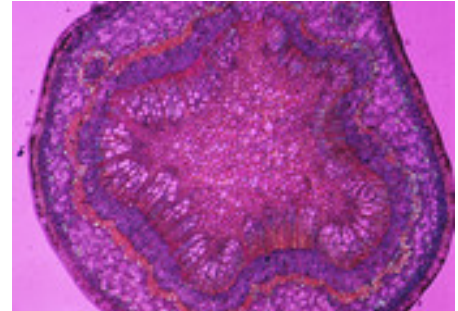


Call for views: Synthetic biology

The Royal Society seeks your views on the emerging area of synthetic biology. This is your opportunity to shape the focus of the Royal Society's future policy work in this important area. We welcome views from individuals or organisations by 27 August 2007. Please see below for submission details.



What is synthetic biology?

Synthetic biology is an emerging area of research that can broadly be described as the design and construction of novel artificial biological pathways, organisms or devices, or the redesign of existing natural biological systems.

Biologists have traditionally sought to understand how life works. In contrast, synthetic biologists seek to design and build new biological systems. The application of engineering principles to the design and construction of complex biological systems is likely to provide a step change from the tweaking of existing genomes, usually described as genetic engineering.

The development of standardised technology and methodology for designing and manufacturing semiconductor chips (electronic components) has transformed information and communications technologies (ICTs) over recent decades. The principles of abstraction and modularisation, which underpinned this transformation, are now being applied to the design and construction of biological systems. Parallels have been drawn between the revolution in ICTs and the potential impact of developments in synthetic biology.

Synthetic biologists are seeking to construct standardised biological parts and instructions for assembling these into biological systems. This could eventually lead to the manufacture of novel biological systems and devices that could have applications in a range of areas such as healthcare, energy and the environment.



Synthetic biologists are also constructing a bacterium with the minimal genome required for life. Genes could be inserted to this genome to build biological pathways with functions that have commercial applications. Research is also seeking to extend and rewrite the genetic code to enable the production of proteins that do not occur naturally, but that could have industrial and medical applications. A few potential applications of synthetic biology are outlined below.

Synthetic biology has developed from the convergence of knowledge and tools from other disciplines such as systems biology, genetic engineering, mechanical engineering, electrical engineering, information theory, physics, nanotechnologies and computer modelling. Like most emerging technologies, the boundaries between synthetic biology and other technologies and scientific disciplines are blurred.

Potential applications of synthetic biology

Potential applications of synthetic biology range widely due to the interdisciplinary nature of the field. It could have implications for agriculture, engineering and processing, energy production and the pharmaceutical industry. A few examples of potential applications include:

- **Development of a cheap anti-malarial drug** – The plant derived drug has a high success rate in treating malaria, but has been impractical and costly to produce by standard chemical methods. By building a new metabolic pathway in yeast and *E coli* with genes from three separate organisms, researchers have created a bacterial strain that can produce amorphadiene. This precursor can then be converted into artemisinin. It is hoped that the drug could be available in the next few years.
- **The beginning stages of a cheap and green, high yield hydrogen production** – Hydrogen could become an important alternative to fossil fuels. A novel synthetic pathway consisting of 13 enzymes derived from five different organisms has been developed to produce hydrogen from starch and water. This pathway is being developed further with the aim of producing hydrogen from cellulose, a more abundant sugar, which could provide hydrogen for fuel cells cheaply and easily.
- **Looking for an answer to environmental contamination** – Communities of micro organisms are responsible for most naturally occurring biodegradation. The metabolic and genetic control mechanisms of these organisms could provide clues to create and develop novel micro organisms to decontaminate the most potent environmental contaminants.
- **Programmable cells for use in gene therapy** – Pathogenic bacteria and viruses are able to identify and manipulate cells to produce harmful affects. Programming a bacterium or virus that can identify malignant cells and deliver a therapeutic agent could have major benefits for treating cancer and similar illnesses.

Call for views

This is your chance to shape the focus of the Royal Society's future policy work in this area. This work could take a number of forms, such as a substantial policy study or a stakeholder workshop.

Synthetic biology has the potential to lead to a wide range of useful applications, but it also raises a number of uncertainties including its possible impact on society. There has been some discussion around the social, ethical and legal issues that synthetic biology may present and the Society is keen to encourage a wider constructive discussion and debate about these issues. We are hoping to receive comments and information from a range of stakeholders on both the opportunities and uncertainties that could accompany the development of synthetic biology.

We would like to receive submissions commenting on any aspects of synthetic biology and would be pleased to hear suggestions on particular areas or issues that the Society should focus on when deciding what work to undertake in this area. Broad topics that you may wish to comment on are listed below. There is no need to comment on all these areas, and we welcome comments on subjects other than those listed:

- Potential developments and applications
- Current research capacity and geographical distribution
- Societal implications
- Ethical concerns
- Biosecurity risks
- Implications for the environment
- Research support and funding
- Implications for human health
- Legal issues and implications for regulation (national and international)
- Ownership, sharing and innovation frameworks (including intellectual property)
- Biosafety concerns
- Education and training
- Governance and oversight of research
- Economic considerations for developed and developing countries

We would be happy to receive electronic copies, links to electronic copies, or hard copies of relevant reports and references.

Submissions

The deadline for submissions is **27 August 2007**, either electronically (preferred format) or by post to:

E-mail synthetic.biology@royalsoc.ac.uk

Post Kate O'Shea, Science Policy, The Royal Society, 6-9 Carlton House Terrace, London SW1Y 5AG, UK

Responses are likely to have the greatest impact if they are restricted to four pages, plus appendices if appropriate.

Confidentiality

A list of organisations and individuals who have submitted views will be listed in our website and the submissions may be published. Please inform us if you **do not** want your name or your submission to be made public. If you are submitting information on behalf of an organisation, please include details of the relevant person to contact should we wish to discuss issues raised in your submission.

If you would like to submit your views but are unable to meet the deadline, or if you have any questions, please contact us on the details above.

About us

The Royal Society is the independent scientific academy of the UK and the Commonwealth, dedicated to promoting excellence in science. As well as providing an authoritative voice and leadership for UK science, it aims to ensure that policies on key issues are influenced by the best independent science and it provides advice for policymakers on science and its relationship with society.

The Royal Society is committed to encouraging the responsible development of new and emerging technologies for the maximum benefit of humanity and the environment. It is well placed to provide an expert, independent and realistic assessment of the risks, benefits and impacts that new and emerging technologies could present. The Society has undertaken projects on a wide range of scientific areas, including nanotechnologies. For more information on our policy work, visit www.royalsoc.ac.uk/policy.

Please circulate this document to other interested parties.