Q11 | very negative | | | | very positive |
| | 1 | 2,3,4,5,6 | | | 7 |

Table 4.2: Relations of Mean Score of Q5, Q8, Q9, Q10 and Q11 with Q1_Sum and Q1_Bio

| | | Q5 | Q8 | Q9 | Q10 | Q11 |
|--------|--------|------|-------|-------|------|------|
| All | | 0.92 | 0.34 | 0.27 | 0.38 | 4.96 |
| Q1_Sum | <0 | 0.94 | -0.50 | 0.00 | 0.83 | 3.83 |
| | 0-5.77 | 0.81 | 0.11 | 0.18 | 0.41 | 4.69 |
| | >5.77 | 1.00 | 0.52 | 0.34 | 0.36 | 5.16 |
| Q1_Bio | <0 | 0.50 | -0.50 | -0.25 | 0.75 | 3.42 |
| | 0 | 0.64 | -0.11 | 0.10 | 0.62 | 4.31 |
| | >0 | 0.99 | 0.45 | 0.32 | 0.33 | 5.12 |

But Q1 shows no direct connection with Q2 & Q3 and Q12. That can be abnormal in common sense. It is generally assumed that if a person shows positive attitudes towards the newly developed technologies, he should also be willing to learn more about the newly developed technologies and their analogs. Thus, those who have high scores in Q1 should have more chance to hear of synthetic biology and know more about it. But such relationship is not seen in this set of data. A possible explanation for this is that it lacks the public promotion of the idea of synthetic biology, making it harder to motivate people to know about it.

Converting Q2 as a parameter and further looking through the data can be a positive support for this supposition. The data in **Table5** shows that respondents who have heard of synthetic biology have higher scores in Q1 and Q12, and great acceptance towards the potential benefits of synthetic biology (Q5). And the difference is wider and more significant when comparing those who have frequently or occasionally focused on the topics related to synthetic biology.

Table 5: Relations of Mean Score of Q1, Q5 and Q12 with Q2 and Q3

| | All | have never heard | have heard | frequently heard |
|-----|------|------------------|------------|------------------|
| Q1 | 5.77 | 5.57 | 6.02 | 7.31 |
| Q5 | 0.92 | 0.73 | 1.16 | 1.38 |
| Q12 | 1.66 | 1.35 | 2.05 | 3.00 |

Discussion and Conclusion

• Effectiveness and Feasibility for Further Spreading

□ The Form of the Survey

To get more effective and valid results, a more widely distributed online survey should be launched and more hard copies should be distributed randomly to the general public. Originally, the form thought to be adapted for this survey is the online version for the easiness to collect mass responses and unlimited access to the Internet. But the results here show that the online form has a strong inherent bias in the respondents, especially in fields like education and age when the distribution range is relatively small. So a solution for this is to still use the online version as a data input agent, but the link should be spread more widely on the Internet, accompanying with bigger range of field surveys.

▫ **The Effectiveness of the Parameters in Part Two**

The variances in the personal background in this set of data do not show significant difference. The inherent problems of the online survey may contribute a lot, but the effectiveness of the parameters is also in doubt. However, this should be further checked with the results from the more widely spread survey

• **Major Hypotheses from the Snapshot Results**

Although the influence of the parameters about the personal information cannot be counted a lot in the analysis due to the relatively big bias, the interaction between the targets of the questions can still give some meaningful hypotheses regarding the factors influencing the general public's perception about synthetic biology. To sum up, there are three major findings or possible hypotheses from this snapshot.

First of all, the overall impression about synthetic biology in HK is more likely to be positive according to the data, but close to neutral. This probably shows a general conservative attitude towards synthetic biology among the general public in Hong Kong since the variance for each parameter is small regardless of the bias.

Secondly, the general publics in HK tend to know little about synthetic biology and that possibly affects their perception of synthetic biology, but does not have much impact on their foresight for its potential risks and future development. Although the overall responses for heard of the term "synthetic biology" is nearly 50%, seldom actually know what synthetic biology is and spare special concerns (measured as the frequency respondents talked or searched about synthetic biology) in this field. The tiny difference of the scores in Q12 between the groups, who have heard of synthetic biology and the groups not is a kind of effective support for that.

However, the mean score of Q12 is significantly higher in groups who frequently confronted the information about synthetic biology (F+ group) than others. Also, this "F+ group" show higher confidence towards the potential benefits brought by synthetic biology (Q5) and fewer tendencies to the tight regulation of synthetic biology (Q10). And according to the analysis, these two features are very closely related to the higher overall impression score of synthetic biology (Q11). Then, that should be modestly surprising to see that this "F+ group" holds more positive attitudes towards synthetic biology.

This tendency is somehow contrary to the familiarity hypothesis (Kahan et al. 2008a; Macoubrie 2006) and the conclusion from the US synthetic biology survey (Pauwels E. et.al. 2009). One possible explanation for this is that the spreading of the idea of synthetic biology is so low in HK that the major problem faced by the public is the lack of information about synthetic biology. The mysterious feeling towards this new

technology outweighs the tradeoff effects between the benefits and risks when asking for its perception. In this case, the clearness of the mysteries will help to increase the support a bit. The highest concerns and curiosity about the “scientific processes and techniques of synthetic biology” in Q4 can also be a side support for the relative blankness of the public’s knowledge for synthetic biology.

Despite the obvious difference in the responses for Q5, Q10, Q11 and Q12 between the “F+ group” and the other groups, there is no differential pattern for their opinions on the possible risks and the future development. All respondents are more inclined to trust the experts and scientific evidence rather than base on the social concerns about the thoughts of the majority when deciding the future development of synthetic biology, and “uncontrollable results may be generated” and “the abuse of the technology by the terrorists” are the top worries for most people. This may prove that the public’s imagination of these two factors is similar regardless of their different familiarity with synthetic biology. The finding from the US synthetic biology survey (Pauwels E. et.al. 2009) that people tend to use the other biological technologies like stem cell technology and genetic engineering as references when dealing with some issues about synthetic biology may be a possible explanation for this.

The third finding is about the price influence on the acceptance of synthetic biology products (Q7). The public turns out to be more acceptable to synthetic biology products if a strong enough price advantage is shown. Although more than 80% respondents choose the ordinary product when the two products are of the same price, only one-third stick to their choice when a more favorable price is introduced to synthetic biology products. And this pattern is independent of the other questions in Part One according to the quantitative testing, but the influence of the parameters is unknown due to the biases.

Acknowledgement

For successfully completing this snapshot survey report, the heartfelt thanks should give to the people below for their continuous support and guidance to this synthetic biology survey:

Mr Markus SCHMIDT and Mr Lei PEI, from IDC <<http://www.idialog.eu/>> and Biofaction <http://www.biofaction.com/?page_id=10>

The Hong Kong University of Science and Technology (HKUST)

Professor King L. CHOW, from the Department of Life Science in HKUST

Professor Michelle YIK, from the Department of Social Science in HKUST

Mr ZENG Jin, Teaching Assistant from the Department of Social Science in HKUST

The Hong Kong Institute of Engineers (HKIE)

The Hong Kong Teachers' Association (HKTA)

Members and Advisors of the iGEM2011 HKUST Team

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Appendix

Appendix I: The online version of the survey can be found at

https://docs.google.com/spreadsheet/viewform?hl=en_US&formkey=dGp3ZDUyNTFNeHN5TllzR2MxUFICdVE6MQ#gid=0

Appendix II: The hard copy version of the survey:

“關於合成生物學的問卷調查-香港 Synthetic Biology Survey (Hong Kong)”

關於合成生物學的問卷調查-香港

Synthetic Biology Survey (Hong Kong)

一、關於你對合成生物學的瞭解與認知

Part One: Your Understanding and Opinions on Synthetic Biology

Q1. 以下所列舉的均為近幾年來新近發展的各项科學研究/新興技術。在您看來，在未來的 20 年內，以下研究/技術會給人類的生活方式帶來怎樣的影響？

Q1. Here you see a list of areas where new technologies are currently being developed. For each of these, do you think, it will have a positive, negative or no effect on our way of life in the next 20 years?

| | | 有利的影響 Positive effect | 不利的影響 Negative effect | 沒有影響 No effect | 很難說 hard to say | 不瞭解這項技術/研究 I don't know this technology |
|---|--|--------------------------|--------------------------|-----------------------|-----------------------|--|
| 1 | 可持續能源技術（太陽能、風能、氫能、生物燃料等等） Sustainable energy (solar, wind, hydrogen, or biofuels) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 2 | 核能技術 Nuclear energy | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 3 | 生物技術和基因工程技術 Biotechnology and genetic engineering | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 4 | 大腦與認知科學 Brain and cognitive enhancement | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 5 | 幹細胞技術 Stem cell technology | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 6 | 個性化醫療 Personal medicine | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 7 | 納米技術 Nanotechnology | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 8 | 宇宙空間探索與航空技術 Space exploration | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

| | | | | | | |
|---|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 9 | 電腦與資訊技術 Computers and information technology | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
|---|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|

合成生物學簡介 Brief Introduction to Synthetic Biology

合成生物學是生物科學在近幾年新近發展出來的一個分支學科，融合了基礎生物學，基因遺傳學，化學與生物工程學。它旨在通過生物工程技術手段，組合不同來源的目標基因，使之成為一個新的生物功能單位，進而促進一些通過自然手段無法獲得的高價值新型生物產品的生產，其在材料科學，能源科學，食品科學，藥物科學等多個領域有相當廣泛的應用。在合成生物學技術的運用過程中，重新改造現有生物是其常用手段。

Synthetic biology is a very new field of biological research bringing together biology, genetics, chemistry and engineering. It is to use an engineering/biological approach to assemble genetic material of diverse sources, the combination of which creates new biological functions or systems, which facilitate production of novel and useful products not possible in the natural world, including material, fuel, food and pharmaceuticals. In the process, re-engineering of living cells as a platform will take place.

Q2. 在今天以前，你曾經聽說過“合成生物學”嗎？

Q2. Before today, have you ever heard anything about synthetic biology?

| | |
|------------------------------|-----------------------|
| 是的，我曾經聽說過 Yes, have heard | <input type="radio"/> |
| 沒有，我從未聽說過 No, have not heard | <input type="radio"/> |

Q3. 你曾經……？

Q3. Have you ever...?

| | 是的，經常 Yes, frequently | 是的，偶爾 Yes, occasionally | 是的，只有一兩次 Yes, only once or twice | 沒有，從不 No, never | 不清楚 I don't know |
|---|-----------------------------|-------------------------------|---|-----------------------|------------------------|
| 在今天以前，和別人談論過有關合成生物學的話題 Talked about synthetic biology with anyone before today | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

| | | | | | |
|---|---|---|---|---|---|
| 流覽過有關合成生物學的資訊 Searched for information about synthetic biology | ○ | ○ | ○ | ○ | ○ |
|---|---|---|---|---|---|

Q4. 如果現在有一個關於“合成生物學”的公眾講座，以下哪個方面是你最關注、最想瞭解的？

Q4. If there is a public dialogue with the legislative body on synthetic biology, what is the most important issue for you on which you would like to know more?

Indicates the top priority

| | | |
|----|--|---|
| 1 | 合成生物學，其具體的科學技術和進程是怎樣的？ What are the scientific processes and techniques? | ○ |
| 2 | 誰在資助合成生物學的研究，他們資助的目的是什麼？ Who is funding the research and why? | ○ |
| 3 | 合成生物學能給我們的生活帶來甚麼好處？ What are the claimed benefits? | ○ |
| 4 | 合成生物學有哪些潛在風險與可能存在的問題？ What are the possible risks? | ○ |
| 5 | 在合成生物學的發展過程中，誰將得到其帶來的利益，誰將承擔其風險？ Who will get the benefits and who will bear the risks? | ○ |
| 6 | 對於合成生物學的監管與控制是怎樣的？ What is being done to regulate and control synthetic biology? | ○ |
| 7 | 對於合成生物學可能牽連的道德和倫理問題怎樣解決？ What is being done to deal with the moral and ethical issues involved? | ○ |
| 8 | 其他 _____ Other _____ | ○ |
| 9 | 沒有想關注、瞭解的 None | ○ |
| 10 | 不清楚 I don't know | ○ |

Q5. “合成生物學”的支持者聲稱，合成生物學的發展將會帶來相當可觀的利益。比方說，通過使用合成生物學技術，可以用被加工過的生物來生產藥物、清理環境、製造化石燃料的替代品等等。

在您看來，合成生物學，在這些方面的應用將會取得怎樣的結果？

Q5. Supporters of synthetic biology claim that the new development will bring considerable benefits. For example, it is hoped to use engineered organisms to produce medicines, clean up the environment, or to make alternatives to fossil based fuels. In your view, how useful do you think synthetic biology will be for such

purposes?

我認為合成生物學在這些方面的應用將會……

I think it is...

| | |
|-------------------------|---|
| 根本沒有用 Not useful at all | 0 |
| 基本沒有用 Little useful | 0 |
| 相當有用 Quite useful | 0 |
| 非常有用 Very useful | 0 |
| 不清楚 I don't know | 0 |

Q6. 當然，也有不少人少認為“合成生物學”的發展會引起一些問題。如果您是合成生物學發展的決策制定者，您會給予下列可能存在的隱患多少關注？

Q6. However, there are also concerns that synthetic biology may raise some problems. If you are the decision-makers who have limited time to deal with all the following regulation problems, how much priority you will give to the following concerns?

| | 關於……的顧慮，應當給予…… The concern that..., should be of ... | 少量關注 low priority | 中等關注 Medium priority | 高度關注 High priority | 最高關注 Highest priority | 不清楚 I don't know |
|---|--|-------------------------|----------------------------|--------------------------|-----------------------------|------------------------|
| 1 | 合成生物學研究過程中，被改造過的生物可能會發展出研究者意料不到的結果 ... man made organisms might behave in unpredictable ways | 0 | 0 | 0 | 0 | 0 |
| 2 | 合成生物學研究過程中，所改造的製造人工生物會引起道德倫理問題 ... creating artificial life forms raises moral and ethical questions | 0 | 0 | 0 | 0 | 0 |
| 3 | 合成生物學的有關技術會被濫用，例如被恐怖分子使用 ... the technology might be misused, for example by terrorists | 0 | 0 | 0 | 0 | 0 |
| 4 | 合成生物學的有關技術只會使工業受益，而普通民眾卻要承擔其風險 ... the technology will benefit industry but normal people will bear the risks | 0 | 0 | 0 | 0 | 0 |
| 5 | 合成生物學可能會破壞民眾的宗教或道德信仰 ... synthetic biology might clash with people's religious or ethical convictions | 0 | 0 | 0 | 0 | 0 |

| | | | | | | |
|---|--|---|---|---|---|---|
| 6 | 其他 _____ (可空) ... others e.g. _____ (can be skipped) | 0 | 0 | 0 | 0 | 0 |
|---|--|---|---|---|---|---|

Q7a. 假設在市場上，同時存在兩種相同的商品（例如，大豆），其中一種經過合成生物學技術處理，另一種為天然產物，且兩種商品價格相同。您會選擇購買……？

Q7a. If there exist two identical products (e.g. soya bean) in the market, one involves synthetic biology processing, the other is natural, and both are of the same price. Which one you tend to buy?

| | |
|---------------------------------------|---|
| 合成生物學產品 The synthetic biology product | 0 |
| 普通的天然產品 The ordinary product | 0 |
| 不清楚 I don't know | 0 |

Q7b. 那麼，如果天然產品的價格比生成生物學產品貴很多呢（即合成生物學產品對天然產品有明顯的價格優勢）？您會選擇購買……？

Q7b. And what if the natural one is much more expensive than the one involving synthetic biology processing (in other words, synthetic biology product has an obvious price advantage over the natural product). Which one you tend to buy?

| | |
|--|---|
| 合成生物學產品 The synthetic biology product | 0 |
| 普通的天然產品 The ordinary product | 0 |
| 不清楚 I don't know | 0 |

Q8. 在您看來，在決定“合成生物學”未來發展規劃時，應當以什麼作為規劃依據？

Q8. Regarding the basic factor which we should depend on for making decisions on further development of synthetic biology,

在決定合成生物學未來發展規劃是，應當……

Decisions about synthetic biology should be...

| | |
|---|---|
| 主要依據科學研究事實 based primarily on scientific evidence | 0 |
| 主要依據社會準則（道德倫理等等） based primarily on the social criteria (e.g. moral and ethical issues) | 0 |
| 同時考慮科學研究事實和社會準則，偏重科學研究事實 weighted between scientific evidence and social concerns, | 0 |

| | |
|--|---|
| with an emphasis on scientific criteria | |
| 同時考慮科學研究事實和社會準則，偏重社會準則 weighted between scientific evidence and social concerns, with an emphasis on social criteria | 0 |
| 不清楚 I don't know | 0 |

Q9. 在您看來，關於誰應當作為“合成生物學”未來發展規劃的主要制定者

Q9. Regarding who should mainly make decisions on further development of synthetic biology

合成生物學的未來發展規劃應當由……主導

Decisions about synthetic biology should be based mainly on...

| | |
|---|---|
| 專家們的意見 the advice of experts | 0 |
| 國家中多數民眾的想法 what the majority of people in a country thinks | 0 |
| 不清楚 I don't know | 0 |

Q10. 在您看來，關於對於“合成生物學”的監督與管制

Q10. Regarding the regulation of synthetic biology

合成生物學應當……

Synthetic biology should be...

| | |
|---|---|
| 像對待核能技術一樣，被嚴格管制 tightly regulated by Government like nuclear energy | 0 |
| 像對待一般科學技術研究一樣，不加以額外的特殊管制 regulated the in same way as other activities of science and technology: No extra regulation should be imposed | 0 |
| 不清楚 I don't know | 0 |

Q11. 總體而言，您對於“合成生物學”的態度是？（請用數字 1-7 表達您的看法，1 非常消極否定/7 非常樂觀肯定）

Q11. Overall, what is your impression about synthetic biology? Please indicate your feeling by number 1-7 (1 for very negative, and 7 for very positive)

| | | | | | | |
|------------------------------|---|---|---|---|---|------------------------------|
| 1 非常消極否定 very negative | 2 | 3 | 4 | 5 | 6 | 7 非常樂觀肯定 very positive |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Q12. 請判斷下列陳述的真實性。以下各項描述的事件均為在過去幾年中真實發生過的事件。

Q12. Please judge the truthfulness of the following statements. The statements all describe the events that actually happened in the past several years.

| | | 符合事實 True | 不符合事實 False | 不清楚 I don't know |
|---|---|--------------|----------------|---------------------|
| 1 | 某合成生物學研究所，通過使用被改造過的含有蜘蛛絲基因的工程重組細菌，大大提高絲質物料的產量。 The high yield production of silk can be achieved by genetically modified bacteria expressing spider silk gene engineered by a synthetic biology lab. | 0 | 0 | 0 |
| 2 | 今年於香港某海鮮餐廳發生的食物中毒事件，是由於該餐廳使用了由某合成生物學技術公司提供的轉基因食物原料而導致的。 Food poisoning in a seafood restaurant in Hong Kong this year is due to the genetic modified raw material used in their dishes which is provided by a synthetic biology company | 0 | 0 | 0 |
| 3 | 某合成生物學研究所開發出了一種可以根據環境中所含重金屬不同而分泌不同顏料分子的工程重組細菌，並以此為基礎開發出新的重金屬檢測方法。 New method of heavy metal detection was developed in a synthetic biology lab using genetic modified bacteria which can produce different color pigments in response to different heavy metals. | 0 | 0 | 0 |
| 4 | 在中國大陸地區造成生物入侵的鳳眼蓮，是被一個進行基因品種改良的合成生物學實驗室意外釋放至環境中的。因其含有額外的促進其生長的基因，大量繁殖，以至造成嚴重的生物入侵。 Water hyacinth plant which caused biological invasion in mainland China is released from a synthetic biology research lab doing plant variety improvement experiments and contains genes to increase its growth rate. | 0 | 0 | 0 |
| 5 | 某合成生物學-醫學研究所所提供的含有多種植物基因的工程重組細菌，使得近年來針對瘧疾的青蒿素得以大量生產。 The high yield production of artemisinin for malaria treatment is achieved by using genetic modified bacteria carrying various plant genes constructed by a synthetic biology lab targeting medical research. | 0 | 0 | 0 |

二、個人基本資訊

Part Two: Demographic Information

Q1. 性別

Q1. Gender

| | |
|----------|-----------------------|
| 男 Male | <input type="radio"/> |
| 女 Female | <input type="radio"/> |
| 拒絕回答 N/A | <input type="radio"/> |

Q2. 年齡

Q2. Age

| 年齡 Age | < 20 | 20-30 | 30-40 | 40-50 | 50-60 | >60 |
|--------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Q3. 請問您是香港本地人嗎?

Q3. Are you local Hong Kong people?

| | |
|-----------------------------|-----------------------|
| 是的, Yes, | <input type="radio"/> |
| 不是, No, 來自 _____ from _____ | <input type="radio"/> |

如果選擇“不是”，請在此詳細說明

Q4. 請問您在香港本地住了多久?

Q4. How long have you lived in Hong Kong?

| | |
|--------------------------|-----------------------|
| 少於一年 Less than one year | <input type="radio"/> |
| 一至三年 one to three years | <input type="radio"/> |
| 三至五年 Three to Five years | <input type="radio"/> |
| 五至十年 Five to ten years | <input type="radio"/> |
| 多於十年 More than ten years | <input type="radio"/> |

Q5. 請問您是否有宗教信仰?

Q5. Do you have any religious belief?

| | | |
|-------|-------------------|---|
| 沒有 No | | 0 |
| 有 Yes | 佛教 Buddhism | 0 |
| | 基督教 Christianity | 0 |
| | 伊斯蘭教 Islamism | 0 |
| | 印度教 Hinduism | 0 |
| | 其他宗教 Others _____ | 0 |

Q6. 請問您每個月的收入是多少？

Q6. How much is your income each month?

| | |
|--------------------------|---|
| 少於 Less than 10,000 HKD | 0 |
| 10,000 HKD – 20,000 HKD | 0 |
| 20,000 HKD-30,000 HKD | 0 |
| 30,000 HKD-50,000 HKD | 0 |
| 50,000 HKD-100,000 HKD | 0 |
| 多於 More than 100,000 HKD | 0 |

Q7. 請問您有多少直系親屬？其中除您本人外，有多少人就職於自然科學、技術或工程（例如：物理、化學、生物、藥物）相關領域，或者在相關領域有大學學士學位？請在以下空白處標明應填入的具體人數。

Q7. How big is your immediate family and how many of them (excluding you) have/had a job or a university qualification in natural science, technology or engineering (e.g. physics, chemistry, biology, medicine)? [Please specify the number in the following blank]

除了我本人外，我有 _____ 位家庭成員，其中 _____ 人就職於自然科學、技術或工程相關領域，或在相關領域具有大學學士學位
 Excluding myself, I have _____ immediate family member(s), and _____ of them have/has/had a job or a university qualification in natural science, technology or engineering

Q8. 你是否曾經修讀過自然科學、技術或者工程的相關課程？是在中學、大學還是其他地方？（你可以選擇多個選項）

Q8. Have you ever studied natural science, technology or engineering at school, in college, in the university or anywhere else? [You can make more than one choice]

| | |
|---|---|
| 是，在大學 Yes, at university | 0 |
| 是，專上院校 Yes, through post-secondary education | 0 |

| | |
|---|---|
| 是, 在小學或中學 Yes, at primary/secondary school | 0 |
| 是, 其他地方_____ Yes, elsewhere _____ | 0 |
| 否, 沒有修讀過相關課程 No, I have never studied any of these | 0 |
| 不清楚 I don't know | 0 |

Q9. 您所取得過的的最高學歷是？

Q9. What is the highest level of education that you have attained (e.g for Hong Kong)

| | |
|---|---|
| 沒有受過正規教育（沒進過學校） No formal education (schooling) | 0 |
| 小學 Primary school | 0 |
| 初中（初級中學水準，中一至中三） Compulsory school (Junior levels of Secondary School) | 0 |
| 香港中學學位 Hong Kong degree of Secondary Education | 0 |
| 高等教育（學士，碩士） Tertiary education (bachelor, master) | 0 |
| 高等教育（博士） Tertiary education (PhD) | 0 |
| 其他高等教育（沒有學位） Other post-secondary education (non-degree) | 0 |