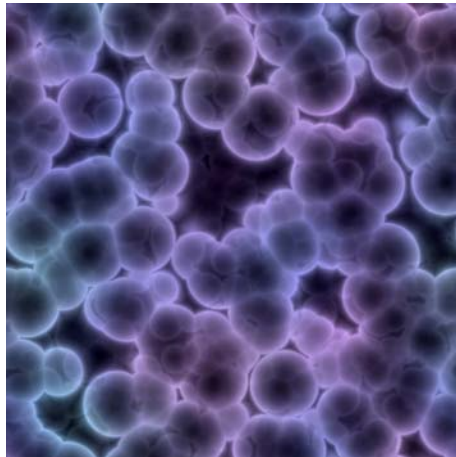


# Engineering Life: the emerging field of synthetic biology



Thursday 24 April 2008

**IOP** Institute of Physics



**RSC** | Advancing the  
Chemical Sciences



## Manchester Interdisciplinary Biocentre

*Cutting-Edge Research at the Interfaces  
between Engineering, the Physical Sciences  
and Bioscience*

John McCarthy

Molecules → Living Systems

# **Engineering Life: The emerging field of synthetic biology**

**Dr Philipp Holliger**  
**MRC Laboratory of Molecular Biology**  
*Applications of synthetic biology*

**Professor Richard Kitney**  
**Chair of Biomedical Systems Engineering, Imperial College**  
*Current research capacity, funding and support for synthetic biology*

**Professor Brian Wynne**  
**ESRC Centre for Economic & Social Aspects of Genomics**  
*Social and ethical issues surrounding synthetic biology*

# Bioscience: From Discovery to Creation

**1978 Nobel Prize** in Physiology or Medicine was awarded to **Arber, Nathans** and **Smith** for their work on **Restriction Enzymes**

In 1978, Waclaw Szybalski commented:

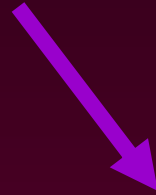
"The work on restriction nucleases not only permits us easily to construct recombinant DNA molecules and to analyze individual genes but also has led us into *the new era of synthetic biology* where not only existing genes are described and analyzed but also new gene arrangements can be constructed and evaluated"



**SYNTHETIC BIOLOGY**

# Bioscience: From Discovery to Creation

**Qualitative, Descriptive (Linnean)**



**Quantitative, Predictive Models**

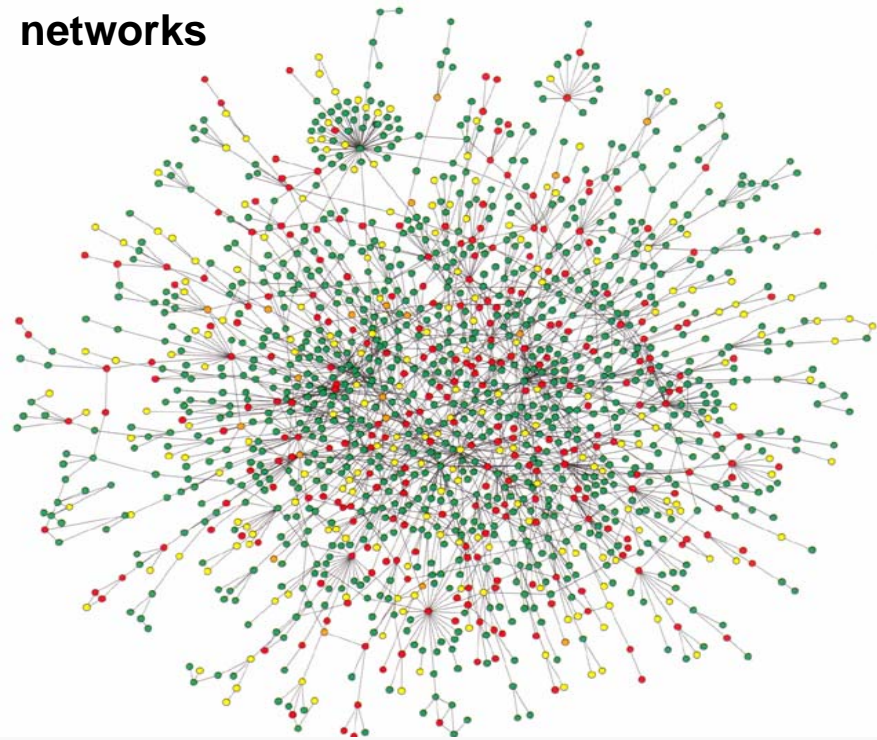


**Engineering of Living Systems**

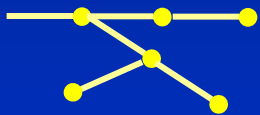


**Integration of Biological  
& Non-biological Components**

## networks



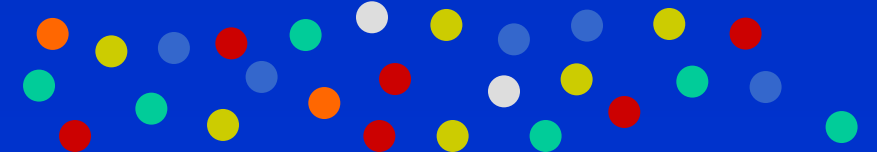
## pathways & circuits



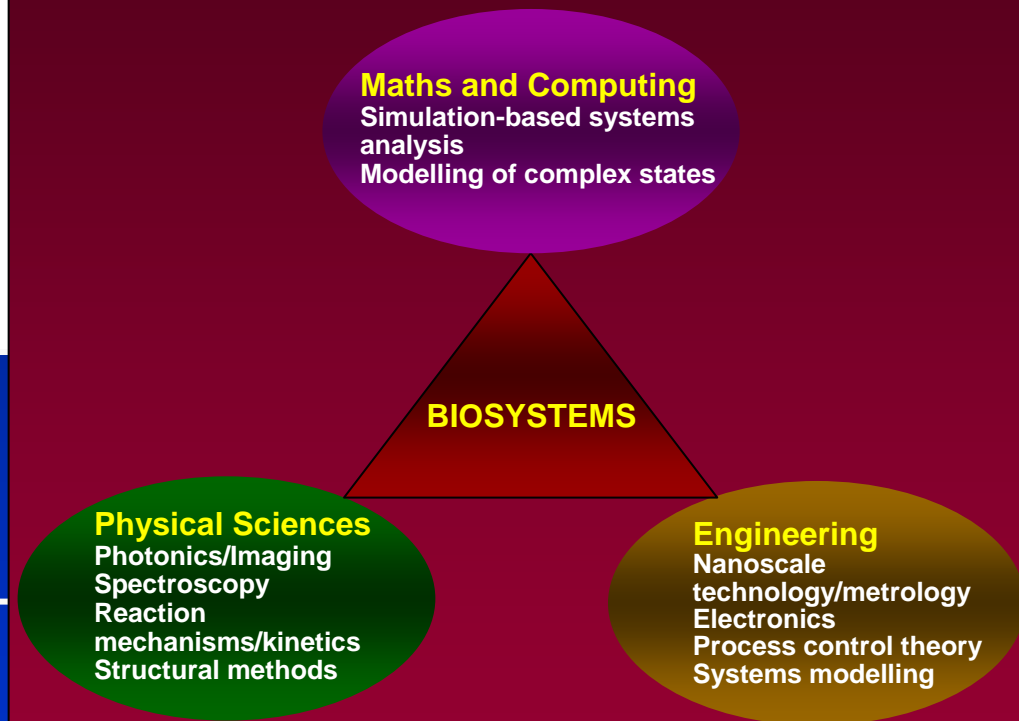
## complexes



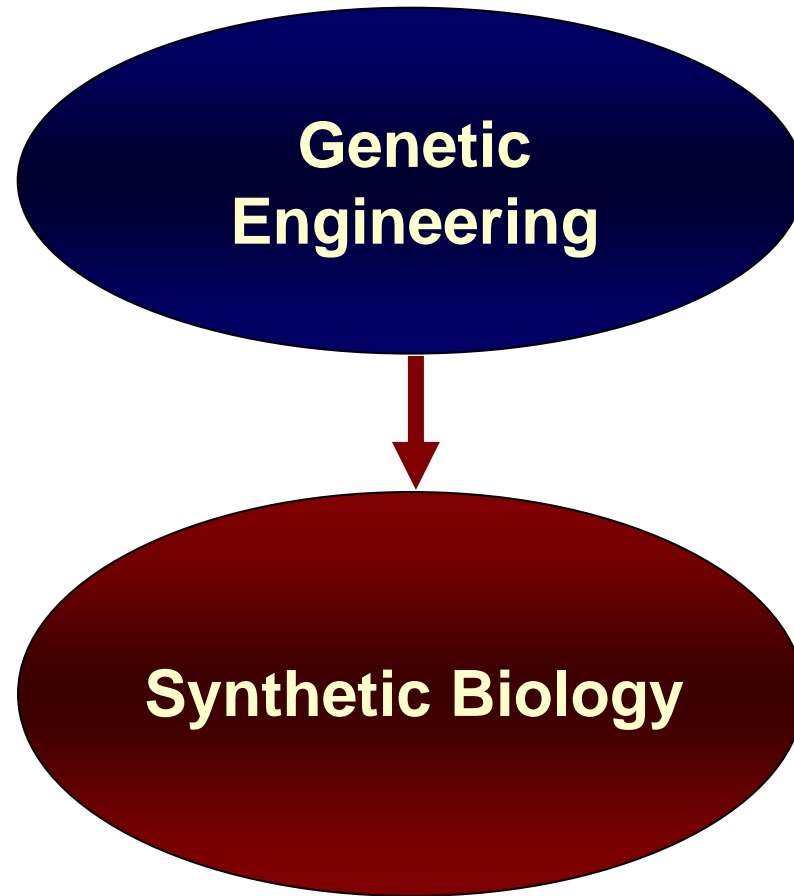
## molecules



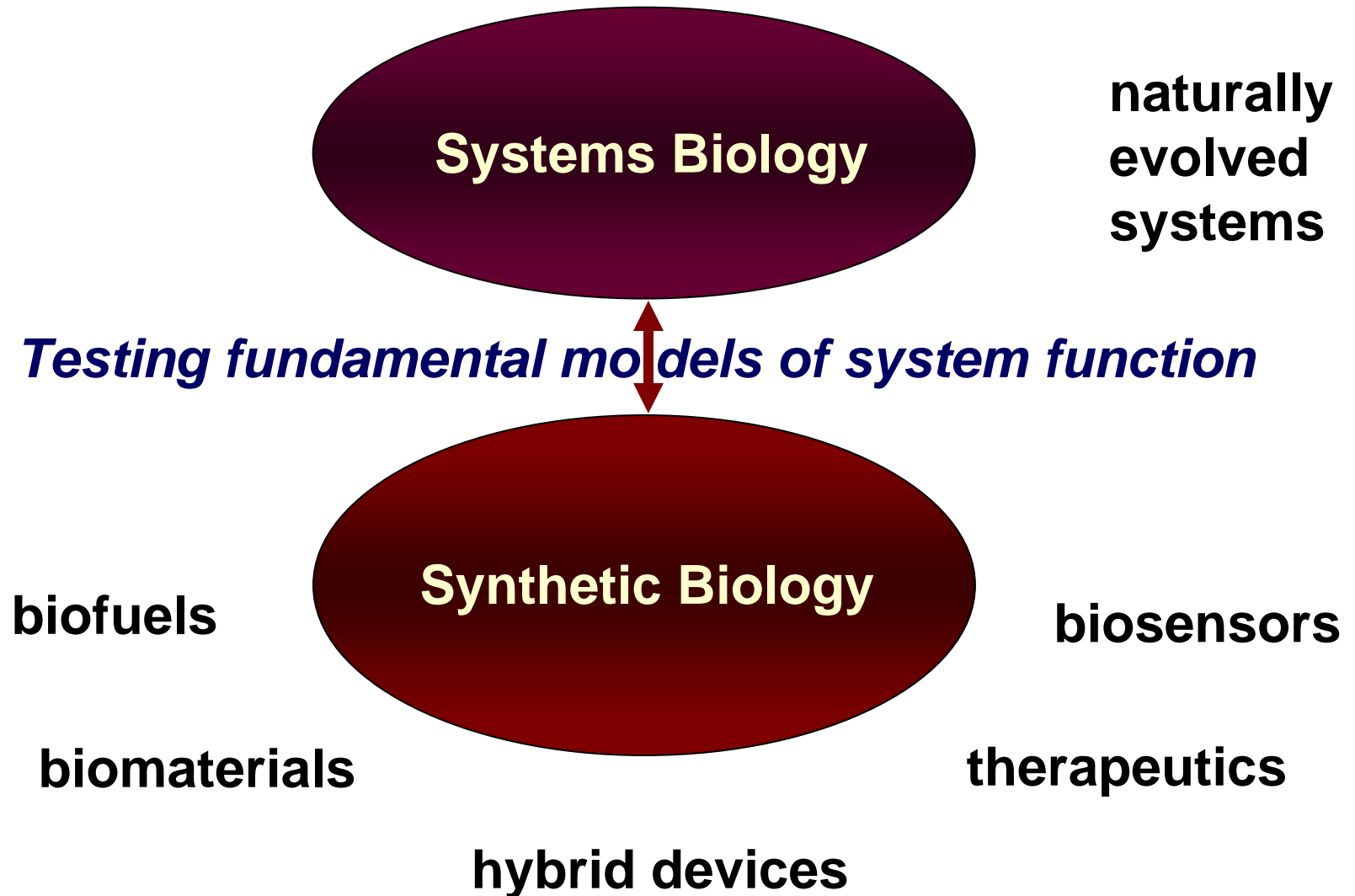
## contributing disciplines



# *What is Synthetic Biology?*



# *What is Synthetic Biology?*



# Coding Capacity vs Physical Limitations

a protein molecule



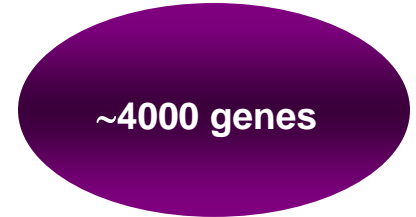
a “minimal cell”



~300 genes

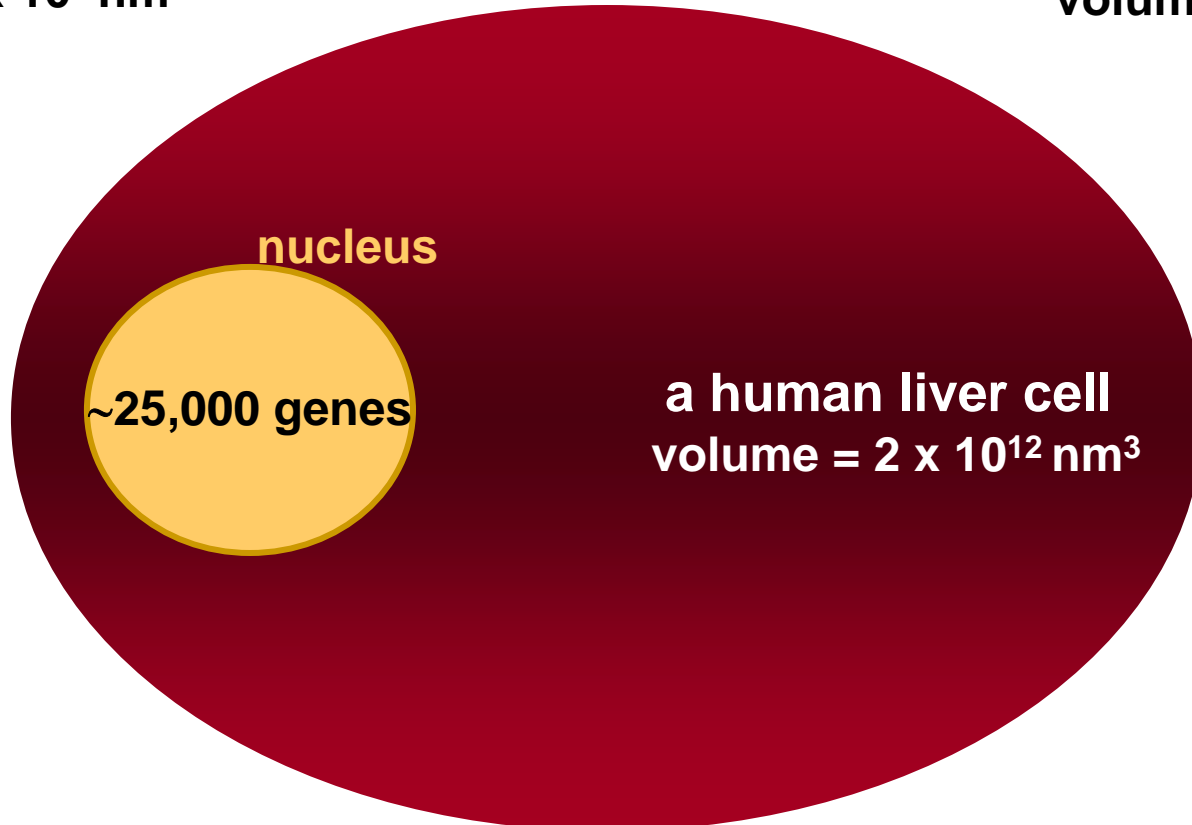
volume =  $3 \times 10^6 \text{ nm}^3$

*Escherichia coli*



~4000 genes

volume =  $5 \times 10^9 \text{ nm}^3$



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# Synthetic Biology – some examples

Make a cell factory for an anti-malarial drug

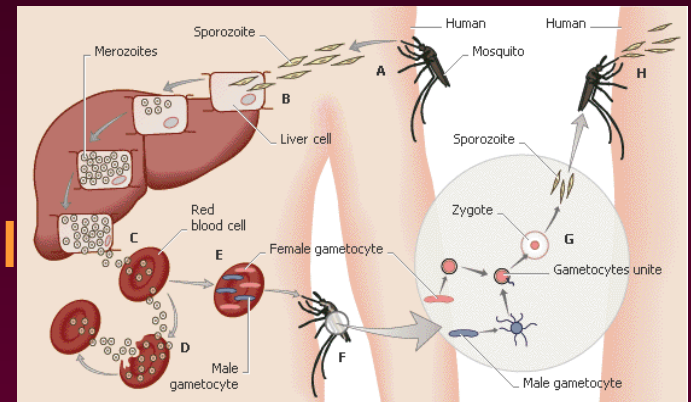
**CELL FACTORY**



*S.cerevisiae*

**DRUG**

artemisinin

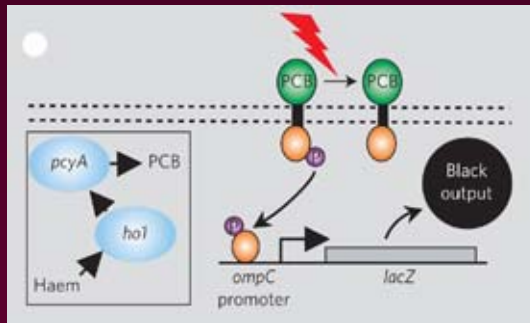


*Plasmodium falciparum*  
life cycle

# Synthetic Biology – some examples

Make “living photographs”

engineer photosensitive  
bacteria



create living  
photographs



# Synthetic Biology – some examples

## Make dynamic patterns

