

Written evidence from British Science Association (ENB0012)

1. The British Science Association (BSA) welcomes this inquiry into engineering biology.
2. Our submission addresses the following questions within the call for evidence:
 - There are regulatory, ethical, and safety concerns that go along with any dual-use technology, particularly in the case of gene-editing. What are the major areas of concern?
 - How are the ethical, safety, and national security concerns raised in Q5 addressed under current regulations? Are regulators sufficiently independent from Government and from industry?
 - What more can the Government do to foster public understanding of engineering biology? Is public acceptability of these technologies a barrier to deployment in the UK?

About the British Science Association

3. The British Science Association (BSA) was founded in 1831 and is a registered charity ¹.
4. We are creating a future where science is more relevant, representative, and connected to society. We work with partners across the UK to bring people and science together. We improve young peoples' experiences of science in their education. We work with community groups and grassroots organisations to give them opportunities to be involved in science. We showcase the amazing work of researchers and academics through our events and activities. We advocate for a more inclusive science community.
5. The BSA seeks to make science more inclusive. Understanding and reporting on public views on science topics to relevant networks is therefore essential in ensuring voices from diverse backgrounds are heard and considered in decision-making.

About Sciencewise

6. The BSA are part of Sciencewise, a public engagement programme to inform policies involving science and technology ².
7. Sciencewise collects, researches, analyses and publishes public perspectives on areas such as the environment, AI, biotechnology and more.
8. Sciencewise is an internationally recognised programme led and funded by UK Research and Innovation (UKRI) with support from

¹ About the British Science Association <https://www.britishsociety.org/Pages/Category/about>

² About Sciencewise <https://sciencewise.org.uk/>

the Department of Science, Innovation and Technology. The consortium is led by public engagement charity Involve, with the BSA and National Co-ordinating Centre for Public Engagement (NCCPE).

9. In 2024, Sciencewise published a two-part report on public attitudes to engineering biology^{3 4}. These reports provide a more detailed analysis of the evidence included in this submission.

Social and ethical issues associated with engineering biology

10. The regulatory, ethical, and safety concerns associated with engineering biology can be grouped into five main categories:
11. **Biosafety and biosecurity:** Manipulating biological matter could, for example, lead to the loss of biodiversity, human health problems, and opportunities for bioterrorism⁵.
12. **Governance:** With so many applications and regulatory approaches, there is a risk of a lack of clarity on who will have oversight of the technology⁶.
13. **Access:** As synthetic biology research advances towards clinical application, the question of how the new technologies are made widely available to the public becomes increasingly relevant. Healthcare, provision of treatment and new therapies, and clinical research are much more regulated in some countries than others, which might result in a health and research tourism⁷.
14. **Naturalness:** Rapid advancements in engineering biology could lead to widespread concerns over “blurring the line” between natural and artificial⁸.
15. **Corporate benefit:** With much innovation being led by the private sector, or with publicly funded research being commercialised, there could be concerns about increased control of these technologies by large companies

Public attitudes and values around engineering biology (general)

16. Here we give a brief summary of the evidence surrounding public attitudes and knowledge about engineering biology.

³ Sciencewise (2024) Public perceptions of engineering biology (part 1: health) <https://sciencewise.org.uk/wp-content/uploads/2024/01/Sciencewise-Engineering-biology-Health.pdf>

⁴ Sciencewise (2024) Public perceptions of engineering biology (part 2: food) <https://sciencewise.org.uk/wp-content/uploads/2024/04/Sciencewise-Engineering-biology-in-food.pdf>

⁵ Akin, H., Rose, K.M., et al. (2017). Mapping the Landscape of Public Attitudes on Synthetic Biology. *BioScience*. <https://academic.oup.com/bioscience/article/67/3/290/2900178>

⁶ Ethical framework on risk governance of synthetic biology (2023) <https://www.sciencedirect.com/science/article/pii/S2588933823000201#s0080>

⁷ Chan, S. (2018). Research translation and emerging health technologies: Synthetic biology and beyond. *Health care analysis*. https://www.pure.ed.ac.uk/ws/portalfiles/portal/29478818/art_3A10.1007_2Fs10728_016_0334_2.pdf

⁸ Howell, E.L., Scheufele, D.A. et al. (2020). Scientists' and the Publics' Views of Synthetic Biology. *Synthetic Biology 2020: Frontiers in Risk Analysis in Governance*. <https://research.manchester.ac.uk/en/publications/scientists-and-the-publics-views-of-synthetic-biology>

17. Synthetic biology and engineering biology are two terms which significantly overlap and are often used interchangeably by experts. We have looked at sources of public opinion on both synthetic biology and engineering biology, and we have mirrored the language used by the source of the evidence.
18. Despite the Government, industry, and researchers' interest in the discipline, recent evidence on public attitudes to engineering biology in the UK is relatively scarce.
19. Many recent studies are from international sources, particularly Australia, China, and the US. These cannot be assumed to mirror UK views, because attitudes may depend on factors like past history with life science technologies like GM, religious beliefs, and trust in science. However, international evidence can provide a helpful starting point for identifying areas to explore with UK populations.
20. It is also worth noting that we found many UK studies and activities looking at public attitudes to synthetic biology which were published prior to 2017. Several experts we consulted pointed us towards resources dating back to 2009-2012, e.g. the Royal Academy of Engineering's report "Synthetic Biology: scope, applications, and implications,"⁹ "Strategic Roadmap for Synthetic Biology in the UK,"¹⁰ and the public dialogue on synthetic biology supported by Sciencewise¹¹. These resources have been an important part of historic attempts to understand public opinion, but it cannot be assumed that their findings are still relevant today.
21. In the UK, the former Department for Business, Energy, and Industrial Strategy reported on what the public think about synthetic biology in their "Public Attitudes to Science" survey published in 2020. Their main findings were¹²:
 - Overall awareness of synthetic biology increased from 61% to 70% between 2014 to 2019.
 - 27% of respondents said they never heard of synthetic biology.
 - Men were more likely to say that they have heard of synthetic biology than women (76% vs 70%).
 - People aged 65+ were less likely to have heard of synthetic biology than those aged under 65 (66% vs 75%).

⁹ Royal Academy of Engineering. (2009). Synthetic biology: scope, applications, and implications. https://raeng.org.uk/media/fvwdlqmx/synthetic_biology.pdf

¹⁰ UK Synthetic Biology Roadmap Coordination Group. (2012). A synthetic biology roadmap for the UK. <https://iuk.ktn-uk.org/wp-content/uploads/2020/08/Synthetic-Biology-Roadmap-Report.pdf>

¹¹ Sciencewise. (2010). Synthetic biology dialogue. <https://live-sciencewise.pantheonsite.io/wp-content/uploads/2018/08/1006-synthetic-biology-dialogue.pdf>

¹² Department for Business, Energy, and Industrial Strategy. (2019). Public attitudes to science 2019. <https://assets.publishing.service.gov.uk/media/5f22cf7bd3bf7f1b1593c15c/public-attitudes-to-science-2019.pdf>

- 83% of those educated to a degree level reported that they have heard of synthetic biology, compared with 46% of those with no qualifications.
 - Of all who have heard of synthetic biology, 32% felt that its benefits outweigh the risks, while 14% felt that synthetic biology's risks are greater than its benefits.
 - The support was higher among those who felt informed about the technology than those who have only heard about it (48% vs 32%).
22. **There are low levels of awareness about engineering biology.** The Australian Office of the Gene Technology Regulator conducted a study on community attitudes to gene technology ¹³. The survey asked the public about their awareness of different technologies, such as biotechnology, genetic modification or GMO, gene editing, and cloning of animals, and found that synthetic biology was the term that the public were the least familiar with.
23. **Attitudes to synthetic biology dependent on the context and people's values.** Researchers in the US studied how the public attitudes to synthetic biology compare with attitudes toward other issues ¹⁴. The study found that the main values and predispositions which correlate with attitudes to synthetic biology are religiosity (note that the UK is more secular than the USA), deference to scientific authority, and trust in scientists.
24. **There is some public optimism about engineering biology.** Researchers at the University of Klagenfurt in Austria analysed public outreach events organised across Europe in the frame of an EU-funded project on Responsible Research and Innovation in synthetic biology ¹⁵. Their analysis shows that the public are largely unfamiliar with the topic, and only comfortable with discussing ethics, risks, and governance of synthetic biology on an abstract level and express their opinions in generic statements which could be made for any new technology. Despite the low level of awareness, the researchers also noted that the participants felt optimistic about synthetic biology and its potential to solve major societal challenges, such as clean energy, health, and environmental protection.
25. **The public have concerns over misuse of engineering biology, and overstepping boundaries.** A survey of US adults

¹³ Office of the Gene Technology Regulator. (2021). Community attitudes towards gene technology. https://www.ogtr.gov.au/sites/default/files/2021-11/community_attitudes_report_2021_.pdf

¹⁴ Howell, E.L., Scheufele, D.A. et al. (2020). Scientists' and the Publics' Views of Synthetic Biology. *Synthetic Biology 2020: Frontiers in Risk Analysis in Governance*.

<https://research.manchester.ac.uk/en/publications/scientists-and-the-publics-views-of-synthetic-biology>

¹⁵ Bauer, A., Bogner, A. (2020) Let's (not) talk about synthetic biology: Framing an emerging technology in public and stakeholder dialogues. *Public Understanding of Science*. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7411530/>

found that most respondents supported regulating synthetic biology and other ways of protecting the public from unknown risks of the technology, with 59% agreeing that academic synthetic biology research should be regulated¹⁶. Several studies mention the perception that some members of the public have about scientists who are creating organisms and DNA from scratch and therefore overstepping humans' authority to alter the natural world, or "playing God"¹⁷

Public attitudes and values around engineering biology (health applications)

26. Here we give a brief summary of the evidence surrounding public attitudes and knowledge about health applications of engineering biology.
27. **Support highest when there is a public health need:** Several of the international studies we found suggest that the public's support for engineering biology is the highest when it is used to improve human health. CSIRO, Australia's national science agency, conducted surveys across seven synthetic biology applications, including managing invasive pests, reducing pollution in waterways, and reducing mosquito-borne diseases³⁷. They found that support for synthetic biology was the highest when there was a public health need or an environmental benefit.
28. **Impact of COVID-19 on public attitudes to biotechnologies:** Researchers at the University of Science and Technology of China conducted an international literature review to profile ethical and societal insights into synthetic biology in the post-COVID-19 era⁴¹. Their research suggests that various conspiracies and rumours about bioweapon and biohazard leakage, which emerged during the pandemic, have had a negative impact on people's confidence over biotechnologies and science institutions. However, at the same time, synthetic biology has allowed rapid development of COVID-19 vaccines and helped to save lives all over the world.
29. **Perception of negative public attitudes as a result of anti-GM sentiment:** Stakeholders from government, research, and civil society have been shown to hold perceptions of negative public

¹⁶ Akin, H., Rose, K.M., et al. (2017). Mapping the Landscape of Public Attitudes on Synthetic Biology. *BioScience*. <https://academic.oup.com/bioscience/article/67/3/290/2900178>

¹⁷ Carter, L., Mankad, Ad. et al. (2022). Three synthetic biology applications and their paths to impact in Australia: Cane toads, bacteriophages, and biomining microbes. *Biotechnology Journal*. https://onlinelibrary.wiley.com/doi/full/10.1002/biot.202200009?_hsenc=p2ANqtz--bXgwtYQcuJmP2jhdF06QEcvBLEylJa2CJi57dF7Oq1TVyjg51qvXx8HU71QxGUBefeSq4IFj_E3-LlyPOZfjn7DyU2w2wBOAllsAd4vGu2-WhVM&_hsmi=216234391&utm_content=buffer53923&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

attitudes towards the use of genetic technologies. The participants of one Australian study often expressed concerns over the lack of public trust in biotechnologies. This is likely to be driven by the perceived anti-GM sentiment in Australia and elsewhere. In the early 2000s, the industries failed to engage the public in the conversation about genetically modified foods, which resulted in the public opposition to genetic interference in food production. These failures continue to affect the attitudes of government and science communities who are anxious about the public acceptability of genetic technologies, even though there is evidence that public mood in many countries has shifted.

30. **Ensuring shared benefits and equal access:** Research by the University of Edinburgh suggests that the interplay of commercial, individual, public and scientific interests creates complex ethical tensions that will need to be carefully considered if the new synthetic biology treatments are to serve the public interest ¹⁸.
31. **Support for regulation:** Evidence suggests that the public are in favour of new technologies being adequately regulated. However, if the regulations are too tight it might mean that some scientists and biotech companies relocate to other countries, which could have economic and political consequences, or that people would travel overseas to access new treatments, which might have implications for the local health care systems. To address this, a global cooperation between both policymakers and scientific community will be needed.

Public attitudes and values around engineering biology (food applications)

32. Here we give a brief summary of the evidence surrounding public attitudes and knowledge about food applications of engineering biology.
33. **Use of engineering biology in food less accepted than in health or environment:** A study by Hart Research Associates ¹⁹ found that the use of synthetic biology to eradicate malaria via mosquitoes was viewed as positive, while agrifood applications, such as the creation of a crop enhancing fertiliser and new food additives, were perceived more negatively by research participants. However, it needs to be noted that this study was conducted in the US in 2013, and it cannot be assumed that similar results would be

¹⁸ Chan, S. (2018). Research translation and emerging health technologies: Synthetic biology and beyond. *Health care analysis*.

https://www.pure.ed.ac.uk/ws/portalfiles/portal/29478818/art_3A10.1007_2Fs10728_016_0334_2.pdf

¹⁹ Hart Research Associates. (2013). Awareness & Impressions of Synthetic Biology: A report of findings. <https://www.cbd.int/doc/emerging-issues/emergingissues-2013-07-WilsonCenter-SynbioSurvey-en.pdf>

found in the UK today, especially in the light of rapid development of engineering biology over the last 10 years.

34. Viewing medical and environmental applications as more acceptable than food applications is not unique to synthetic biology. Research suggests that public attitudes to other emerging technologies, such as GM and nanotechnology, follow a similar pattern ²⁰. It is possible that people perceive medical applications as more “necessary” than agricultural and food applications, and, therefore, as more acceptable. However, even within the agrifood sector, different applications are likely to evoke different perceptions.
35. **Views on engineering biology similar to those on GM but more ambivalent:** In 2020, the Food Standards Agency published a rapid evidence assessment of consumer views on emerging food technologies ²¹. Their review of existing literature found that one of the key themes across the reviewed papers was that views towards synthetic biology in food have some similarities to views towards genetic modification (GM).
36. Several studies note that negative views towards the use of synthetic biology in food follow similar lines to negative perceptions of GM technology. People often cite potential environmental and human health impacts, as well as moral and value-related issues as key concerns about both synthetic biology and GM. The public are also worried about increased control of these technologies by large companies, and their unknown long-term health impacts.
37. However, there is also limited evidence that public attitudes towards synthetic biology might be more ambivalent than they have been towards GM. Research shows that people often refer to a sense of hope when talking about synthetic biology and its potential to address societal challenges such as food security.
38. A study by researchers in China and the UK suggests that rather than being inherently negative or positive, public perceptions of synthetic biology are dependent on the context, such as the product type, portrayal in the media, peer influence, and risk framing ²². This implies that more systematic studies into specific food-related applications of engineering biology are needed to

²⁰ Jin, S., Clark, B. et al. (2019). Synthetic biology applied in the agrifood sector: Public perceptions, attitudes and implications for future studies. *Trends in Food Science & Technology*.

<https://www.sciencedirect.com/science/article/pii/S092422441830863X>

²¹ Food Standards Agency. (2020). A rapid evidence assessment of consumer views on emerging food technologies. https://www.food.gov.uk/sites/default/files/media/document/a-rapid-evidence-assessment-of-consumer-views-on-emerging-food-technologies_0.pdf

²² Jin, S., Clark, B. et al. (2019). Synthetic biology applied in the agrifood sector: Public perceptions, attitudes and implications for future studies. *Trends in Food Science & Technology*.

<https://www.sciencedirect.com/science/article/pii/S092422441830863X>

better understand which factors impact peoples' perceptions of the technology.

39. **Early signs that negative perceptions are shifting:** As most studies on public perceptions of engineering biology focus on the technology itself rather than on specific applications, evidence on how views affect food choices is lacking. One of the themes explored by researchers is perceived anti-GM sentiment, which continues to affect the attitudes of policy leaders and science communities ²³ . These groups often express concerns about the public acceptability of genetic technologies in food production, but there are early signs that attitudes might be shifting. Eurobarometer research shows that between 2005 and 2019, the level of concern about the use of GM ingredients in food or drinks has dropped from 63% to 27% ²⁴ . Similar results were reported by the Alliance for Science (AfS) in their study funded by the Bill and Melinda Gates Foundation. They looked at over 100,000 articles published in English and social media interactions between 2018 and 2020, and found that the overall tone of coverage and conversations about GM was positive, with 73% either neutral or favourable comments.

Recommendations

40. Our research suggests that there are evidence gaps around public knowledge and attitudes to engineering biology.
41. We suggest that Committee considers the following recommendations to improve public engagement with engineering biology.
42. Steps should be taken to update UK-based research on public attitudes to engineering biology to build on the findings we outline above and ensure that any public engagement efforts are evidence-based. This research could include:
- A detailed national survey
 - A public dialogue
 - A citizen jury or workshop
43. The Government and public bodies should jointly develop a public engagement and communication strategy for engineering biology (and the other critical technologies) This strategy could include:

²³ Carter, L., Mankad, A. et al. (2022). Three synthetic biology applications and their paths to impact in Australia: Cane toads, bacteriophages, and biomining microbes. *Biotechnology Journal*.
<https://analyticalsciencejournals.onlinelibrary.wiley.com/doi/full/10.1002/biot.202200009>

²⁴ Food Navigator Europe. (2022). Is the stigma of 'Frankenfood' lifting? Investigating attitudes to GMOs, genetic engineering and synbio in food. Accessed March 2024.
<https://www.foodnavigator.com/Article/2022/10/21/Attitudes-to-GMOs-and-genetic-engineering-in-food>

- How communication and engagement can respond to peoples' views and concerns
- How scientists and engineers can be supported to engage with the public about their work
- How the public can be involved in setting the direction and regulation of engineering biology

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