BBSRC bioscience for the future

EPSRC Pioneering research and skills

sciencewise EXPERT RESOURCE CENTRE

Synthetic Biology Dialogue

Overview

Summary: Synthetic Biology Dialogue

Synthetic biology is an emerging area of science and technology. It uses developments in engineering and bioscience to create biological parts, or redesign existing ones for new tasks. Scientists are also finding new ways of using existing materials. Examples include biofuels and anti-malaria drugs made by microbes like yeast or bacteria.

Progress in the field has been significant. Researchers have built on advances in DNA sequencing and DNA synthesis and now have powerful tools to study, engineer and assemble genomes. This potential though gives rise to a host of questions around ethics, social justice and bio-security. The Biotechnology and Biological Sciences Research Council (BBSRC) and the Engineering and Physical Sciences Research Council (EPSRC) initiated a project to develop a dialogue with the public, stakeholders and scientists about these groups' concerns and aspirations for this field.

This is a summary of some of the key findings – a full copy of the report which details the full findings can be found at **www.bbsrc.ac.uk/syntheticbiologydialogue**

About the Dialogue: Aims and Objectives

The project took place during 2009-2010 and included workshops in London, Edinburgh, Newcastle and North Wales. Researchers devised a total of three different workshops and each was convened at all of the four locations. Overall, 160 members of the public were recruited to take part in these sessions, 40 in each of the chosen locations. Researchers also carried out 41 interviews with stakeholders including consumer groups, industry and scientists. These interviews focused on the science and issues surrounding synthetic biology. The overall aim of the research was to enable people to articulate their diverse views clearly and in public. This is so future research and policies can better take account of these views.

Synthetic biology: Summary of Findings

It is important to state this is an overview. The full report goes into detail on the contrasting views between participants, especially between different stakeholders. A firm consensus on a given issue was rare, even within a particular stakeholder group. It would also be wrong to assume the public was either for or against the technology.

Public and Stakeholder Views

When considering science and technology, people expressed support for progress but they also believe developments in biotechnologies and genetic sciences push moral boundaries and might widen the rich/poor divide.

Overall, synthetic biology is regarded as both exciting and scary by the public. A specific concern among participants is it could impact on our relationship with nature. They feel artificial entities have less intrinsic value than natural ones. **Scientists and engineers often feel this idea of creating nature is an unhelpful way of viewing their work**. Stakeholders are aware that there are potential risks with synthetic biology and that regulation is needed. But many risks are currently unknown so any comprehensive 'assessment' is difficult.

The dialogue report shows that stakeholders are apprehensive at the lack of clear 'boundaries' around what is acceptable for the potential applications of synthetic biology. The public has clear concerns about the potential risks involved with the release of synthetic materials into the environment and use of the internet to order materials.

The public sector is identified as the main funder for synthetic biology, especially the research councils. Though stakeholders accept that development of the technology will involve private funding, some participants fear researchers 'getting into bed with business' and innovations being taken in directions less beneficial for society.

'The root of it is respect for other people's views; we need to find the balance between respect, and holding on to being scientific.'

Scientist/Engineer

Stakeholders do support robust regulation which also allows for legitimate innovation and progress. For the public, the need for effective regulation and control is one of the most important issues - they do not believe scientists should self-regulate.

The report highlights people's desire to be more involved in the development of synthetic biology. However, some scientists are anxious about the level of this involvement.

Questions for scientists involved in synthetic biology

A key conclusion from the report is that synthetic biology scientists must be encouraged to think through the responsibilities of their work more robustly.

The central questions for synthetic biology that emerged from the workshops were:

- **What is the purpose?**
- **Why do you want to do it?**
- **What are you going to gain from it?**
- **What else is it going to do?**
- **How do you know you are right?**

Applications of Synthetic Biology: the Public View

During the workshops, participants discussed and explored developments in several application areas where synthetic biology could be applied, including medicine, energy and biofuels and the environment.

Medical

Potential therapies - The public and stakeholder responses were relatively positive to the medical application of synthetic biology such as in vaccine development. But views vary according to whether applications would be used in the lab to produce drugs for example or used 'in-body'. Drug development has slowed in recent years and some stakeholders raised synthetic biology as a possible way to speed up delivery of new treatments.

Bio-safety - Stakeholders highlighted possible concerns in this area as did the public who feared the potential for deliberately creating new diseases. The public see any risks/benefits in medical application areas as mainly a choice for the individual, though recognise the need to consider the wider public interest.

'…what are they arguing about? If it saves someone's life…I know if anything was there that could make my child's life better, I would take it. I would grab it.'

Female participant

'In ten years we will be making synthetic proteins, which will have the potential to be as important as the development of small molecules in creating what we now call drugs.'

Scientist/Engineer

Energy and Biofuels

Clean energy - Many stakeholders feel the production of biofuel, as an alternative to fossil fuel, is an environmental, economic and social imperative. But the public see synthetic biology as just one approach among many, although they do perceive its health/environmental impact may be lower than other methods.

Land use - Significant concerns were raised by stakeholders over the potential of biomass crops to compete with land needed to grow food. A key condition from the public is that synthetic biology should focus on using agricultural materials which are currently wasted and not place greater pressure on arable land.

Applications of Synthetic Biology: the Public View

Environment and Agricultural

Bioremediation - Public participants discussed the potential for synthetic micro-organisms to clean up the environment. The concern is that creating problem-solving organisms, could mean the cause of that problem is ignored or could even create more problems in the future. This view is shared by stakeholders who viewed deliberate release of synthetic organisms as more controversial than contained processes.

Access to food - Synthetic biology was viewed initially by the public as a tool to tackle food scarcity. But concerns exist that large corporations could patent developments, create monopolies and leave developing countries dependent on the West. Stakeholders believe applications in this area are inevitable in the face of climate change and increasing global demand for food.

GM - Stakeholders drew parallels between synthetic biology and genetic modification. They anticipated agri-environmental applications would be the most controversial area for the public. Some expressed frustration that public concerns were holding back work on GM crops but did acknowledge that uncertainties remain.

'Do you want to eat these vegetables when they're pumped full of chemicals? We don't know what's in there; we don't know what they're going to do to us.'

Female participant

Synthetic biology: the Different Views between Stakeholders

Any firm agreement among stakeholders on a given issue was rare, even within particular groups.

The report highlights the difference, for example, in views on how novel the field of synthetic biology is. Scientists in particular are cautious about 'over-defining' the field. There is also a perception among scientists and social scientists that academics are 'rebranding' their research as synthetic biology to attract funding.

The findings also reveal that scientists see their own work as 'unremarkable.' This contrasts sharply with the field as a whole which they see as transformative. They also perceive the field is moving forward without much industry involvement. But social scientists, NGOs and consumer groups point to the increasing interest in synthetic biology from large corporations.

Stakeholders also vary in their levels of enthusiasm for discussing possible applications. Social scientists believe the field's potential has been over-hyped. Consumer groups feel it is important to be involved in the debate on synthetic biology as early as possible, before products become available. Regulators, consumer groups, faith groups and NGOs say they prefer to consider applications on a case by case basis.

Overall, stakeholders are positive about the value of public engagement. However, there is some anxiety among scientists about how much influence public input should have on funding priorities. Funders feel public engagement will be simpler when the field is more established and applications are more tangible.

On the issue of regulation and control, there is a lack of consensus on the adequacy of current regulations. Some scientists express a preference for bottom-up regulations led by the experience and needs of researchers. Consumer groups suggest independent labs could test products before they go to market. NGOs emphasise the importance of integrating social, economic and cultural risk factors into any risk assessment.

Synthetic biology: Dialogue Conclusions

'With regard to the risks, I think without taking the risks we would not be where we are today. There are so many things we have discovered by just throwing this in a pot and seeing what happens. It could be too regulated and could be missing out on many things.'

Participant

There was conditional support for synthetic biology: there was great enthusiasm for the potential of synthetic biology, but fears about control, who benefits, health and environmental impacts, misuse and regulation. Overall, six key themes emerged:

The Technology

- A tension exists over the application of engineering principles to biological systems. There is unease about living in a 'synthetic' world where evolution was 'speeded up' and biological parts produced on an industrial scale.

- Creating life is considered acceptable when balanced with the benefits of synthetic biology and that this is done with humility.

Leadership and Funding

- Research Councils are seen to have a key role. However, there is concern that funding of 'good science' focuses on technical excellence and could sideline ethical issues. The grant process needs reviewing with more effective checks/balances on applications.

- The public want the opportunity to feed in their aspirations and concerns at an early stage and for Research Councils to make the science accessible.

- It is fundamental that Research Councils appoint the right leaders, in the right place and for the right reasons in relation to synthetic biology development.

Responsibility

- There is a disconnect for scientists/engineers between the unremarkable nature of their own work and the transformative nature of the field as a whole. This highlights the need for scientists to think more carefully about the significance of their work, their motivations for research and to develop greater responsibility.

- People expect that some work in synthetic biology will go wrong, so scientists/regulators should not claim to know everything. Scientists need more support in understanding potential impacts and in being more open about early research findings.

Innovation

- There is a need for an alternative to the 'pipeline' model of innovation where ideas are created in a lab, embedded in products and distributed to consumers. The public should be involved throughout, not just at the end.

- The innovation process needs to be more 'thoughtful'. Research Council leaders, learned societies, universities and Government should ensure research and new developments are informed by social values, not just led by technology.

Regulation

- Robust and independent regulation is key, the public did not trust a voluntary or self regulation system. There were concerns over the ability of the current framework to deal with novel organisms.

- International co-ordination and regulation to control technology development and access in global markets is a major challenge. Controls need to mitigate deliberate misuse , such as bio-terrorism.

The Future

The report has begun to identify key public aspirations and concerns around synthetic biology and has asked questions of those developing the field. Research Councils now have a duty to continue engaging with participants and explain how some of the conditions they have placed on the research have been met.

Background to the Dialogue

The BBSRC's Bioscience for Society strategy panel set up a working group in 2006 to look at issues around synthetic biology. Chaired by Brian Johnson, the working group commissioned the Balmer and Martin report (published May 2008). This made a series of recommendations including the need for better controls.

A meeting was convened of key regulatory bodies to re-examine the robustness of existing frameworks which applied to synthetic biology. They concluded that most developments would be covered by controls that already govern GM.

Around this time, The Royal Academy of Engineering independently commissioned a small scale public dialogue around synthetic biology.

The Engineering and Physical Sciences Research Council (EPSRC) also looked at the field of synthetic biology through its Societal Issues Panel (SIP). This led to plans in late 2008 for a public engagement process - or dialogue - organised by the EPSRC and BBSRC with support from Sciencewise-ERC. A steering group was set up to advise the Research Councils on appropriate methods, timings and scales. This group recommended that an oversight panel be established to ensure the dialogue complied with best practice.

The aim of the dialogue was to engage with the widest range possible of stakeholders and the public to inform policy making. The contract to deliver this dialogue was awarded to researchers TNS-BMRB and Laura Grant Associates was appointed as the independent evaluator.

About BBSRC and EPSRC

- **In total they invest over a billion pounds of public money annually in the engineering, physical sciences and biosciences.**
- **Improving quality of life in the UK is the strategic focus of BBSRC and EPSRC.**
- **They have already established seven Networks for Synthetic Biology across the UK, as well as the Centre for Synthetic Biology and Innovation at Imperial College London to assist with communication and networking between researchers.**

The Biotechnology and Biological Sciences Research Council (BBSRC) is the UK funding agency for research in the life sciences. Sponsored by Government, BBSRC annually invests around £380 million in a wide range of research that makes a significant contribution to the quality of life for UK citizens and supports a number of important industrial stakeholders including the agriculture, food, chemical, healthcare and pharmaceutical sectors.
http://www.bbsrc.ac.uk/syntheticbiologydialogue

The Engineering and Physical Sciences Research Council (EPSRC) is the main UK government agency for funding research and training in engineering and the physical sciences, investing more than £850 million a year in a broad range of subjects – from mathematics to materials science, and from information technology to structural engineering. **www.epsrc.ac.uk**

BBSRC and EPSRC are part of the Research Councils UK partnership (RCUK). **www.rcuk.ac.uk**

Sciencewise-ERC is a Department for Business, Innovation and Skills funded programme to bring scientists, government and the public together to explore the impact of science and technology in our lives. It helps Government departments and agencies commission and use public dialogue to inform policy making, involving science and technology issues. Its core aim is to develop the capacity of Government to carry out good dialogue, to gather and disseminate good practice, have successful two-way communications with the public and other stakeholders, and to embed the principles of good dialogue into internal Government processes.
www.sciencewise-erc.org.uk

February 2011

Produced by RCUK's internal service provider