Introduction into Synthetic Biology and the Workshop Goals

Dr.Sibylle Gaisser,
Fraunhofer Institute for Systems and Innovation Research,
Karlsruhe, Germany

What is Synthetic Biology about?

(1) engineer and study biological systems that do not exist as such in nature, and

(2) use this approach for

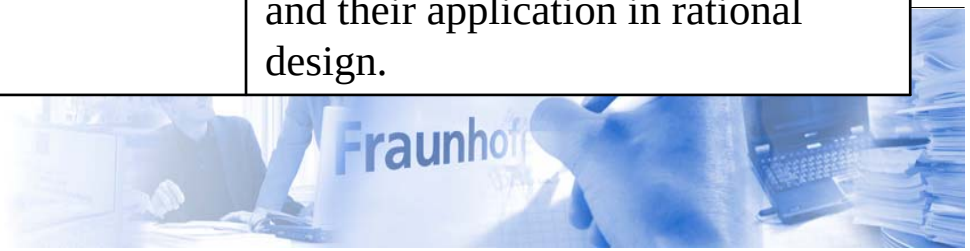
- achieving better understanding of life processes,
- generating and assembling functional modular components,
- developing novel applications or processes.

Dr. Sibylle Gaisser

Fraunhofer Institute Systems and Innovation Research

How to distinguish….

Characteristics	Classical Biotechnology	Synthetic Biology
Subject of study	Organisms or parts of them	De novo engineered, artificial biological parts or systems or parts of naturally occurring biological systems
Analytical instruments	Sequential use of biological methods and engineering approaches for production purposes and downstream processing (process engineering downstream of biological methods)	Biological methods and engineering approaches interact in order to develop a production system
Goal	Exploitation of biological systems, living organisms or parts of them in order to enlarge knowledge base, produce goods or provide services.	Provision of biological parts and de-novo synthesis of non-natural biological systems.
Knowledge base	Detailed knowledge of individual molecular structures and associated mechanisms	Systematic and broad knowledge of a variety of molecular structures and their application in rational design.



How to distinguish….

Characteristics	Classical Biotechnology	Synthetic Biology
Documentation of knowledge	Publication in peer reviewed journals	Publication in systematic, publicly accessible databases/repositories and peer reviewed journals
Level of abstraction	Dependency of individual parts/organisms from each other ("Black box")	Modularity of parts, availability of orthogonal systems
Accessibility of carrier of information	Each DNA molecule is hand-made	Standardized cloning and de novo DNA-design
Connection between DNA-design and design of organisms	Production of new DNA and new organisms are carried out within one project by one group of researchers	Production of DNA and of new organism are carried out sparately. Automatic assembly of parts possible.

But what about Systems Biology ?

- Often considered as "two sides of the coin"
- Often covered in one conference "Science and Society Implications of Systems and Synthetic Biology" (EMBO/EMBL-conference 7-8 November 2008)
- Systems Biology is taken to its natural conclusion in synthetic biology (Jane Calvert: "A sociological perspective on systems biology")
- Differences between the fields:
  - synthetic biology = construction
  - systems biology = understanding
- But not a clear-cut distinction:
  - greater understanding of biological systems can be gained from synthetic approaches and vice versa
  - “a reductionist approach to systems biology” (James Collins in Ferber 2004:158)

Dr. Sibylle Gaisser

Fraunhofer Institute Systems and Innovation Research

How to distinguish…

Characteristics	Systems Biology	Synthetic Biology
Subject of study	Complex biological systems as a whole	De novo engineered, artificial biological parts or systems or parts of naturally occurring biological systems
Analytical instruments	Analysis of components and their interaction	Characterisation of natural and artificial individual components
	Modelling	Modelling
	Simulation	Simulation
	Comparison with experimental systesm as a whole (e.g. organisms, tissue, organs) Systems approach is conceptual basis	Comparison with reduced, experimental system (e.g. microorganisms with reduced genome)

Dr. Sibylle Gaisser

Fraunhofer Institute Systems and Innovation Research

How to distinguish…

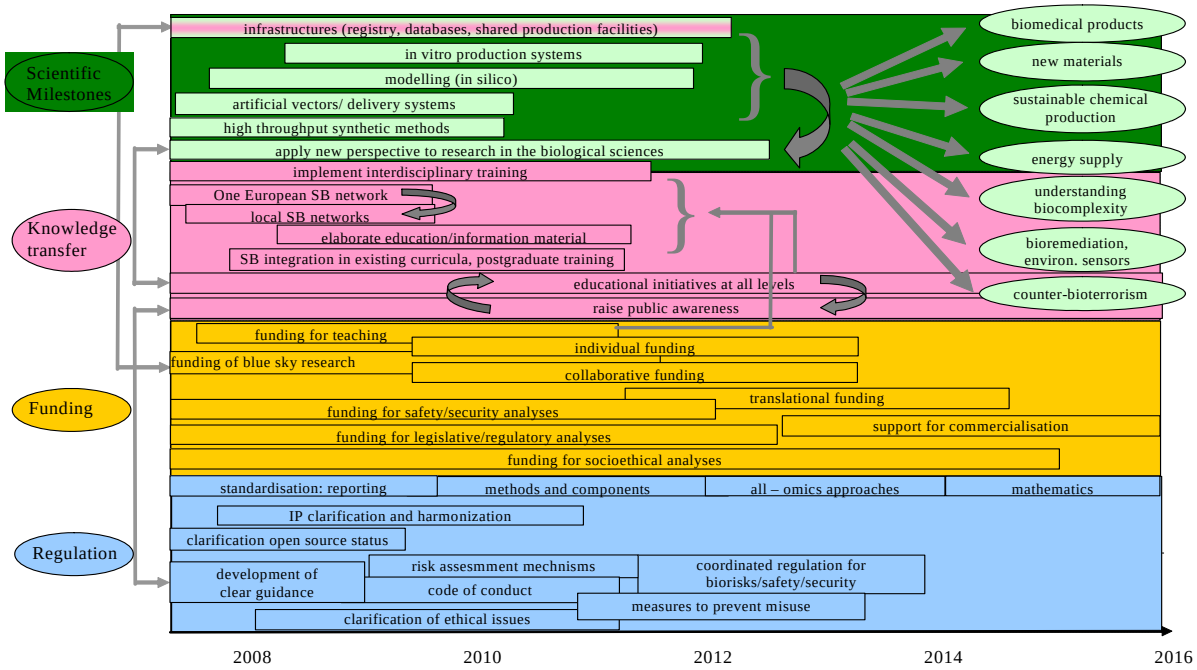
Characteristics	Systems Biology	Synthetic Biology
Goal	Characterisation of coherence of biological systems	Characterisation and simplification of individual biological components
		Allocation of biological parts (in repositories)
	Elucidation/understanding of basic and fundamental live processes	Elucidation of essential live processes by determination of minimal functional units
	Elucidation of overal context of biological processes and their visualisation (representation)	
	Creation of the theoretical basis of biological functions and systems	De nove construction of unnatural biological systems
Perspective	Top-down integration	Bottom-up construction

Dr. Sibylle Gaisser

Fraunhofer Institute Systems and Innovation Research

Workshop Goals

1. Provide an insight into funding needs and funding options
2. Discuss challenges and hurdles in Synthetic Biology funding
3. Discuss approaches for the development of a Synthetic Biology (funding) strategy.



Dr. Sibylle Gaisser

Fraunhofer ISI Institute Systems and Innovation Research