ENGINEERING AND PHYSICAL SCIENCES RESEARCH COUNCIL

# Synthetic Biology at EPSRC and Opportunities for Researchers

Susan Soulsby

EPSRC

Engineering and Physical Sciences Research Council

# Today's Presentation

- The Research Councils
- Synthetic Biology and EPSRC
- The Current Research Portfolio
  - Applying to EPSRC & Signposting
  - Capacity building
  - Current and future activity
- Public dialogue
- Summary

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# The Engineering and Physical Sciences Research Council

- We are the main UK government agency for funding research and training in engineering and the physical sciences,
- Investing more than £800 million a year in a broad range of subjects – from mathematics to materials science, and from information technology to structural engineering.

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# Synthetic Biology and the Research Councils

The Research Councils consider Synthetic Biology as:

- an emerging multidisciplinary area,
- at the interface of many different research areas,
- an area which has the potential to raise significant ethical, legal and social issues.

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# Why does the Engineering and Physical Sciences Research Council support Synthetic Biology?

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# EPSRC and Synthetic Biology
## The EPSRC definition

- The design and manufacture of biologically-based parts, devices and systems that do not exist in the natural world as well as the redesign of existing, natural biological systems
- Research should apply the principals and tools of engineering to biological systems

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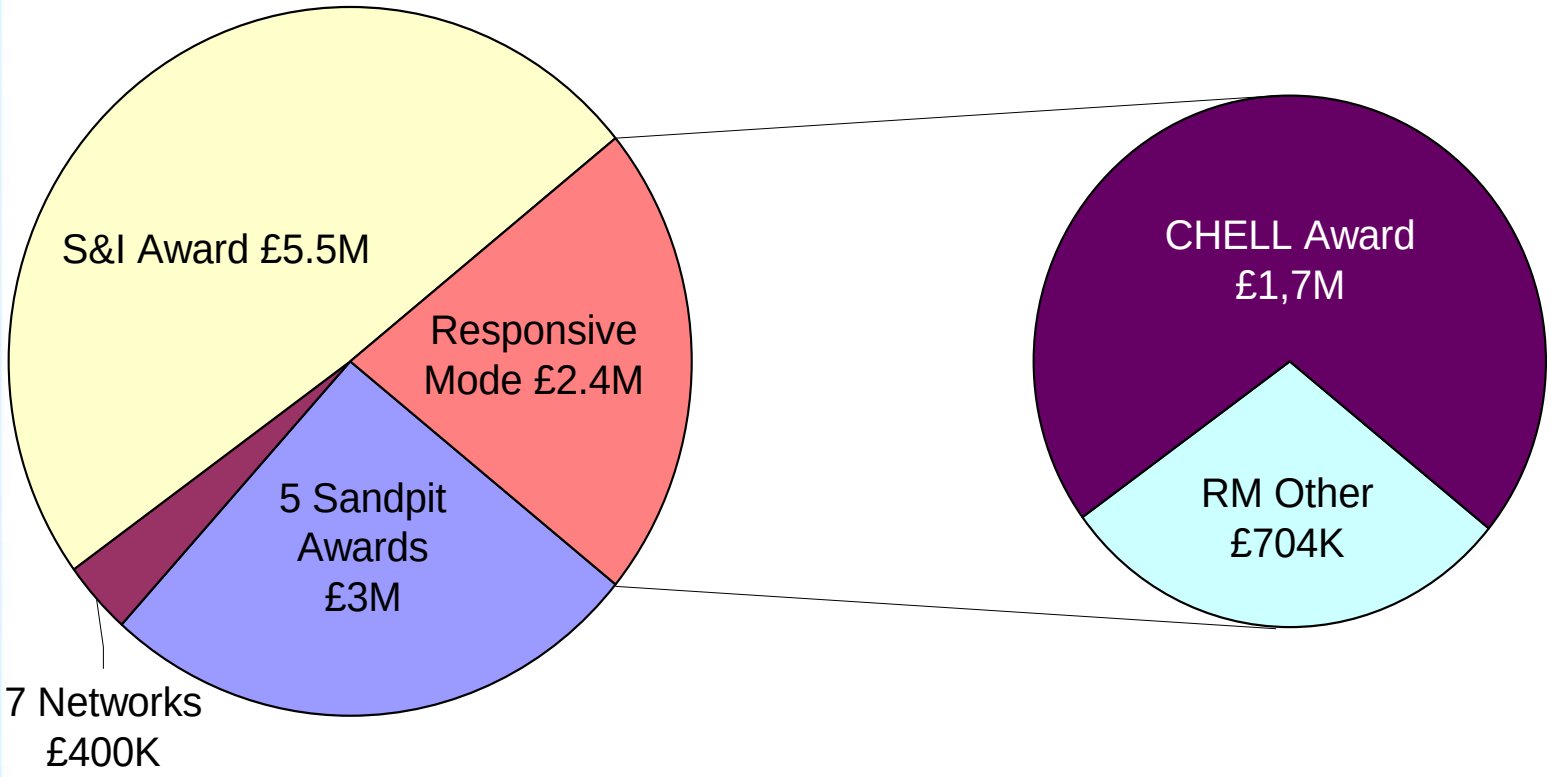
# Synthetic Biology, EPSRC Portfolio

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# Synthetic Biology

Linking bioscience, engineering and computer sciences to develop rationally designed biological parts, devices and systems.

bbsrc

## Ethical and other societal issues

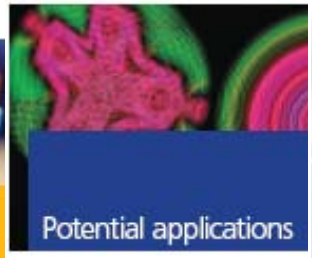
It is very important that ethical and other social issues are identified at this early stage in the development of Synthetic Biology, before new products and processes are made, so that research funders and researchers can take these into consideration.

In 2007, BBSRC's Bioscience for Society Strategy Panel established a working group to consider the societal issues raised by Synthetic Biology. The group commissioned an independent review of UK Synthetic Biology and its broader social context, *Synthetic Biology: Social and Ethical Challenges* by Andrew Balmer and Paul Martin of the Institute for Science and Society, University of Nottingham.

We are using the findings of this review (www.bbsrc.ac.uk/society/ethics/synthetic_biology.html) to inform our policy and funding decisions and to help us to raise public awareness and stimulate constructive public debate. We are working closely with EPSRC, AHRC, ESRC and other bodies within RCUK, with BBSRC focusing initially on working with Government advisory committees and others to ensure that the UK regulatory framework can provide robust safeguards while taking Synthetic Biology forward safely and responsibly.

**The review by Balmer and Martin drew attention to several issues, including:**

- intentional or accidental release of synthetic organisms into the environment
- misuse of synthetic organisms e.g. to create biological weapons
- a need to employ the precautionary principle
- commercial race to synthesise and privatise synthetic life forms
- current patent law may stifle collaboration and development, and overcomplicate the patent process
- perceptions of scientists 'playing God'



## Potential applications

Some of the earliest applications of Synthetic Biology are likely to be in 'second generation' biosensors and diagnostics for use in bio medicine and environmental monitoring and protection. In these cases, Synthetic Biology will be providing an expanded 'tool box' that enables existing genetic or protein synthesis and manipulation at the level of individual molecules to be conducted more quickly, and across a wider range of applications than currently possible.

**Projected areas of application include:**

- Novel and improved diagnostics, vaccines and biopharmaceutical drugs
- Biosensors
- Hydrogen fuel cells
- New cell biofactories
- Microbial communities for environmental clean-up
- New biomaterials
- Programmable cells for use in gene therapy
- New biofuels
- New food ingredients

At the level of individual cells, Synthetic Biology will provide new capability for scientists to ramp-up what can be done at the moment in terms of the profile of products, and to increase the efficiency of producing high-value compounds. This is expected to improve existing processes for manufacturing biopharmaceuticals. Longer-term, researchers might be able to add their own building blocks to core materials such as nucleic acids and proteins to produce novel products.

Advances in understanding and manipulating cell-to-cell signalling will offer new opportunities to use Synthetic Biology to build simple communities of cells, for example, to make scaffolds and biofilms, for example for use in new materials, for environmental clean-up and filters, and to make cell cultures as feedstocks for production of biopharmaceuticals, other high-value bioproducts and energy.

**"Synthetic Biology offers new tools for research and a new framework for biotechnologies. Until now, biotechnological and biomanufacturing processes have been confined largely to the use of single genes or proteins in bespoke applications, each requiring its own specific set of tools and reagents. Synthetic Biology brings the prospect of universal tool kits and interchangeable components combined to construct biological pathways and more complex systems, including artificial cells. An example is the potential to design and produce biological fermentation processes that can convert non-edible parts of food crops and wastes into energy."**

Professor Nigel Brown, BBSRC Director of Science and Technology

The Biotechnology and Biological Sciences Research Council (BBSRC) is leading national efforts to increase UK capacity and competitiveness in Synthetic Biology – where the research market is predicted to rise to £1.8bn in the next 10 years.

In partnership with the Engineering and Physical Sciences Research Council (EPSRC), we have established 'Networks' for Synthetic Biology around research groups at the universities of Bristol, Durham, Edinburgh, University College London and Birkbeck College, Nottingham, Sheffield and Oxford. These take forward the science, and ethical and social issues surrounding its applications, the latter supported by funding from the Arts and Humanities Research Council (AHRC) and the Economic and Social Research Council (ESRC).

BBSRC is also leading the UK in Europe through TESSY (Towards a European Strategy for Synthetic Biology), a collaborative activity for developing Synthetic Biology across the EU.

BBSRC-supported early career scientists participate in the International Genetically Engineered Machine (iGEM) competition, an MIT (Campus) programme initiative, in the USA funded by Microsoft Corp. (http://igem.org).

For further information contact
Dr Amanda Collis (amanda.collis@bbsrc.ac.uk) or
Dr Sophia Abbasi (sophia.abbasi@bbsrc.ac.uk).

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BBSRC bioscience for the future

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## Bristol - Synthetic Components Network: Towards Synthetic Biology from the Bottom Up

**Leader: Professor Derek Woolfson**

## UCL, Birkbeck College - The UCL Network in Synthetic Biology

**Leaders: Professor John Ward and Dr Irilenia Nobeli**

## Nottingham - A Synthetic Biology Network for Modelling and Programming Cell-Chell Interactions

**Leader: Dr Natalio Krasnogor**

## Oxford - From Robust Synthetic Biological Parts to Whole Systems: Theoretical, Practical and Ethical Challenges

**Leader: Professor Antonis Papachristodoulou**

## Durham - A Network for Synthetic Plant Products for Industry

**Leader: Professor Robert Edwards**

## Edinburgh - Standards for the Design and Engineering of Modular Biological Devices

**Leader: Dr Alistair Elfick**

## Sheffield - Microbial Applications to Tissue Engineering: An Exemplar of Synthetic Biology

**Leader: Professor Phillip Wright**

# Synthetic Biology Signpost

Who knows about signposting in responsive mode?

Who here has thought about submitting to the signpost?

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# Synthetic Biology Signpost
## - does you research have the potential to

- create novel biological products and functionality that do not exist in nature?
- formulate existing biological products and functionality in improved ways?
- improve our understanding of biological systems through research into the role of modularity in biology?
- help validate the predictive models developed in systems biology?
- develop tools and resources to support biological research?

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# Synthetic Biology Public Dialogue

- EPSRC and BBSRC, with funding from Sciencewise Expert Resource Centre, have commissioned the British Market Research Bureau (BMRB) to conduct a public dialogue on synthetic biology.
- This dialogue plans to **frame the issues** and **promote discussion** of those raised by synthetic biology research.
- This will help the Research Councils and others to ensure that future policies better reflect the views, concerns and aspirations of the public.

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# Current Activities

- EUROCORES
- Flashlight Funding
- Synthetic Biology Signpost
- EPSRC Impact! Exhibition
- House of Commons Science and Technology Committee inquiry into bio-engineering

# Impact! Exhibition at the RCA from 16-21st March


The Engineering and Physical Sciences Research Council (EPSRC) and the National Endowment for Science, Technology and the Arts (NESTA) are working with designers from the Royal College of Art (RCA) to create an exhibition of design proposals which explores the relationship between research and society.

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## The House of Commons Science and Technology Committee announced its inquiry into bio-engineering, examining how the UK can maintain a globally competitive position in emerging and existing bio-engineering research fields.

The inquiry focused on synthetic biology, stem cells and genetic modification in order to explore the issues of research, translation and regulation.

View the oral evidence online
http://www.parliamentlive.tv/Main/Player.aspx?meetingId=5446&wfs=true

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# Summary

- Synthetic Biology Signpost in EPSRC Responsive Mode -for a limited time only!
- Public Dialogue -Summer 2010
- EPSRC Impact! Exhibition 16-21st March
- House of Commons Science and Technology Committee inquiry into bio-engineering

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Thank you for listening

Any Questions?

Susan Soulsby
Synthetic Biology Portfolio Manager
email: susan.soulsby@epsrc.ac.uk

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