BBSRC 2023 SCIENCE FUTURES WORKSHOP: REPORT

DATE: 5th APRIL 2023

LOCATION: Virtual

Breakout sessions Chairs: Professor Anne Ferguson-Smith
Professor Joanna Price
Professor Ijeoma Uchegbu

SUMMARY

This report provides a summary of the key themes emerging from the first BBSRC Science Futures Workshop and supporting community consultation. The event aimed to engage members from across BBSRC's science advisory structures (Council, Strategy Advisory Panels, and Committees) to provide a science-led perspective on the direction of travel for UK bioscience and where it can make significant positive impact.

KEY THEMES:

- Bioscience has the potential to make significant positive impact on challenges facing humanity. Net zero, climate change, food security, nutrition, health and wellbeing, antimicrobial resistance and a sustainable future being a few of the areas in which bioscience can underpin or deliver positive change
- Complex problems cannot be addressed by bioscience alone. Increasingly there is need to work across disciplines and advances in technology provide opportunity to ask and address questions we could not before
- Fundamental and blues skies research is essential to develop new bodies of knowledge and tools that will underpin the delivery of future impacts
- Data and its use are a major driver of change in the biosciences. The quality of data, what data we have and where gaps exist, along with the skillsets for analysis are key issues
- Advances in digital technologies are delivering step-changes in our ability leverage insight from data to solve real world problems, create connections, and improve accuracy and objectivity
- Career structures in the biosciences could be reshaped to remove barriers to retention of the workforce and to better enable development of skillsets needed, for example multidisciplinary working, working with industry, working with policy, and building international partnerships
- The pace and agility of the system is a barrier to our ability to respond to opportunities and threats, learning can be taken from the COVID19 response and funders such as Wellcome and the Gates Foundation to improve this
- Risk aversion is an issue within the system, building risk appetite would better enable innovation
- Better interactions and interfaces with industry are required to support and enable translational research
- Building communication and partnerships across disciplines, sectors, and stakeholder groups is vital to enable and deliver science and technology that can address global challenges, and to ensure that bioscience is trusted and valued in the UK
- Better engagement is needed with policy makers to ensure that the development of regulations and policies are underpinned by high quality science.

INTRODUCTION

1. In 2019 BBSRC Council undertook a review of BBSRC's Strategy Advisory Panels (SAPs), the resulting recommendations leading to a refresh of BBSRC's strategy advisory structures, ways of working and membership. A key recommendation of this review was for connectivity to be maintained and strengthened across BBSRC's remit and activities. An annual workshop, with a strong 'bottom-up' focus on science and horizon scanning, discussing emerging opportunities from the research base, was recommended as the optimal vehicle through which BBSRC could build on the cross-cutting expertise held within its advisory structure. The aim of this workshop would be to deliver unique, expert-led, and evidence-based insight into emerging opportunities and issues from the research and innovation base to support the development of BBSRC's scientific strategy.

THE WORKSHOP AND COMMUNITY CONSULTATION

2. The first "BBSRC Science Futures Workshop" was held on April 5th 2023 as a virtual event and engaged chairs and members from all BBSRC Strategy Advisory Panels (SAPs) and Committees. In addition, breakout sessions at the workshop were chaired by BBSRC Council members, ensuring connectivity across BBSRC's advisory structures. The aim of the event was to look beyond existing strategy and consider the direction of travel for bioscience and where it could make significant positive impact. The agenda for the workshop is at Annex 1.

3. In advance of the workshop, BBSRC engaged its wider stakeholder community to provide insight to frame discussions. Through social media, stakeholders were invited to contribute views in answer to the question "Looking forward to 2050, where could bioscience make significant positive impact?". Responses received to this survey are at Annex 2. The workshop was structured to draw out what is evolving and driving change in the biosciences, what new bodies of knowledge might be needed to deliver the impacts referred to in the survey returns, where opportunities or barriers exist, and where partnerships are needed. Attendees were grouped into three breakout groups, each chaired by a member of BBSRC Council. Groups were not divided by expertise; each contained a balance of cross-cutting panel and committee membership as well as sector backgrounds.

WHERE BIOSCIENCE CAN MAKE POSITIVE IMPACT

4. Responses from BBSRC's wider community clearly show that bioscience has the potential to deliver significant positive impact toward addressing many of the challenges humanity faces. In addition to the community survey, workshop attendees were invited to complete a short poll "What headlines would you like to see bioscience making?" outputs of which are at Annex 3. The aim of this survey was to frame thinking around potential future scenarios where bioscience has achieved impact. The following themes emerged from the consultation and poll:

Climate Change

5. Climate change, adaptation to climate change, and the protection of the natural world came through strongly as areas in which bioscience could make significant positive impact. Reversing the impacts of climate change or losses to biodiversity and successfully limiting the rise in global

temperature. Discussion at the workshop noted that public awareness and understanding of climate change had increased leading to more acceptance around the use of biotechnology such as genome editing to provide solutions to environmental and human challenges. The continuation of this would be dependent on consistent government policy and messaging.

Food security

6. Food security and the delivery of sustainable productive agriculture were also themes overarching many of the responses to the survey. Delivering on future food needs through the provision of economically and environmentally sustainable and affordable food for all came through as an ambition. The potential for bioscience and biotechnology to deliver crops that have enhanced resilience and nutrition; effective pest control without reliance on synthetic pesticides; animals with enhanced efficiency and reduced carbon footprints; or the restoration of soils through plants engineered to fix nitrogen or alternative fertilisers were just a few ways through which there is the power to deliver significant positive impact. Interfaces with the environmental sciences were noted as particularly important in this space.

Nutritious Food

7. The low carbon supply and production of nutritious food and its impact on health crosses the interface between fundamental research, agriculture, human biology, and the social sciences. Bioscience was noted to have a significant role in delivering food that is sustainable and nutritious to all. Building understanding of the biology of hunger and food insecurity or the impacts of ultra-processed foods were also flagged as goals. Noting the need for public understanding and support in order to deliver impacts, the need to work with the social sciences was highlighted. A desirable outcome was noted as personalised diets and diets for a healthy population.

Health and Wellbeing

8. Bioscience underpins the delivery of impacts promoting and maintaining health and wellbeing in both humans and animals. ONE health, sustainably balancing and optimizing the health of people, animals and ecosystems came through in the survey responses. Bioscience can deliver fundamental understanding of health that will enable the realisation of increases to healthspan through supporting healthier ageing, better diagnostics, or the delivery of personalised and precision medicine. Critical to this is the development and utilisation of better models of biological function and disorder, from molecular and cellular models to whole organism/environment models. Better access to, and ability to analyse, data was also seen as key to progress; linking data from multiple sources and public records to deliver a comprehensive overview of biological, environmental and social factors that impact on health.

Microbes and Infection

9. The control of antimicrobial resistance was a grand challenge coming through the survey with bioscience having a critical role through delivering both fundamental understanding of resistance and the delivery of solutions to this growing issue. The development of alternative growth promoters, vaccines, novel drugs and anti-infection therapeutics were highlighted as examples where bioscience can deliver solutions. Pathogen genomics and genomic monitoring

was highlighted for its potential to feed into a national infrastructure enabling preparedness and prevention of outbreaks. A role for microbes in the production of clean energy and water and bioremediation was also raised, highlighting the potential of microbial bioscience to play a role in addressing multiple grand challenges.

Bio-based processes and products

10. The bioproduction of energy and fuel helping toward achieving net zero was another area in which bioscience could make significant impact, contributing to the transition from fossil fuels. The use of enhanced photosynthesis to produce bioenergy and capture carbon, and the derivation, testing, and use of novel biomaterials were seen as routes through which bioscience could contribute to the green economy and sustainability agenda. Achieving better recycling of metals and non-biodegradable materials was also highlighted.

Fundamental Bioscience

11. The importance of fundamental and blue skies research was strongly stated. Without solid fundamental bioscience it is not possible to deliver impactful translational research. Blue Skies research generates the next generation of impact and innovation, often in 10+ years' time. The critical value of understanding fundamental mechanisms underpinning life was highlighted. Ion channel biology, electrical fields, a holistic view of organisms, understanding the microbiome, and the origins of life were some examples of fundamental bioscience flagged as interesting and with potential to deliver knew understanding that could lead to positive impacts.

DIRECTION OF TRAVEL FOR BIOSCIENCE: KEY THEMES

12. Using the returns from the community survey to frame discussions, workshop participants considered what was evolving and driving change in the biosciences, what new bodies of knowledge were needed to deliver impacts against challenges and where opportunities and barriers existed. In addition to the breakout sessions, a poll "What are emerging trends or disruptors impacting the biosciences?" was undertaken the outputs of which are at Annex 4. A number of key themes, summarised below, emerged as common themes from these breakout groups.

Multi-/interdisciplinary Research

13. It was agreed across all groups that complex problems and grand challenges cannot be solved by the biosciences alone. There is ever increasing need for multidisciplinary and interdisciplinary working across the biosciences, social sciences, environmental sciences, economic, physical and computational sciences. Researchers need to understand other disciplines and "speak the language" to ask the right questions and direct other disciplines to address problems. Drivers for multidisciplinary working include advances in technology enabling bioscientists to do things previously impossible, for example advances in big data, machine learning (ML), artificial intelligence (AI) and quantum computing leveraging insights at scale, opening new opportunities.

14. Opportunities exist to build understanding and linkages between disciplines. People were considered to be key to this – building multi- and interdisciplinarity into the training of future researchers would create a system that was more agile and able to address big questions. However, it was recognised that multidisciplinary working was not always required in the long-term nor were large multidisciplinary consortia always the answer. There is need to build communication between disciplines to enable conversations that build understanding and foster innovation as and when needed. There also need to be structures and funding available to support these collaborations appropriately, ensuring that researchers can work across disciplinary and funding boundaries.

15. The benefits of working across sectors was also stated, industry often drives innovation and the need for collaboration was noted. In addition, the importance of increasing policy influence was flagged. Building understanding of the benefits of collaboration and engagement with UKRI would strengthen our position in the space. Structural issues both within the community and with UKRI and funders were seen as barriers to delivering impact. It was considered that more flexibility and agility would better enable multidisciplinary research.

Technology Development and Data and Digital Technologies

16. Technology is transforming how bioscience can work. It is developing rapidly, and we can ask and answer questions that we wouldn't have before. Breaking down siloes and utilising tools and technologies from other disciplines brings new approaches and reveals new connections. But a barrier is the development of people with the right skillsets. Biology as a technology and its power to impact other fields should not be underplayed.

17. Data was considered a major driver and opportunity for change for the biosciences. Enormous amounts are being generated and collected at ever increasing rates. There is need to understand what we have enough of and build a culture of examining, sharing, archiving, and reusing data. Where data sits, and the ownership of data is evolving, and consideration is needed regarding how to deal with these changes and the impacts, for example societal concerns relating to storage and use of health data. The need for big data to dock into better experimental understanding of the biological processes impacted was highlighted. A current barrier to progress was considered the need for, and lack of, interoperable datasets. There is also need to raise skills for data analytics, AI etc in bioscience staff.

18. Digital technologies like AI., machine learning and quantum computing are delivering step-changes in our ability to crack problems and draw and exploit insights from data. Quality and standardisation of data was raised as a concern, the outputs of AI are only as good as the inputs. Most researchers are trying to work out how to use these technologies and understand their limitations. Machine learning was flagged as an important tool to see if data are relevant, providing cleaner datasets. Tools such as ChatGPT were also highlighted for their potential to find connections to areas of research through insights from AI that wouldn't be achieved by human networking. However, caution was expressed as these tools are trained using existing data and not the data we would like to have. Quality data was again highlighted as critical.

19. Automation was considered to be an opportunity, leading to better accuracy and objectivity, producing higher quality data. Designing experiments on a computer and having robots undertake the work and return the data was also flagged as a means of democratizing biology. Not everyone has to have all the kit, reducing cost.

20. Other technologies highlighted included augmented reality for its power to allow researchers to perturb systems and imagine potential changes to the entire system, and the ground-breaking Alphafold demonstrating the power of digital technology to deliver answers to some of biology's most pressing questions and deliver real world impact.

System, Funding Environment, People and Culture

21. The pace and the agility of the system, both within UKRI and wider, was considered a barrier to bioscience. The time from application to delivery being too long. There is a new funding service platform under development at UKRI which is simpler and should benefit applicants, reviewers, panels and UKRI. However, it was noted that UKRI has responsibilities around managing taxpayers' money and there is need to ensure that money is invested through robust and transparent processes. Bureaucracy at Universities was also flagged as a factor affecting the system. Ways of reducing bureaucracy and reducing burden on the community should be explored. One example suggested being to more frequently utilise expression of interest stages in calls enabling failing early and small. Learning should be taken from the COVID19 response and also from Wellcome, DARPA and the Gates Foundation who have successfully reduced the review and award processes.

22. A national culture of risk aversion was considered to be a fundamental issue. Risk and how to appropriately consider risk within funding mechanisms needs be reviewed. High-risk/ disruptive science is disincentivised in the system. New schemes such as the Pioneer awards were beginning to address risk aversion and ARIA was also aiming to be less risk averse. Building a culture of accepting risk requires balancing the potential of research against the risk and acceptance that while a project may not achieve its end point as outlined in the original grant if knowledge is generated and shared there is progress. Building in ways to change research direction within projects would be beneficial and reframing thinking around failure. Discussions also covered the way Committees and Panels considered risk and fundamental, multidisciplinary, applied, and biotechnology. It was suggested that this could be reviewed to ensure that areas or types of science weren't disadvantaged in the system.

23. Careers and career pathways in the biosciences were considered an area in need of consideration and reshaping. With increasing need to work in multidisciplinary ways, people are struggling to find opportunities to develop a broad skill set and move between sectors. Learning could be taken from industry (eg Google) which is leading the way in recognising and rewarding multidisciplinary research structures. Suggestions were made of increasing the length of fellowships or introducing fellowships for the development of collaborations (across all career stages). Providing early career researchers (ECRs) with time to step out and undertake independent thinking or building of skillsets moving away from having to be hypothesis driven when presenting a research proposal would help idea generation and empower ECRs. In

addition, considering the structure of awards for new investigators, for example including the ability to have co-investigators would help build collaborations. Length of contracts for post-docs were also seen as a barrier to keeping individuals in academia. Engagement in schools by scientists (undergraduates, PhD students, and post-docs) conveying the excitement and non-linearity of science will help attract a wider range of people into science. Concerns were also raised about diminishing numbers of experienced technicians to handle specialist pieces of equipment and more generally a loss of workforce.

24. The stability of the political environment and its impact on bioscience was raised. Short term cycles, geopolitics, and the movement of people were all discussed as factors impacting on bioscience and the UKs ability to attract global talent. There needs to be strong messaging that bioscience is valued. Bold approaches and longer programmes require stability. Bringing policy makers to the table and ensuring that they use data to inform decision making and build understanding of the potential consequences of emerging policies could help. Science should help shape policy and regulations. It is crucial that the research agenda keeps up with technology and the challenges that science could address. There is need to build a culture of global horizon scanning to identify emerging issues and make links to emerging technology solutions, enabling agile science application.

Collaboration and Partnership

25. Better interfaces and interactions with industry are required to support translational research. There is opportunity for UKRI to improve the agility and pace of funding mechanisms to remove barriers to interactions with Industry and Small and medium-sized enterprises (SMEs). The current speed of moving from concept to application can mean that results are not available in timescales that are relevant to industry pressure points. Better understanding is needed of barriers in the path to translation. Integration of flexible funding into all grants for mobility to different areas such as industry, policy etc.could be beneficial. The need for better training for scientists around how to work with industry, how to translate research, early stage concepts into market, industrial requirements and scalability was also a cross-cutting theme. With respect to commercialisation, IP agreements, and licencing of research, participants discussed issues with different institutions having differing requirements, creating a barrier to industry engagement. It was questioned whether UKRI could have a role in developing model contracts or frameworks.

26. Science is global and we need to foster international partnerships and work with the world-leading consortia to address global problems. Interaction with people across the world with diverse backgrounds helps inform on the science we need to do – not all will have the same access to resources but will bring direct access to the knowledge / key aspects of research required. Again, lessons learned from COVID19 vaccine development were highlighted. It was recommended that the UK engages with the USA with respect to the recent US biotechnology agenda, there was the potential for this to drain resources and knowledge from elsewhere in the globe. There is opportunity to encourage biomanufacturing in UK rather than going overseas. Concern was expressed over the decreasing attractiveness of UK research positions to EU nationals and the reduction in scope for international experience for early career

researchers. International experience, for example through visiting fellowships, is important.

27. The need to work across UKRI in order to enable multidisciplinary research was discussed. Suggestions of pooled funding models at a UKRI level, rather than just co-funding, were put forward to help solve big problems with fewer barriers. It was considered that effective mechanisms aren't there yet. Working more closely in partnership with InnovateUK at an early stage, for example through cofounding where there is a spinout opportunity, could create more efficiency in exploitation.

Stakeholder engagement and Impact

28. There has been a shift in public understanding and awareness of science and its role in addressing societal issues such as climate change and pandemic prevention and responses and this should be harnessed. Consumer expectations are aligning more strongly to grand challenges and there is greater emphasis on sustainability (reduced waste; not off-shoring environmental impacts; an increasing interest in animal welfare; synthetic meats). Acceptance of the use of science and technology for example gene editing is increasing. However, negative press is still impacting on the adoption of new technology. The recent example of media coverage of potential risks of AI was highlighted as concerning. We must bring society along with technology development – consider those affected and how they might be engaged. Collaborating with the social sciences and psychology to improve public adoption of recommendations and technologies is required. Providing stakeholders with more explanation of regulation processes could also give reassurance regarding the underpinning science.

29. There is need to communicate positive impacts of research, working with the media to convey the importance of bioscience and what it can deliver for society and the economy. Regulators and policy makers need to be kept continually aware of the value of good science, building on the learnings achieved during the COVID experience. There is political interest in boosting R&D investment, but other worthy priorities compete for investment. Those advocating for bioscience and research and innovation more broadly must engage with the public on the societal value of investing public funds.

30. It is important to build understanding of innovation and impact in a broad sense. Recognising that impact is a major driver of innovation and not just the consequence. Clearer definition of impact was considered important. Building impact into training for post-docs, academics etc. was suggested as a positive step. In a number of discussions, the removal of the “Pathways to impact” statement from grant applications was stated as unfortunate and there was support stated for this being reintroduced. Fundamental science can be framed in terms of the knowledge it delivers, possible future impacts, or its potential to re-write what we already know about more challenge level areas. Ensuring that fundamental and blues skies research was labelled as such was noted as important in order to justify spend. CRISPR was considered a good example, demonstrating the trajectory from blue skies research, without direct impact, to transformational impact in most areas of science. Often the biggest impacts are seen ten years down the line and are not directly evident at the point of ideation.

Annex 1

BBSRC Science Futures Workshop: Agenda

10.00 – 10.15 Introduction

Amanda Collis, Executive Director Research Strategy and Programmes

10.15 – 11.00 Breakout session one

Facilitated by BBSRC Council members Professor Anne Ferguson-Smith, Professor Ijeoma Uchegbu, and Professor Joanna Price.

To help frame discussions, a survey was run with BBSRC's external stakeholders asking, "Looking forward to 2050 where do you think bioscience could make significant positive impact?". A summary of returns is at Annex 2 and the full return will be available for viewing on the Miro board.

Discussion points:

What's evolving / changing for the biosciences?
What is driving the changes?
What new bodies of knowledge are required to deliver impacts?

11.00 – 11.15 Break and Mentimeter poll:

"What are emerging disruptors or trends impacting the biosciences?"

11.15 – 12.00 Breakout session two Facilitated by BBSRC Council members Professor Anne Ferguson-Smith, Professor Ijeoma Uchegbu, and Professor Joanna Price

Discussion points:

What are the opportunities for bioscience?
What are barriers / gaps that affect the ability of bioscience to deliver impact?
Who else should be working with?

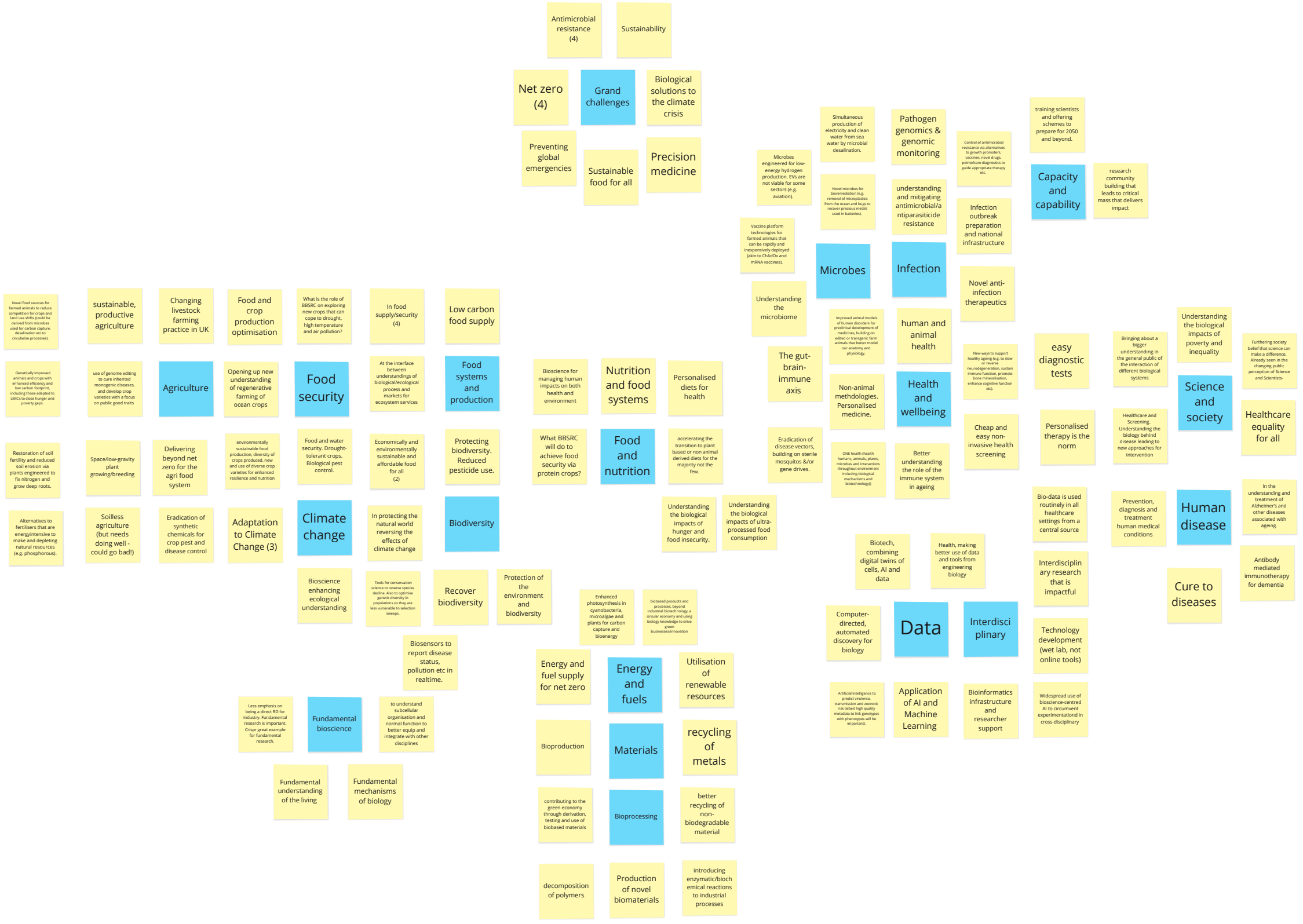
12.00 – 12.15 Break and Mentimeter poll:

"In 10 years' time, what headlines would you like to see bioscience making?"

12.15 – 12.55 – Plenary discussion Reflections on cross-cutting themes and open discussion

12.55 Thanks and Close

Annex 2: Outputs of BBSRC community consultation "Looking forward to 2050, where could bioscience make significant positive impact?"



Annex 3: Workshop poll results
'In 10 years' time, what headlines would you like to see bioscience making?'

MacDonalds Happy Meal offering nutritional dense low cost meal that actively reduces type 2 diabetes	First saltwater wheat grown in salt flats in East Anglia	Resilient crops reduce global hunger	UK Scientists develop: personalised gene therapies based on RNA structure function research	Biobased materials that sequester carbon and provide safe building in earthquake zones	what the gut microbiome actually does	We have reduced the gap in healthy life expectancy (20 years gap in 2023) between poorest and richest citizens via a mission-based approach involving sciece, tech, investment, govt &other key groups
All industrial commodity materials/products are manufactured from renewable free/v v cheap power and above ground CO2 as feedstocks (not oil/gas like today) with biology.	Antimicrobial resistance threat reduced through global action	Bio manufacturing takes over - oil production stopped	Biobased value chains for new chemical entities that displace petrochemicals	Bioprocessing/synthetic biology replaces the use of fossil fuels in manufacturing.	Bioscience discoveries underpin the revolution in personalized medicine and the ability to undertake at-home testing.	Bioscience solves human, animal and fish health disease challenges faster and better
Breakthroughs in crop science leading to greater use of residual crop biomass from food crops (e.g. chemicals)	Citizen science stopped Disease X in its tracks	Climate change global temperature increase limited to 1.5C	Contractual agreements pre-agreed and pre-approved prior to multi-organisation grant application	Farmed seafood creates protein from nothing	From Peas to Humans-- how understanding heat stress in peas shows how humans can survive climate change. International Collaboration on Human Data transforms scientific community,	gene therapies for every genetic disease
General public much more accepting that advances in biotechnology are safe	Global pandemics averted!	Happy birthday! Patient's implanted organoid now in 10th year, still functioning and delivering relief from illness completely safely.	Healthspan match lifespan	healthy diets which use best crop science/biofortification to deliver safe nutritious food to those who need it most - and which promotes healthy ageing - physically and cognitively	Human health advanced by biological breakthroughs in fish farming	I would love to see examples of major societal impact which can be clearly traced back to fundamental research!
implantable sensing cells maintain wellness throughout the life course	implanted sensing cells prevent disease	Knowledge of the structure/function of every protein	Long term Investment in platform technologies being realised and valued. I.e. as was seen in the vaccine devs.	Low cost, low environ impact and equitable supply of food and nutrition is available to all humankind.	Major advances in personalised diet advice	Net Zero achieved due to bioscience
Nutritious Food is medicine	Online next day doorstep delivery of pill/medicine for one time dose to cure any cancer	Protecting the planet better.....removal of plastics, sustainable food. Better quality of life in last years of life.	Real influence in Net Zero gains or sustainability. With demonstrated strong potential for the years beyond 10.	Robots find the cure for cancer	Routine use of AI underpins huge increase in research productivity and innovation as researchers are freed to think!	Safe, secure and sustainable food from innovation
Solutions not problems	Technical career pathways on a par with faculty roles	The Good Life: London breaks even on self-generated food supply (also with net zero energy use)	Time from grant application to funding approval within 2 months	Translational technologies that fundamentally change the way we can do science/discovery. As NGS has done.	UK self-sustaining in food production	understanding of the ageing brain and how to treat dementia

Annex 4: Workshop poll results
'What are emerging disruptors or trends impacting the biosciences?'

public perceptions of advances in biosciences

Modelling real biological systems as the holobiome (not just a single model organism)

Chat GPT and related AI technologies

Data

Quantum computing

climate change; impact of (poor) diet on health; sustainable food production/food security; behaviour change

Ensuring research itself trends towards being NetZero.

mobility of talent from biosciences to other sectors may be a challenge BUT it can also have a positive impact through enhanced awareness, collaborations and connectivity between sectors.

AI and ML drives the need for rich, high quality big data from high-throughput methods, likely coming from novel disruptive technologies

multiplex DNA synthesis - no need to clone or design everything perfectly

Intensification of agriculture (and people) living in closer proximity to each other

AI, specifically ChatGPT

real time big data and the feedback loop

AI/ML - having data that is ready to be used to effectively train models. Determining where best to apply AI and how to interpret its output

AI- as mentioned, it has been around for a while, but recently, there have been step changes in impact (ChatGPT, Alphafold, etc.)

Cross scale experimental technologies will impact depth and breadth of data generation and challenge single investigator models work

the real need for solutions for the climate crisis particularly the development of sustainable food production and healthy diets

Movement away from protein therapeutics to genomic modalities including mRNA and gene therapeutics

Climate change is the number 1 disruptor which it is imperative that we address in multiple ways: regenerative agriculture, clean manufacturing etc- but we need multidisciplinarity to get ther

Climate Change/Breakdown
Food Security
Biodiversity Loss
Biological sciences for clean technologies/manufacture

Scaling up technologies to allow the development of biobased products

Increasing health inequalities and global conflict/climate change risk overpowering anything the biosciences can achieve

Climate change

Emerging evidence that invertebrate animals and plants have behavioural and cognitive abilities that were previously believed to be restricted to vertebrates.

Animate materials. Constructed materials that are sensitive to their environment and are based on/inspired by living materials

The emergence of frontier technologies including AI, quantum computing and systems biology that can leverage insights at scale taking an interdisciplinary approach to solve big societal challenges

Real world, real time data streams

cost of living / brexit making it harder to attract and retain talent in academia

Tech.
eg machine learning/AI (eg alpha fold for structural biology), human iPSCs, RNAseq, precision targeting, Fund more high risk!

Interdisciplinarity is going to have a positive impact on the biosciences. We have to be humble and appreciate what other disciplines have to offer.

Multidisciplinary research, AI, Engineering Biology

Unaffordable energy

Cell imaging

lack of capacity relating to skills shortages in key areas.

AI and machine learning (ML) - the ability for Biologists to understand what is and isn't achievable by working with these technologies will be crucial. They are no a panacea.

AI , generative pretrained transformer models.

AI and math/ data analysis