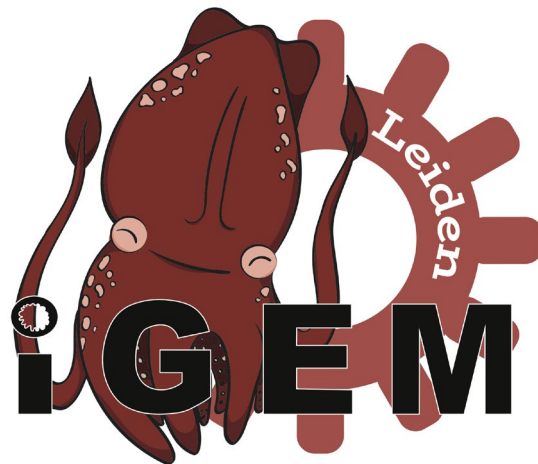


Collaboration on a survey on medical GMOs



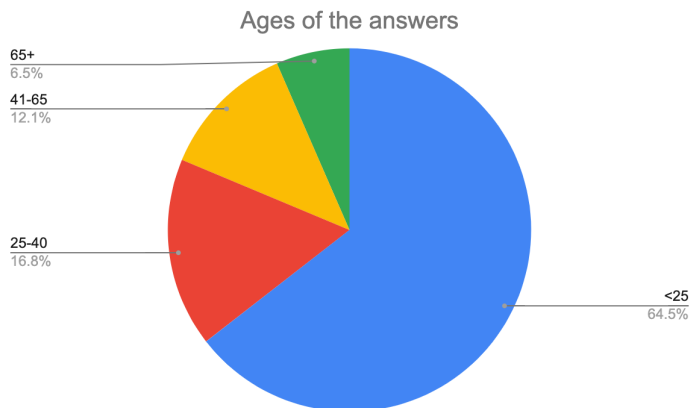
It is well known that public perception can often be a barrier between scientific progress and real-world application. Hence, one of the important aspects of our project was to understand how the general public perceives different products involving GMOs for diagnostic or therapeutic purposes. In order to do this, we teamed up and created a survey with iGEM Oxford and iGEM Leiden, who are both working on medical GMOs (Oxford is developing a super - probiotic strain to combat *C.difficile* infection, while Leiden is working on a therapeutic hydrogel for treating burns).

The main objectives of the survey were to get an idea of the general public's knowledge of GMOs, to identify their concerns within genetic engineering, and to understand their opinions on using GMOs in developing health-related products (diagnostics and therapeutics) like ours. We are developing a diagnostic chewing gum that contains a yeast-based biosensor and can detect ovulation in women. We are using the data from the survey to inform our Human Practices outreach work so that we can narrow the gap between understanding and use of genetic engineering.

Our methods for conducting the survey were approved by our supervisors as well as the institution. We designed our survey in compliance with the AAPOR Task Force report "Evaluating Survey Quality in Today's Complex Environment" and Best Practices for Survey Research guidelines: The survey was anonymized and our methods for conducting it were approved by our PIs and the institution, respectively. We pretested questionnaires and procedures and afterwards we tallied all of the answers to get our final results. The survey itself contained a disclaimer paragraph informing the participants about the purpose of the survey, and contact information in case of any concern. This was followed by two demographics questions, and then five questions designed to better comprehend the public understanding of, reaction to, and opinion on GMOs. Finally, two questions were designed to give us specific opinions about the drug designs of our individual projects. At the end, participants could give us any further comments on our projects or survey, as well as voice any concerns. We purposefully decided against a fully multiple-choice survey to give participants the chance to give their differentiated and unbiased opinion. Finally, we performed a detailed analysis of the survey to get the final results.

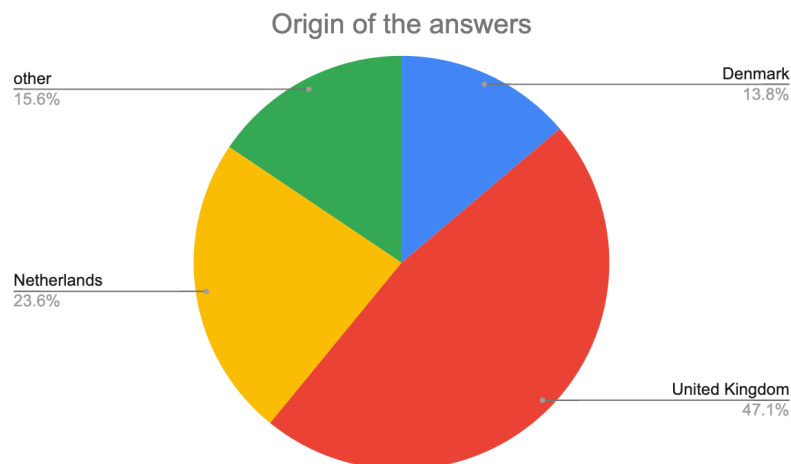
Some of the important findings of our survey are highlighted here:

1. Geographical and age distribution of all participants



Graph 1: Age distribution of the people answering the survey

Because it was an online survey and because we sent it out through social media, we were aware that our polling population might have some bias. As expected, we saw this bias in our demographic results, where the average age was 29.3 years and 24% were within typical university student age. From graph 1 it can be seen that the majority of the people that answered our survey were under 25 years old: 64,5% were under 25 years old, 16,8% were between 25-40 years old, 12,1% were between 41-65 years old, and 6,5% were over 65 years old. However, we still think that our data can provide some useful insights into the general public's opinion.

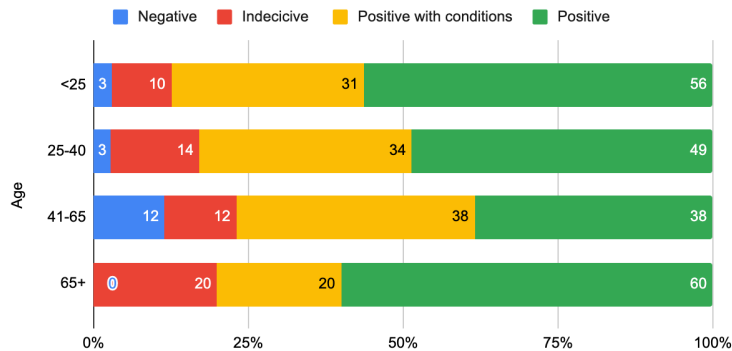


Graph 2: Geographical origin of the people answering the survey

Overall, 221 people filled out our survey. 102 of the participants were from the UK (47,1%), 54 from the Netherlands (23,6%), 31 from Denmark (13,8%), and 35 from other countries (15,6%).

2. General opinion on genetic engineering

General opinion on genetic engineering by age group



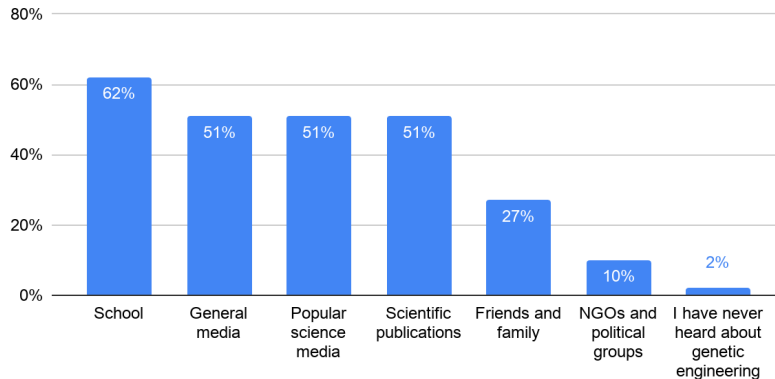
Graph 3: The general opinions on genetic engineering by age groups

The aim of the survey was to understand the general opinion about genetically modified organisms. Our survey showed that most people feel quite positively about genetic engineering. People over 65 years old are the most enthusiastic about genetic engineering. Amongst them, over 60% answered that they are positive about it, and 20% were positive to have GMOs with conditions. 20% were indecisive. The people under 25-years old were the next most accepting of genetic engineering, followed by the people between 25-40 years old. The people between 41-65 were the least accepting of genetic engineering although only 12% had a negative opinion about it.

However, we need to be careful with the interpretation since this could be also due to the sampling population as the survey was sent out by iGEM participants to their friends and families. The immediate surroundings of people working in iGEM might be positively biased since they are all in some way related to a person who has knowledge about this subject and is also passionate about educating people on it.

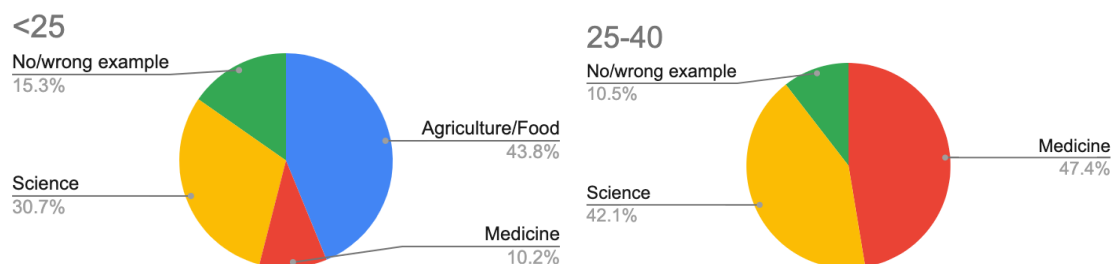
3. Analysis on background knowledge of participants

Where have you heard about genetic engineering? (multiple answers are possible)



Graph 4: Sources of information on genetic engineering

Most of the people answering our survey have heard about genetic engineering in school (62%). Many people have heard about genetic engineering in scientific publications and popular science media, suggesting that a lot of the people answering our survey are scientists. A lot of the people have also received information about genetic engineering through general media showing that genetic engineering is a subject getting a lot of attention in the media currently. As one participant mentioned: *“A lot of people (including myself) do not know that much about it [genetic engineering]. They have probably heard the word in school and some examples, but not really know the consequences or if it is really good or bad.”* Therefore, we should be careful in interpreting these results, in combination with our data on the opinions.



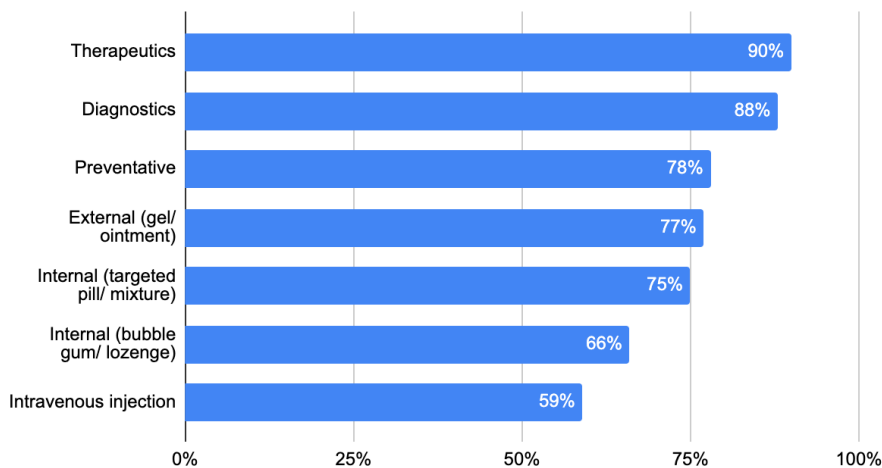


Graph 5: Examples of genetic engineering separated by age

We asked all participants to name an example of genetic engineering, so we could estimate where their knowledge came from. We categorized their answers into: 'agriculture/food', 'medicine', 'science' and 'no/wrong example'. It is interesting to note that each age group has a major area of knowledge: medicine (47.4%) for participants from 25-40; agriculture (65.4%) for participants from 41-65; science (60.0%) for participants of 65+. The group of participants under 25 showed the most diversity in their answers, yet 'agriculture' still had a majority with 43.8%.

4. Opinions on GM treatments

What kind of GM would you use? (multiple answers possible)

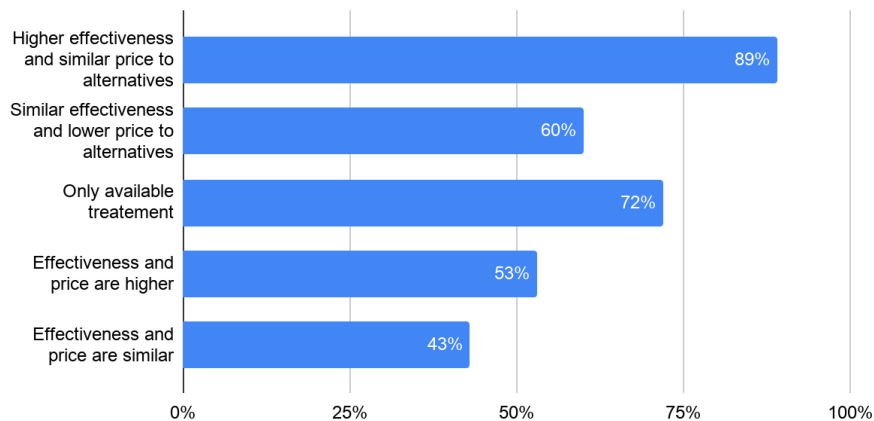


Graph 6: Examples of GM products that people would use

In graph 6 it can be seen that most people answering our survey would use genetically modified products if they were therapeutics or diagnostics (90% and 88% respectively), whereas

intravenous injection was least opted (59%). In general, this trend is seen throughout the data, where external scored higher than internal applications.

Would you choose a product containing GMO if: (multiple options possible)



Graph 7: Motivation for choosing a GMO over a conventional product

We further tried to find out what a GMO drug would need to deliver to replace a traditional treatment. From graph 7 we can conclude that people find effectiveness more important than price when deciding whether to use a product containing a GMO. Of all participants, 89% indicated that they could be convinced by a GMO treatment with higher effectiveness at a comparable or lower price, whereas 60% would consider a GMO drug with a lower price, but similar effectiveness. This would be important to implement into the development of our products. It is also interesting that 43% said they would still consider a GMO medicine even without an obvious advantage in effectiveness or price. This, in combination with the overall high response, provides further indication to the positive attitude towards GMO treatment. This might be due to the education people have received on genetic engineering, as one participant highlighted that *“people can be very fearful about new technology and myths are spread. Educating people will benefit society by reducing people’s reservations about GMOs so they can get the most effective treatment possible”*.

Conclusions:

We have to be careful drawing conclusions since our survey didn't reach enough people. And because it was distributed through social media, it has reached a lot of our friends that are studying science at universities and are more prone to being positive towards GMOs. However, from our survey, it can be concluded that people have a rather positive opinion towards GMO and are not against using GMO products.

Summary

- Most of our participants were under 25 (64.5%) and from the UK (47.1%).
- The participants had a general positive attitude towards genetic engineering (51% were positive, and 31% were positive with conditions).
- The majority of the participants had previously heard about genetic engineering (mostly through school: 62%).
- All age groups had their knowledge about genetic engineering predominantly in one field.
- People are more open towards GMO products that are applied externally compared to those that are applied internally.
- Effectiveness of a product is important when choosing between a medical GMO product and a non-GMO product.
- In general, the data suggests that most participants had a scientific background, which is evident by their stated source of information about genetic engineering. In addition, the general positive attitude towards genetic engineering indicates a scientific background as well.