



**A Foundation for Synthetic Biology in Europe**



**A Foundation for Synthetic Biology in Europe**

2nd Advisory Board Meeting  
Hongkong, October 10, 2008

## What is EMERGENCE?

EMERGENCE is a COORDINATION ACTION funded by the EU-FP6 NEST PATHFINDER program.

Duration: Dec 2006- Nov 2009 (36 months)

Volume: 1.5 Mln €

Purpose: (next page)

# Synthetic Biology



“Synthetic biology has emerged as a very recent but highly promising approach to re-organizing the scientific biological endeavour by integrating central elements of engineering design.”

“..., synthetic biology aims at no less than revolutionizing the way we do bioengineering today.”

**“However, such an endeavour requires urgently a coordination effort from the very beginning in order to point the transitions into the most promising directions.”**

# Who is EMERGENCE?



1. ETH Zurich: *Jörg Stelling, Sven Panke* (Bioinformatics, bioprocess eng.)
2. CSIC (Madrid, ES): Victor de Lorenzo (Microbial mol. biol)
3. CNIO (Madrid, ES): Alfonso Valencia (Bioinformatics)
4. HZI (Braunschweig, D): *Vitor Martins dos Santos* (Met. engineering)
5. DSM (Basel, CH): *Luis Pasamontes* (Industrial applications)
6. UCL (London, UK): Nicolas Szita (Microfluidics)
7. Geneart AG (Regensburg, D): *Ralf Wagner* (DNA synthesis)
8. CRG (Barcelona, E): Luis Serrano (Systems biology)
9. UCAM (Cambridge, UK): *Jim Haseloff* (Plant biology)
10. EP (Paris, F): *Alfonso Jaramillo* (Comp. protein design)

*Associated*

MIT (Cambridge, USA): *Randy Rettberg* (iGEM)

**Plus:**

**The SynBio Community in Europe**

# EMERGENCE wants to



Provide the means for

- the community to identify itself and network with each other

Provide the means to

- identify crucial topics for the development of SB
- mature these topics and make them “actionable“
- agree on best practices/strategies for these topics

Provide flagship projects to visualize crucial concepts

- bioinformatics infrastructure
- standardizations for promoters

Provide the means to address other central issues

- education
- the industry/academic interface

Serve as an umbrella for “associated” SynBio projects:

SYNBIOSAFE, TESSY, SYNBIOCOMM

EMERGENCE aims to LEAD TO:

- A clear and actionable concept on how to continue developing SB in the future (what is the research needed most?)
- Convincing and useful demonstrator projects
- A clear perspective on industrial expectations and the potential of SB for industry and whether we can/want meet this perspective
- A broader student base
- An improved communication with the public

**$\Sigma$ : an identifiable and fundable research field whose community is on the way to fully realizing the disruptive potential of Synthetic Biology**

**... in an interactive process in which the community uses the CA towards these goals.**

A brief history of Syn Bio in Europe;



2004: First EU NEST Call

“The core of this vision is that, drawing on the *knowledge developed in biology and adapting engineering design and production principles* that have been developed in the Information and Communication Technology arena, it is possible now to set off the *creation of essentially artificial (i.e. “synthetic”) systems* using biological engineering design principles *with unprecedented power and efficiency*. These systems will be intended for diverse uses throughout the economy, in areas such as health, energy, environment or materials”

(1st reference document)

### STREPS:

EEUROBIOSYN: A modular platform for biosynthesis of complex molecules

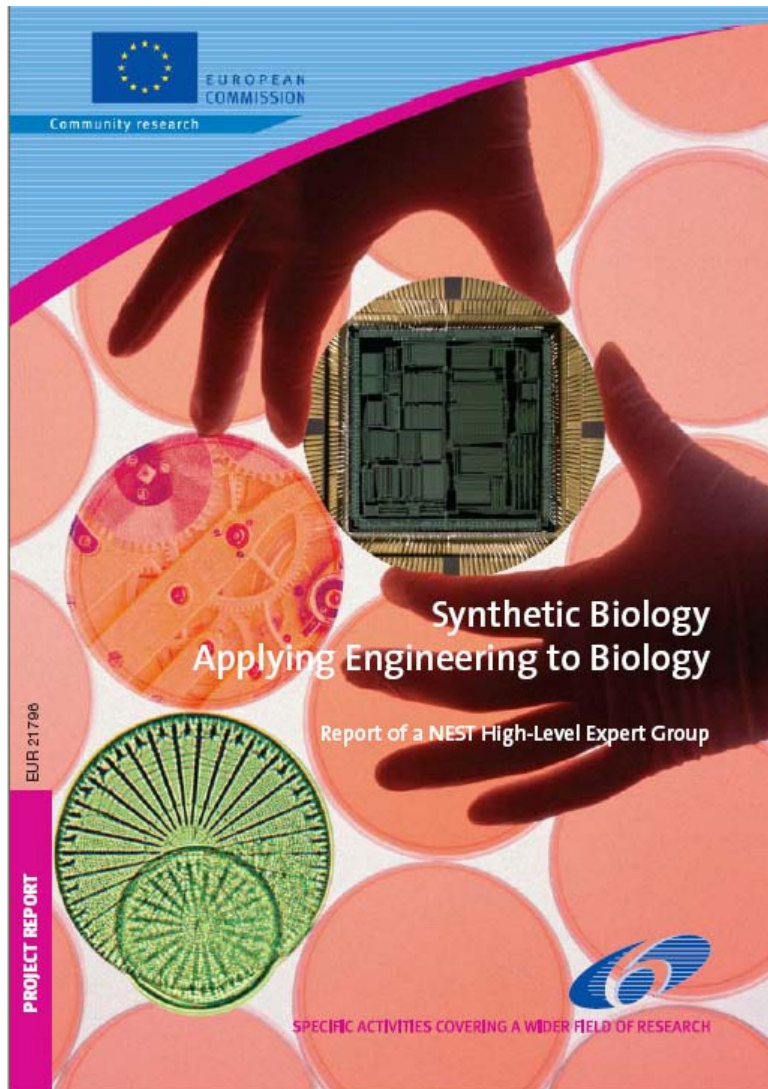
HYBLIB: Human monoclonal antibodies from a library of hybridomas

NEONUCLEI: Self-assembly of synthetic nuclei: key modules for semibiotic

NETSENSOR: Design and engineering of gene networks to respond to and correct alterations in signal transduction pathways

### SSA:

SYNBIOLOGY: An analysis of Synthetic Biology research in Europe and North America



2005: Second EU NEST Call

STREPS:

**NANOMOT:** Synthetic biomimetic nanoengines: A modular platform for engineering of nanomechanical actuator building blocks

**PROBACTYS:** Programmable bacterial catalyst

**ORTHOSOME:** An orthogonal episome: An artificial genetic system based on a novel type of nucleic acids

SSA:

**SYNBIOCOM:** Towards a European Synthetic Biology community

EU HLEG-report "Synthetic Biology – Applying Engineering to Biology"

[ftp://ftp.cordis.europa.eu/pub/nest/docs/syntheticbiology\\_b5\\_eur21796\\_en.pdf](ftp://ftp.cordis.europa.eu/pub/nest/docs/syntheticbiology_b5_eur21796_en.pdf)



2006: Third EU NEST Call



STREPS:

SYNTHCELLS: Approaches to the bioengineering of synthetic minimal cells

FUSYMEM: Functionalized synthetic membranes for GPCR based sensing

COBIOS: Engineering and COntrol of BIOlogical systems: a new way to tackle complex diseases and biotechnological innovation

CELLCOMPUT: Biological computation built on cell communication systems

BIONANOSWITCH: A biological nanoactuator as a molecular switch for Biosensing

BIOMODULAR H2: Engineered modular bacterial photoproduction of H<sub>2</sub>

SSA:

TESSY: Towards a European strategy for synthetic biology

SYNBIOSAFE: Safety and ethical aspects of synthetic biology

CA:

EMERGENCE: Consolidating the base for Synthetic Biology in Europe

Σ:

**13 STREPS**

**3 SSAs**

**1 CA**

**Ca. 120 researchers**

# Syn Bio @ Europe is (already) alive and kicking

iGEM 2008:

23 European  
Teams

<http://www.igem.org>






ed for iGEM 2008 - ung.igem.org - Windows Internet Explorer

p://ung.igem.org/Team\_List

avorites Tools Help Konvertieren Auswählen

Registered for iGEM 2008 - ung.igem.org

**GEM Users & Groups**   

on-wiki Log in

Teams Registered for iGEM 2008 [Return to the iGEM Registration Page](#)

These 85 teams are registered for iGEM 2008

<a href="#">Alberta_NINT</a>	<a href="#">Bay_Area_RSI</a>	<a href="#">BCCS-Bristol</a>	<a href="#">Beijing_Normal</a>
<a href="#">Bologna</a>	<a href="#">Brown</a>	<a href="#">BrownTwo</a>	<a href="#">Calgary_Ethics</a>
<a href="#">Calgary_Software</a>	<a href="#">Calgary_Wetware</a>	<a href="#">Caltech</a>	<a href="#">Cambridge</a>
<a href="#">Chiba</a>	<a href="#">Colombia</a>	<a href="#">CPU-NanJing</a>	<a href="#">Davidson-Missouri_Western</a>
<a href="#">Duke</a>	<a href="#">Edinburgh</a>	<a href="#">EPF-Lausanne</a>	<a href="#">ESBS-Strasbourg</a>
<a href="#">ETH_Zurich</a>	<a href="#">Freiburg</a>	<a href="#">Groningen</a>	<a href="#">Guelph</a>
<a href="#">Harvard</a>	<a href="#">Hawaii</a>	<a href="#">Heidelberg</a>	<a href="#">HKUSTers</a>
<a href="#">iHKU</a>	<a href="#">IIT_Madras</a>	<a href="#">Illinois</a>	<a href="#">Imperial_College</a>
<a href="#">Istanbul</a>	<a href="#">Johns_Hopkins</a>	<a href="#">KULeuven</a>	<a href="#">Kyoto</a>
<a href="#">LCG-UNAM-Mexico</a>	<a href="#">Lethbridge_CCS</a>	<a href="#">Melbourne</a>	<a href="#">METU_Turkey</a>
<a href="#">Mexico-UNAM-IPN</a>	<a href="#">Michigan</a>	<a href="#">Minnesota</a>	<a href="#">Mississippi_State</a>
<a href="#">Missouri_Miners</a>	<a href="#">MIT</a>	<a href="#">Montreal</a>	<a href="#">Newcastle_University</a>
<a href="#">NTU-Singapore</a>	<a href="#">NYMU-Taipei</a>	<a href="#">Paris</a>	<a href="#">Peking_University</a>
<a href="#">PennState</a>	<a href="#">Peru</a>	<a href="#">Prairie_View</a>	<a href="#">Princeton</a>
<a href="#">Purdue</a>	<a href="#">Rensselaer</a>	<a href="#">Rice_University</a>	<a href="#">Slovenia</a>
<a href="#">Tianjin</a>	<a href="#">Tokyo_Tech</a>	<a href="#">Toronto_Bluegenes</a>	<a href="#">Tsinghua</a>
<a href="#">TUDelft</a>	<a href="#">TU_Munchen</a>	<a href="#">UCSF</a>	<a href="#">UC_Berkeley</a>
<a href="#">UC_Berkeley_Tools</a>	<a href="#">UNIPV-Pavia</a>	<a href="#">University_of_Alberta</a>	<a href="#">University_of_Chicago</a>
<a href="#">University_of_Lethbridge</a>	<a href="#">University_of_Ottawa</a>	<a href="#">University_of_Sheffield</a>	<a href="#">University_of_Washington</a>
<a href="#">USTC</a>	<a href="#">Utah_State</a>	<a href="#">Valencia</a>	<a href="#">Virginia</a>
<a href="#">Warsaw</a>	<a href="#">Waterloo</a>	<a href="#">WEGO_Taipei</a>	<a href="#">Wisconsin</a>



# Syn Bio @ Europe is alive and kicking



Synthetic Biology 3.0 - Microsoft Internet Explorer

Edit View Favorites Tools Help



Address <http://www.syntheticbiology3.ethz.ch/index.htm>

Google  Go  Bookmarks  22 blocked  Check  Look for Map  AutoFill  Settings

## Synthetic Biology 3.0

24th-26th June 2007

Zurich, Switzerland



[Welcome](#)  
[Board](#)  
[Program](#)  
[Registration](#)  
[Contact us](#)



**ETH**

Microsoft  
**Research**

**GENEART**  
THE GENE OF YOUR CHOICE

### Welcome to Synthetic Biology 3.0

Synthetic biology is a new and rapidly emerging discipline that aims at the (re-)design and construction of (new) biological systems. Its interdisciplinary nature between science and engineering, as well as the many potential applications, amongst others, in the health, material, and energy sectors, make it particularly exciting. The previous conferences [SB1.0](#) and [SB2.0](#) conveyed this spirit very well.

The third international conference of Synthetic Biology will be held this year at the Swiss Federal Institute of Technology (ETH) in Zurich. We have excellent line-up of speakers and workshops for those who are new to Synthetic Biology. We look forward to an inspiring conference and to welcoming you to Zurich.

### Important dates

- Compulsory deadline for pre-registration/abstract submission - 31st March 2007
- Notification of acceptance to SB3.0 - 9th April 2007
- Deadline for payment - 27th April 2007

# Syn Bio @ Europe is alive and kicking



## Synth Bio meetings in 2007&8:

- 10/2006 “Synthetic approaches to cellular functions”, HZI, G
- 02/2007 BBSRC Workshop in Synthetic Biology, Wroughton, UK
- 02/2007 Bologna Winterschool „Bioinformatics in Systems and Synthetic Biology“, I
- 06/2007 SB 3.0, Zurich, CH
- 08/2007 9th functional genomics meeting; Synthetic Biology, Sw
- 10/2007 Systems and Synthetic Biology Network, UK
- 11/2007 ESF Conference on Synthetic Biology, Barcelona, ES
- 04/2008 BioFine, Freiburg, Germany
- 04/2008 BioSysBio, UK
- 05/2008 Workshop on Synthetic Biology and Marine Genomics, P
- 06/2008 Workshop on design in SynBio, F
- 08/2008 ICSB – Special Session on SynBio, Sw

Workshop Synthetic Biology, Groningen, NL, 6.-8.11.2008

Wellcome Trust Workshop, London, UK, 3./4.11.2009

## Academic Institutions:

Imperial, UK: Institute of Systems and Synthetic Biology

ETHZ, CH: Department of Biosystems Science and Engineering

Genopole & U Evry: Institute of Systems and Synthetic Biology

U Edinburgh, UK: Synthetic Biology Institute

U Freiburg, G: Center for Biological Signalling Studies

NEST FP6: 25 Mln €

FP7: TARPOL Coordination Action for SynBio in Environmental Sciences

UK: BBSRC/EPSRC Call for Research Networks in SynBio, 0.9 Mln £

UK: ITI Translational Research Call, 10 Mln £

# EMERGENCE communication

[www.emergence.ethz.ch](http://www.emergence.ethz.ch)



Communication/outreach:

Get in contact with the EMERGENCE WP leaders!!

(V. Martins dos Santos, S. Panke, A. Valencia, V. de Lorenzo, R. Wagner)

Via the EMERGENCE website: [www.emergence.ethz.ch](http://www.emergence.ethz.ch)

Via the EMERGENCE Newsletter (subscription via emergence webpage)

Via the various meetings – interact with the EMERGENCE participants

Via the EMERGENCE meeting support (WP1), see emergence webpage, or talk to Vitor Martins dos Santo

**Via the EMERGENCE Advisory Board**

## The EMERGENCE advisory board:



Invited: all NEST project leaders

Plus: any PI who feels she/he can contribute there

Goal: The advisory board as a reference group to critically analyze and deliver input to the work of the CA

Strategy: To have the EMERGENCE team meeting with the advisory board at regular intervals and exchange

Particular topics: The developments pertaining standardization, data acquisition/storage, curing, characterization of parts, databases, protocols, etc.

# EMERGENCE



1.5 Mln € to work on:

WP1: **General networking activities** (Victor Martins dos Santos)

WP2: **Attracting talents to Synthetic Biology in Europe** (Sven Panke)

WP3: **European IT infrastructure for Synthetic Biology** (Jörg Stelling)

WP4: **Standardization of promoter components through formatting and categorization of working states** (Rafael Rocha)

WP5: **Building the academic/industry interface (incl. IP rights)** (Ralf Wagner)



# Questions Introduction?



# **EMERGENGE: A foundation for Synthetic Biology in Europe**

## **WP1: General Networking activities**

**Fostering a community of knowledge**

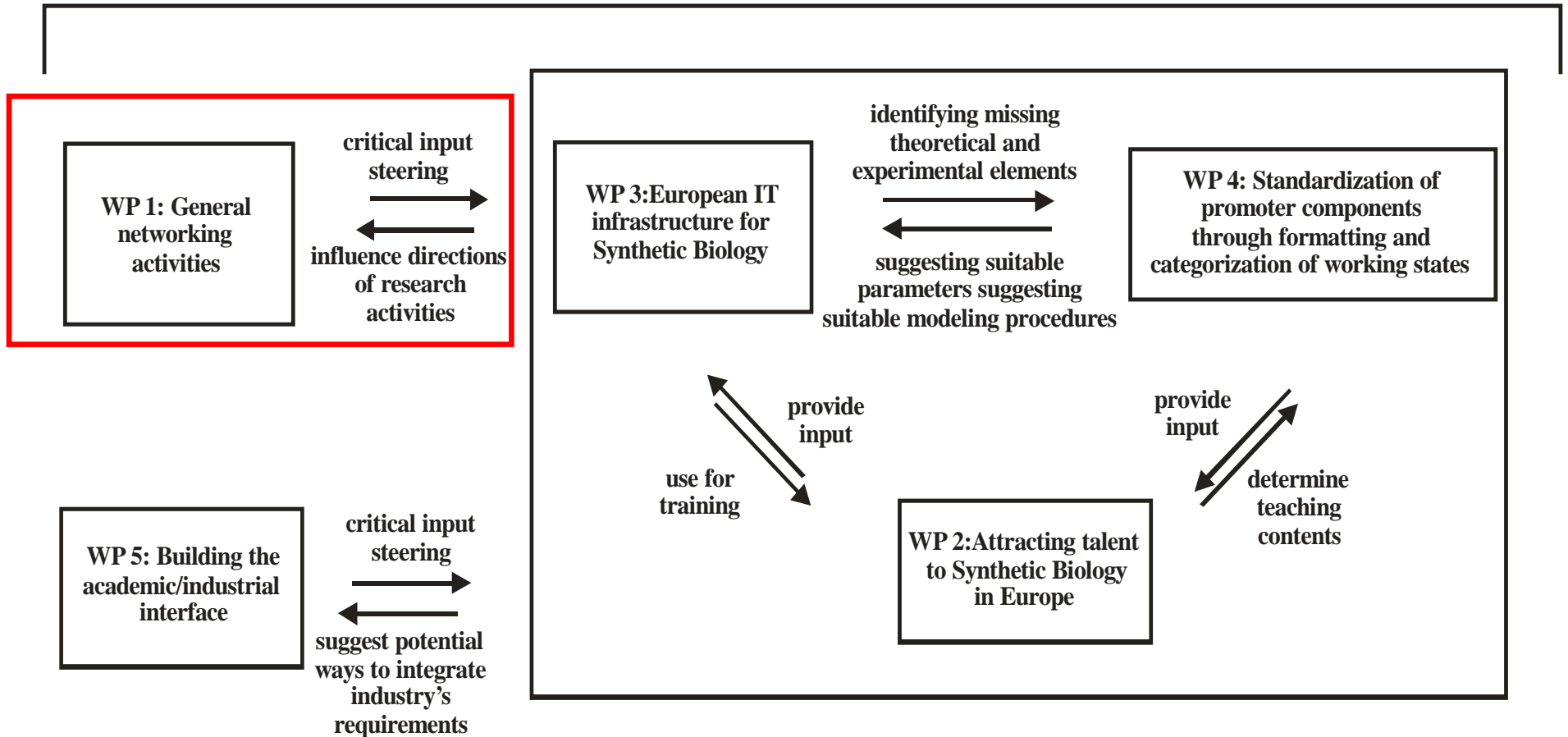
**Vítor Martins dos Santos**

**Systems and Synthetic Biology Group**

**Helmholtz Centre for Infection Research  
Braunschweig, Germany**

# Project Structure

WP6: Project management



WP 1: General networking activities

critical input steering  
influence directions of research activities

WP 3: European IT infrastructure for Synthetic Biology

identifying missing theoretical and experimental elements  
suggesting suitable parameters suggesting suitable modeling procedures

WP 4: Standardization of promoter components through formatting and categorization of working states

provide input  
use for training

WP 2: Attracting talent to Synthetic Biology in Europe

provide input  
determine teaching contents

WP 5: Building the academic/industrial interface

critical input steering  
suggest potential ways to integrate industry's requirements

## WP1: General Networking Activities

### Objectives:

- To establish a networking platform for current and future synthetic biology projects
- b) To rapidly organize workshops for urgent issues in European synthetic biology
- c) To implement a Europe-wide, cross-disciplinary framework for discussion on the possibilities, needs, limitations, and implications of synthetic biology.
- d) To foster interactions with extra-European initiatives, with special emphasis on US, the Mid-East and Asia: Global knowledge space

## Description of Tasks I

**Task 1: *Developing, maintaining, and evaluating a standardized meeting structure*** that allows efficient review and distribution of the conclusions obtained at individual meetings.

Overarching, jointly with WP Management

**Task 2: *Hosting workshops on development of the European IT infrastructure for synthetic biology, design tools for synthetic biology, and/or standardization of biological parts.***

Jointly with WP3 (IT infrastructure), WP4 (Design tools and Biological parts), Standardisation Issues (Overarching)

## Description of Tasks II

### ***Task 3: Establishment of study groups on specific subjects relevant to synthetic biology***

“Foundational” technologies, including e.g. high-throughput genome minimization, DNA synthesis),  
potential of genetic circuits, modularity in proteins, handling noise & error  
propagation in biological systems,  
robustness in biological systems,  
transferability of engineering foundations

.....

## Description of Tasks II

**Task 4: *Platform for organizing thematic workshops/courses/meetings, resulting from maturation of study groups into specific workshops***, courses, or small scientific meetings, or from initiatives from members of the advisory board or the steering committee.

**Task 5: *EMERGENCE will promote exchange and training visits between European and overseas participants***, in particular with the Middle East and Asia, including:

- invitations for a number of leading scientists in the field to participate in study groups;
- seeking actively to participate in similar initiatives in those countries; and inclusion of Middle Eastern/Asian researchers in the EMERGENCE
- communication and dissemination pipelines.
- The participation of senior European synthetic biology scientists in Asian meetings will be particularly encouraged.



## **Deliverables Month 1-18**

**D1.1: Material and rules for standardized meeting structure in place for the first time (month 3). Responsible: HZI**

**D1.2: Report on the first workshop on development of the European IT infrastructure for synthetic biology (month 8) Responsible: HZI**

**D1.3: Report on the first workshop for design tools for synthetic biology (month 4) Responsible: CNIO**

**D1.4. Report on recommendations of the intra-consortium expert group on suitable promoter standardization formats (month 12) Responsible: CNB**





## Deliverables 18-36 month

**D1.5: Updated material for the appropriate section in the quarterly Synthetic Biology Newsletter regarding tasks 2, 3, and 4 (months 3, 6, 9, 12, etc):**

Responsible ETH

D1.6. Report on workshop on foundations of measurement statistics in synthetic biology (month 24)

D1.7. Document identifying “common European-Asian interests and ways to develop them” or similar document in place and signed by extra-European and European groups/organizations involved in synthetic biology (month 32)

## Milestones and expected results

M1.1. **Recommendations for the European IT infrastructure for synthetic biology** are discussed and recommendations issued (month 3)

M1.2. **Recommendations for design tools on the IT infrastructure** are discussed and recommendations issued (month 4)

M1.3 **First experiences with the study group format** are reviewed by the steering committee after 6 months and by advisory board and steering committee after 12 months and the format is adapted, if necessary (month 6, 12)

M1.4. **Recommendations on standardization of biological parts** are discussed (month 11)

M1.5. **Recommendations on measurement systems in synthetic biology** are discussed (month 24)

M1.6. Steering committee and advisory board decide whether the **critical mass in Europe-Asian relations in synthetic biology** has been reached and drafting a “common interests” document is going to be useful (month 24)

## D1.1 - Material and rules for standardized meeting structure

### **Web-based template document:**

Definition of the theme and Scope

The need for the SynBio community and goals

Implementation plan (size, mode, participants

Timeline

Financing possibilities

### **Process:**

Submission to Steering committee (WP-leaders, Coordinator)

Eg. IT: A. Valencia; Teaching: Sven P.; INdustry: L. Pasamontes

## D1.1 - Material and rules for standardized meeting structure: examples themes

Tier	Theme	Number of Participants	Length	Contribution to Emergence	Deliverable	Estimated Cost (€)	Financial contribution requested (€)	WP

Tier means 1 - initial, 2 - follow-up or 3 - full meeting

WP means the Work package to which the proposed meeting would contribute

**minimal genomes / minimal systems**

**what to measure / how to measure?**

**design concepts**

**how can we handle “systems“ (made of parts)?**

**context-independent biological systems/modules**

**microfluidics technologies / single cell measurements**

**D1.2 -Report on the first workshop on development  
of the European IT infrastructure for synthetic  
biology**

**Workshop Computational Infrastructure and  
Methods for Synthetic Biology**

**The 9th Annual BioPathways Meeting**

Vítor Martins dos Santos  
Vincent Schachter  
Vincent Danos  
Joanne Luciano  
Aviv Regev  
Eric Neumann

*July 19-20, 2008*  
Satellite Meeting ISMB 2008  
Toronto, Canada

<b>7:30 – 8:30</b>	<b>Registration</b>	
<b>8:30-8:45</b>	Vítor Martins dos Santos, Helmholtz Center for Infection Research, Braunschweig, DE	Opening remarks
<b>Session 1 &amp; Analysis : Databases &amp; Software Tools</b>		
Chair: Vítor Martins dos Santos		
<b>8:45-09:30</b>	Trey Ideker, University California San Diego, USA	Mapping pathways through integration of physical and genetic interactions
<b>9:30-10:15</b>	Peter Karp, AI.SRI, Menlo Park, USA	The MetaCyc and BioCyc database collection
<b>10:15-10:45</b>	<b>Coffee Break</b>	
<b>10:45-11:30</b>	Phillip Bourne, University California San Diego, USA	The role of biopathways in drug repositioning and determining side effects
<b>11:30-12:00</b>	Geoffrey Winsor, Simon Fraser University, CA	InnateDB - Facilitating Systems Level Analyses of the Mammalian Innate Immune Response
<b>12:00-12:30</b>	Jennifer Gardy, Centre for Microbial Diseases & Immunity Research, University of British Columbia, CA	Cerebral 2.0: A Cytoscape plugin for the network-based visualization of datasets from multiple experimental conditions
<b>12:30-13:30</b>	<b>Lunch</b>	
<b>Session 2: Network Reconstruction &amp; Analysis</b>		
Chair: Eric Neumann, Teranode		
<b>13:30-14:10</b>	Rune Linding – Institute for Cancer Researctch, London, UK	Constructing in vivo phosphorylation networks
<b>14:10-14:50</b>	Terry Gasterland, University California at San Diego, USA	Examining Cell Cycle Control Networks at Single Cell Resolution
<b>14:50-15:30</b>	Kobi Benenson, Harvard University, Cambridge, USA	Molecular automata: from concepts to applications
<b>15:30-16:00</b>	<b>Coffee Break</b>	
<b>16:00-16:35</b>	Ran Kafri, Harvard Medical School, Boston, USA	Functional redundancies - an evolutionarily conserved control element in signal transduction and metabolism
<b>16:35-17:05</b>	Tijana Milenković, Nataša Pržulj, University California Irvine, USA	From network structure to biological function in protein-protein interaction networks
<b>17:05-17:35</b>	Jean Krivine, Harvard Medical School, Boston, USA	Rule-based modeling of large protein networks
<b>17:35-18:15</b>	Peer Bork, EMBL, Heidleberg, DE	Get the most out of your metagenome: computational analysis of environmental sequence data
<b>General Discussion</b>		
<b>18:15-18:30</b>	<b>Network analysis, Databases &amp; Tools</b>	

<b>Session 3 : Computational Methods and Infrastructure for Synthetic Biology</b>		
Chair: Kobi Benenson, Bauer Centre		
<b>8:30-9:00</b>	Vitor Martins dos Santos, Helmholtz Center for Infection Research, Braunschweig, DE	EMERGENCE: a Foundation for Synthetic Biology in Europe
<b>9:00-9:40</b>	Randy Rettberg, MIT, Cambridge, USA	Synthetic Biology Based on Standard Parts: Design Competitions and Catalogs
<b>9:40-10:15</b>	Ildefonso Cases, CNIO, Madrid, ES	Bioinformatics tools to help in the design of biological systems
<b>10:15-10:45</b>	<b>Coffee Break</b>	
<b>10:45-11:25</b>	Shoshana Wodak, Hospital Sick Children, Toronto, CA	Identifying meaningful pathways in metabolic networks without the help of chemistry
<b>11:25-12:00</b>	David Gilbert, University of Glasgow, UK	A behaviour driven approach to design and implementation in Synthetic Biology
<b>12:00-12:30</b>	Martijn van Iersel, University of Maastricht, NL	WikiPathways, pathway creation and online collaboration
<b>12:30-13:30</b>	<b>Lunch</b>	
<b>Session 4: Evolution of pathways and networks</b>		
Chair: Joanne Luciano, MITRE		
<b>13:30-14:15</b>	Chris Sander, Sloan-Kettering, New York, USA	Systems biology modeling
<b>14:15-14:50</b>	Edwin Wang, National Research Council, McGill University, Montreal, CA	Principles of microRNA regulation of cellular networks
<b>14:50-15:30</b>	Chris Myers, Cornell University, USA	Sloppiness in cellular networks
<b>15:30-16:00</b>	<b>Coffee Break</b>	
<b>15:30-16:05</b>	Matthew de Jongh, Hope College, Holland (MI), USA	Generation and Refinement of Metabolic Reaction Networks in the SEED
<b>16:05-16:35</b>	Andrey Ptitsyn, Colorado State University, Fort Collins, USA	The Structure of Biological Pathways in Time
<b>16:35-17:10</b>	Zhenjun Hu, Boston University, USA	Metagraph: a new graph structure for multiple-scale visualization and modeling of biological networks/pathways
<b>17:10-17:45</b>	Pedro Beltrao, University California San Francisco	Evolution of Cellular Networks
<b>Round Table Discussion</b>		

**D1.3 - Report on workshop for design tools for  
synthetic biology (CNB)**

**Satellite meeting to the ESF – EMBO on SynBio**

**November 2007**

**(Alfonso, Jörg, Randy, etc)**

**Report finished (CNIO)**



**D1.4 - Report on recommendations of the intra-consortium expert group on suitable promoter standardization formats (CNB)**

**VDL – Report ready in website**

**Silva-Rocha R, de Lorenzo V.  
Mining logic gates in prokaryotic transcriptional  
regulation networks.  
FEBS Lett. 2008 Apr 9;582(8):1237-44.**

**D1.4 -Updated material for the appropriate section  
in the quarterly Synthetic Biology Newsletter  
regarding tasks 2, 3, and 4**

**Frauke Greve / Sven Panke**

**Newsletters Dec 2006, June 2007, Dec 2008, June  
2009**

**Includes list of conferences, research highlights,  
press releases, funding activities**

## Activities towards Task 4 (European Networking)



UNIVERSITAT DE BARCELONA



### RESEARCH CONFERENCES

ESF-UB Conference in Biomedicine

## European Conference on Synthetic Biology (ECSB): Design, Programming and Optimisation of Biological Systems

Hotel Eden Roc, Sant Feliu de Guixols • Spain  
24-29 November 2007

Chair: **Alfonso Valencia**, CNIO Madrid, ES

Co-Chairs: **Natalio Krasnogor**, University of Nottingham, UK

- **Sven Panke**, ETH, Zürich Institute of Process Engineering, CH

- **Victor de Lorenzo**, Centro Nacional de Biotecnología, Madrid, ES

[www.esf.org/conferences/07241](http://www.esf.org/conferences/07241)

## Activities towards Task 4 (European Networking)

Series of Workshops on different aspects of SynBio:

- Biofine (Tessy), Freiburg April 10, 2008
- Genopole (Jaramillo), 26-27 June, 2008
- IRGC Workshop Session on the Risk Governance of Synthetic Biology (26 & 27 June - Geneva, Switzerland)
- Stakeholder meeting Roadmap SynBio (Tessy), 10 June 2008
- ESF workshop on Minimal Systems (with A. Moya), in planning
- Etc.....

## Activities towards Task 4 (Global Networking)

**Workshop on:**

**Synthetic Approaches to Cellular Functions, Tokyo, 13 October 2006**

**Organised jointly by D. Kige (JP), H. Ueda (JP), D. Endy (US), Martins dos Santos („EU“)**

**About 120 worldwide attendants, 50+ posters. NEST-PATHFINDER SB projects presented. Overwhelming reaction**

## **Future networking activities Asia**

**Sino-German Exploratory Workshop on Synthetic Biology, Hangzhou, China, 2008. Couple to Probiactys (EU) and perhaps other projects**

**To be organised jointly with Huanming Yang (Beijing Genome Institute, CN)**

**Exchange of students/ scientists:**

**China (2 students 7 month each plus 2 scientists 1 week in 2007)**

**India (2 Students 4 month each, plus scientist 1 week 2008)**

**Explorative project in Israel on digital evolving microbial communities**

**Indian - EU workshop on Synthetic Biology (September 2009)**

**ESF-JSPS Frontier Science Conference Series for Young Researchers  
(Synbio tentative for 2009)**



**Future activities, other**

**Questions WP1?**

# Workpackage 2





**ETH**

Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich



## WP 2: Attracting talents to Synthetic Biology in Europe

 **Emergence**

The logo for the Emergence foundation, featuring a stylized graphic of a DNA double helix or similar structure in white and yellow, followed by the word 'Emergence' in a bold, yellow, serif font.

A Foundation for Synthetic Biology in Europe

1. ETH Zurich (Zurich, CH): Panke, WP leader
2. UCAM (Cambridge, UK): Jim Haseloff
3. EP (Paris, F): Alfonso Jaramillo



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## Overview WP 2 activities

1. Establishment of an “Education focus group”
2. Two summer schools (including wet-lab)
3. A European MSc-program for SynBio
4. Spreading the word: an internet resource at “The IET”

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## Education focus group

Alfonso Jaramillo, EP  
Jim Haselhoff, UCAM  
Gos Micklem, UCAM  
Chris French, Edinburg  
Sven Panke, ETHZ

---

# Summer school:

## Summer school 1

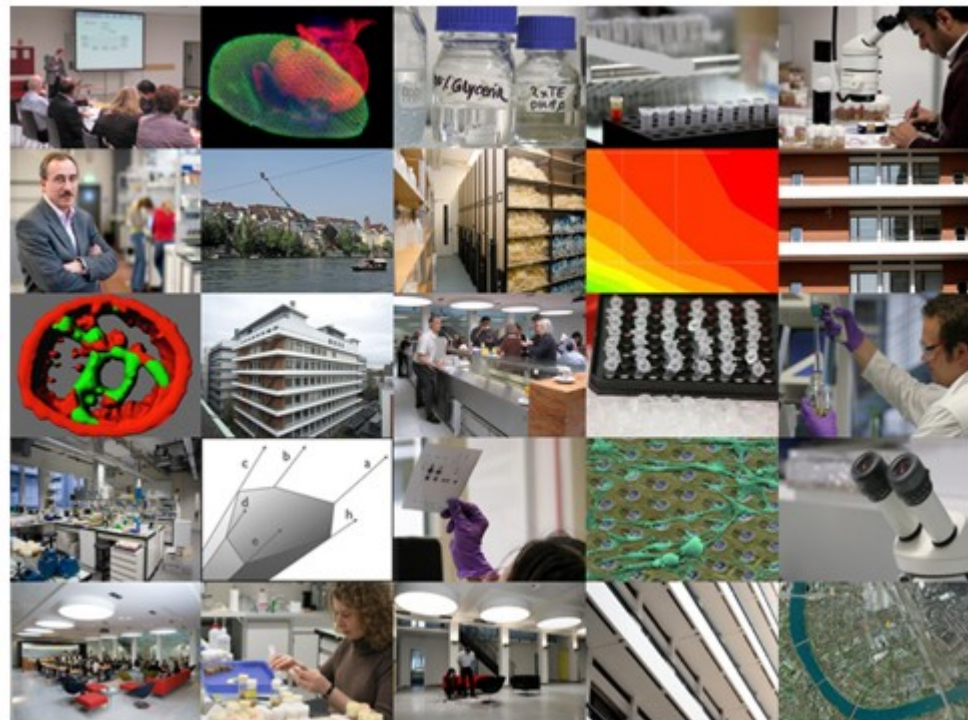
1-13.June 2009, ETHZ BSSE  
Basel, Switzerland

Structure:

- a) Scientific lectures on eminent topics in SynBio
- b) 3 twin theory/wet-lab sections over the 2 weeks

Currently inviting instructors and lecturers

Summer school 2:  
Summer 2010, part of TARPOL



# European Master on Synthetic Biology

Alfonso Jaramillo  
Ecole Polytechnique

# **INSTITUTE OF SYSTEMS AND SYNTHETIC BIOLOGY (ISSB)**

Genopole®-Univ. Evry



## Schedule

- **November 2007.** Proposal to French ministry.
- **February 2008** Dissemination of M2SB
- **April 2008** Ministry approval IMBI-M2SB
- **September 2009** Start courses.
- **October 2009** Finish proposal for *quadriennal*.
- **March 2009** Proposal Erasmus Mundus.

# M2SB

Francois Kepes  
Alfonso Jaramillo

- Introduction to genomics biology (optional)
- Fundamental concepts of computer science (optional)
- Introduction to mathematics for biology (optional)
  
- Design, construction and characterization of biological parts and devices
- Language and modelling for design in systems and synthetic biology
- Molecular modelling: protein interactions and protein design
- An integrated and spatial view of the cellular machinery:  
from biology to modelling
- Symbolic approaches to genetic regulatory networks
- Integrated modelling for physiology
- Practice of genetic engineering
- Modelling and engineering networks of molecular interactions
- Introduction to machine learning for network inference
- Statistical analysis of biological sequences and gene expression



“Spreading the word”: an educational internet resource at “The IET”

<http://www.theiet.org/>

The Institution of Engineering and Technology was formed by the Institution of Electrical Engineers (IEE) and the Institution of Incorporated Engineers (IIE) and now has more than 150,000 members worldwide. It is the largest professional engineering society in Europe and the second largest of its type in the world.

Goal:

- Downloadable teaching materials
- Video presentations
- Online reviews
- Technical articles
- Example: a server at <http://www.iet.tv> will provide dual screen, streaming video containing review and technical material. The resource will be available free of charge.

<http://www.theiet.org/synbio>

<http://tv.theiet.org/channels/research/1552.cfm>

## The IET: Addressing/educating laymen audiences

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Some prefer the aeroplane impression, others the shirt over head. Or there's the ring kiss and even the robot. Who does the best goal celebrations and why do they do it? We investigate in the latest issue of *Flipside*. Plus: Night at the Museum, making games explosions more explosive, the world's weirdest toilets and weirdest things underground, how to YouTube, tagging the Great White and much more. Flipside is no longer available in the shops but you can **subscribe here**.



**FLIPSIDE**  
SPORTS BODY LANGUAGE  
Who does the best celebrations?  
WIN MONEY AND A PRO FOOTBALL PLAYER

**SUBSCRIBE NOW - DON'T MISS OUT**

CURRENT POLL

**Does Daniel Craig make a better Bond than:**

- Pierce Brosnan
- Sean Connery
- Neither

**Send >>**

Pics: Dan Tobin Smith  
SPL/NHPA

# The IET: Providing new channels for communication with the public

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Sean Wargo  
Kris Sangani interviews Sean Wargo, director, industry analysis at CES 2007.  
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##### Futures Sources of Energy

Professor Paul Ekins  
28 Feb 2007 Research Channel  
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## Questions WP2?

## **WP3: IT Infrastructure for Synthetic Biology**

Jörg Stelling

[joerg.stelling@bsse.ethz.ch](mailto:joerg.stelling@bsse.ethz.ch)

EMERGENCE SAB Meeting

Hong Kong, October 2008

## WP3: Aims and Tasks

- **Specific aims and responsibilities:**
  - Information integration via (an instance of) the MIT Registry of Standardized Biological Parts (**CNIO, CGR, GBF**).
  - Methods and tools for model-based parts and systems design (**CGR, ETHZ**).
  - Tools for gene synthesis and assembly (**Geneart**).
- **IT infrastructure: Integrated work-flow for the design of synthetic genetic circuits similar to 'traditional' engineering disciplines.**

# Status: Information Integration (1)

The screenshot shows the iGEM Parts Viewer interface. The browser address bar displays the URL: [http://ubio.bioinfo.cnio.es/people/icases/iGemViewer/index?part=BBa\\_J45270](http://ubio.bioinfo.cnio.es/people/icases/iGemViewer/index?part=BBa_J45270). The page title is "iGEM Parts Viewer". The main content area displays the part name "BBa\_J45270" and its description: "Stationary phase dependent banana odor generator (1802 nucleotides)". Below the description is a sequence viewer showing the DNA sequence: `TTCAAAATTCGTGATCTATATTTAAACAATAC TAGAGTCACACAGGAAAGTACTAGATGAATGAAATCGATGAGAAAAATCAGGCCCCCGTGCAACAAGAAATGCCCTGA`. An iGEM logo is visible below the sequence. The page also shows metadata for the part, including "85:1659 cds" and "none" for orientation, score, target, and phase. A "help" popup is visible in the bottom left corner, listing keyboard navigation instructions: "Left Arrow: Select Next Domain", "Right Arrow: Select Previous Domain", "Down Arrow: Select Next Track", "Up Arrow: Select Previous Track", and "Space or Enter: Open Link to Domain".

The screenshot shows the Available DAS sources web application. The browser address bar displays the URL: <http://www.dasregistry.org/listServices.jsp>. The page title is "Available DAS sources". The main content area displays the heading "AVAILABLE DAS SOURCES" and "available DAS services". Below the heading is a filter section with the following fields: "organism:" (any), "authority:" (any), "type:" (any), "capability:" (any), and "label:" (any). A "display" button is located to the right of the "label:" field. Below the filter section is a table with the following columns: "pos id", "clients", "nickname", "status", "capabilities", "coordinateSystem", "description", and "project". The table contains one row of data: "1", "DS\_415", "RSBP Parts", "types", "UniProt, Protein Sequence", "null". Below the table is a "DAS - client legend" section with the following items: "... SPICE", "... Ensembl", and "... Dasty". The footer of the page contains navigation links: "home", "list sources", "validate", "register new", "statistics", "history", and "docu".

- ❑ Information distribution tools and methods are needed for integration, visualization and processing.
- ❑ Approach: Infrastructure based on DAS protocol (prototypes for Parts reference server, annotation server based on Uniprot).

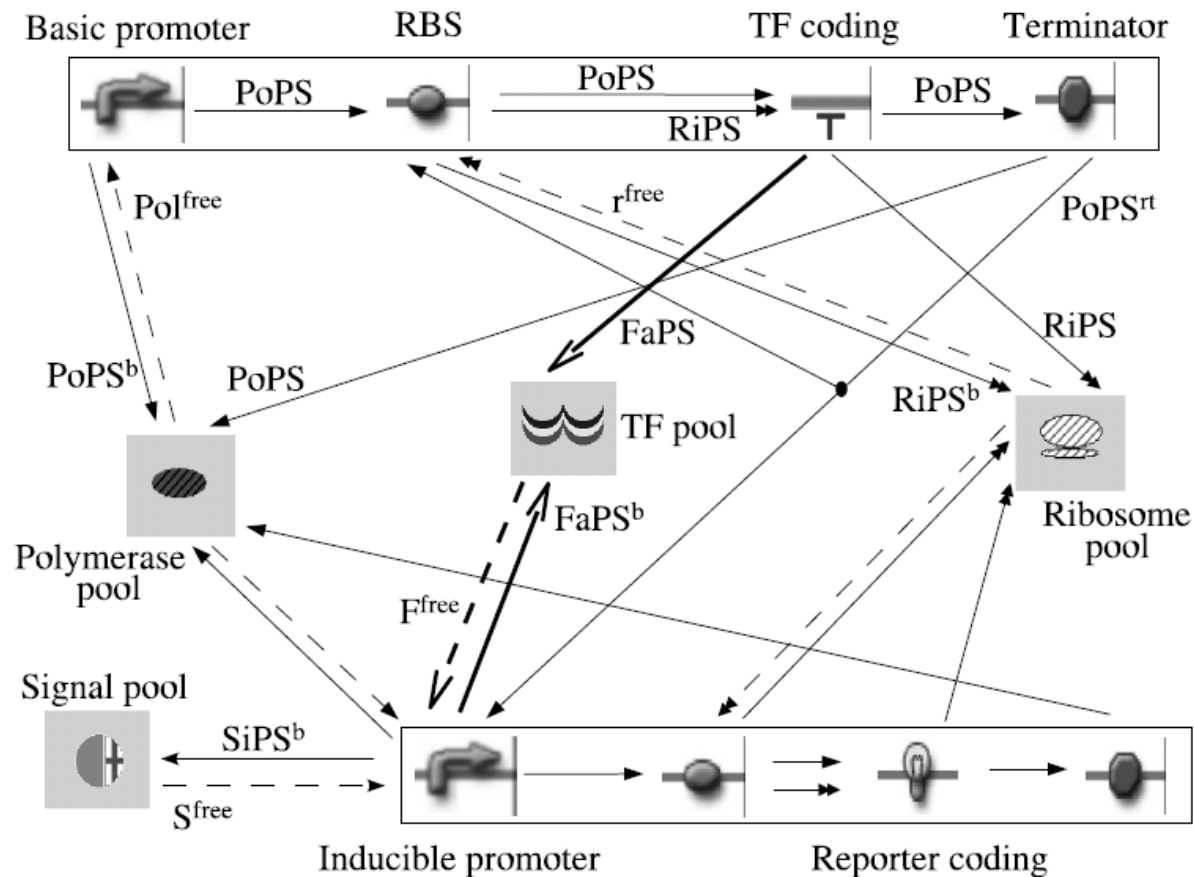
# Status: Information Integration (2)

The screenshot displays the MaDAS 2.0 web interface. At the top, the MaDAS logo and version '2.0 Released' are visible. A navigation bar includes 'Welcome Osvaldo Granna' and links for 'Home', 'Projects', 'Plugins', and 'Help'. On the left, a 'VISUALIZATION PLUGINS' sidebar offers 'Manage project' and 'Visualization plugins'. The main area features a genomic track with a scale from 0 to 7917. A modal window is open, showing details for a protein: 'Label: UNIPROTKB\_Q8NF91\_VAR\_SEQ\_1444\_8797', 'Type: alternative\_sequence\_site', 'Start: 1444', and 'End: 8797'. The modal includes 'Edit', 'Duplicate', and 'Delete' buttons. On the right, a 'Now Working In' section lists project details for 'Protein Test', including the creator 'Victor De La Torre', creation date '2008-02-23', category 'test projects', and security 'public'. Below this, a 'Project Members (4)' list includes 'Victor de la Torre (APPROVED)', 'Oswaldo Granna (APPROVED)', and two 'guest' members. A 'Join Similar Projects' button is at the bottom right.

- ❑ Multi-user annotation system MaDAS 2.0 for collaboration.
- ❑ Limitation: Standard vocabularies and formats lacking.
- ❑ Limitation: Low-level distribution method needed (e.g. SQL).

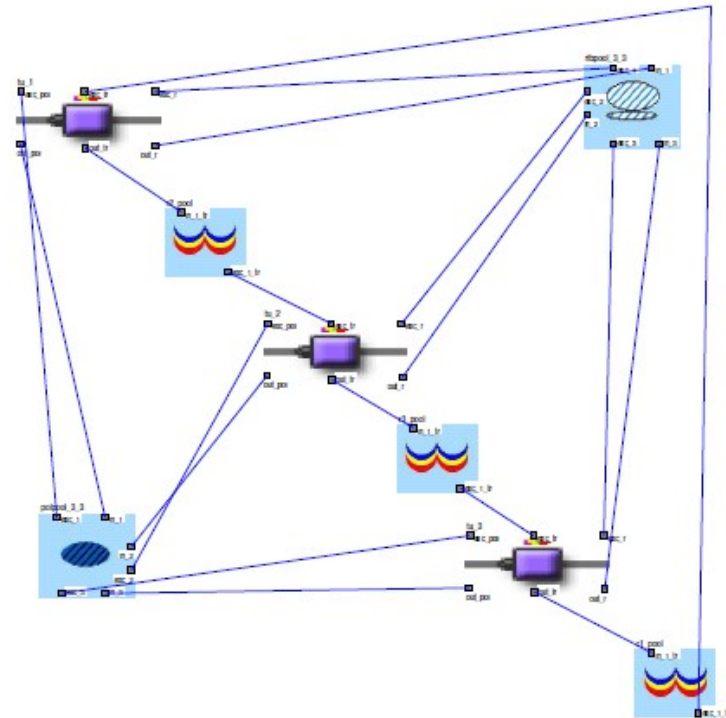
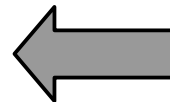
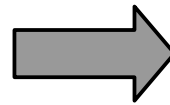
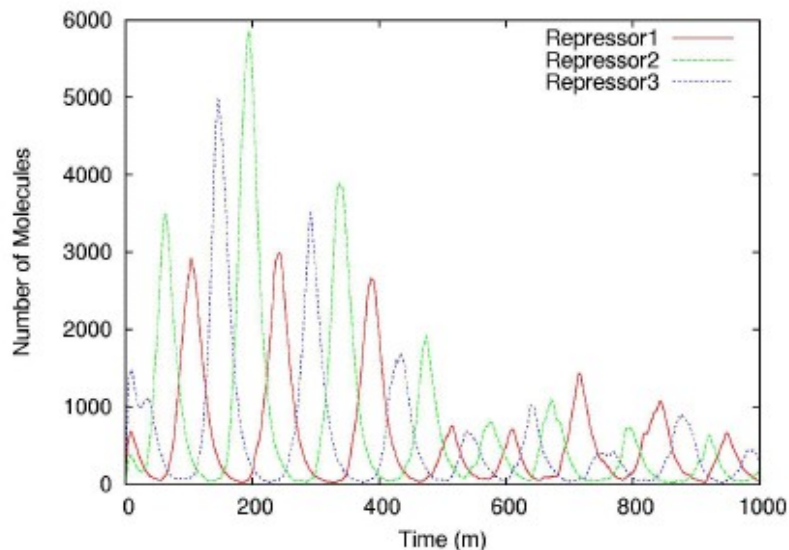
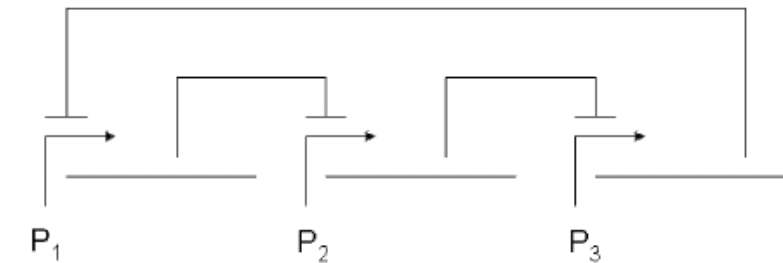


# Status: Model-based Design (1)



- Key challenges: Composability and functional composition.
- Composability: Standardized methods for modular and hierarchical aggregation of parts (and models thereof).

## Status: Model-based Design (2)



- ❑ Model library for standard biological parts incorporated into 'drag&drop' modeling software (ProMoT, MPI Magdeburg).
- ❑ Limitations: Functional composition and automatic design.

## WP3: Perspectives

### □ **Forward integration into tool chain:**

- Links between registry, annotation / database system, parts and systems modeling & simulation; expansions of all of the above technical capabilities.
- Standardized interfaces and parts characterizations.

### □ **Current bottlenecks for proof-of-principle:**

- Unclear relationships with MIT Registry: To be solved.
- Insufficient information on parts and systems: WP4 and integration of *in silico* predictions / literature mining.

"Remember that all models are wrong; the practical question is how wrong do they have to be to not be useful."

G.E. Box (Statistician)

Questions WP3 ?

# Refactoring the *Pseudomonas* TOL transcriptional circuit

Rafael Silva-Rocha and Víctor de Lorenzo

[rsilva@cnb.csic.es](mailto:rsilva@cnb.csic.es)

Centro Nacional de Biotecnología - CSIC - Madrid

Molecular Environmental Microbiology Laboratory

SB4 - Hong Kong

2008

Environmental Microbiology

Bioremediation

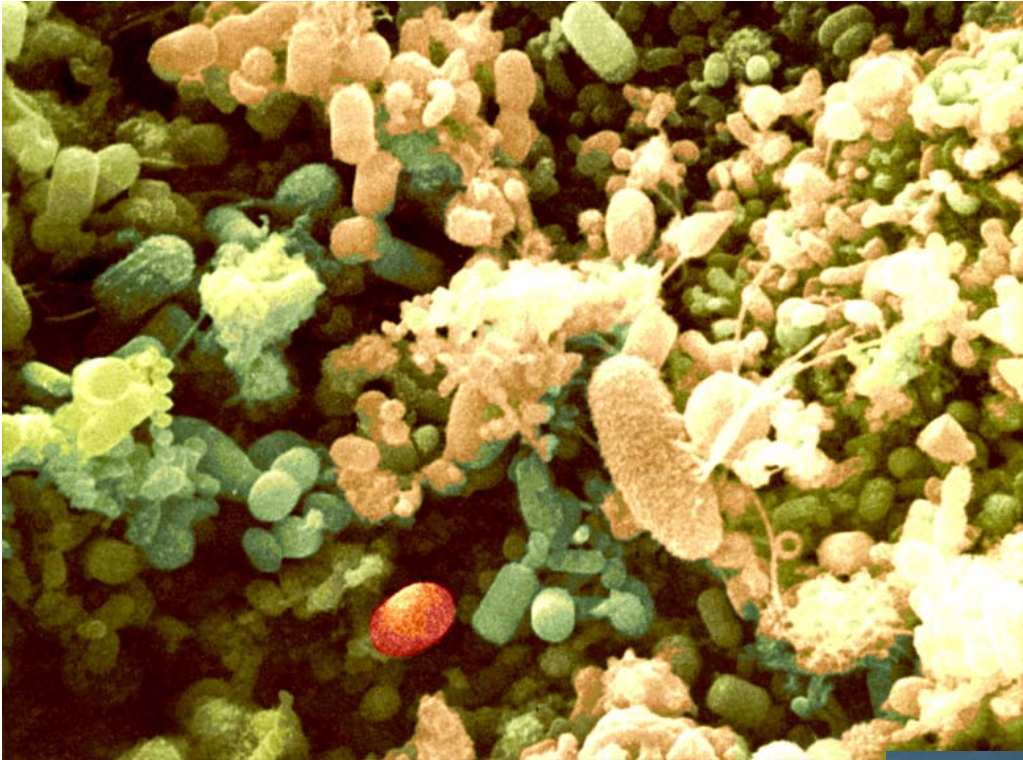
*Pseudomonas putida* mt-2

TOL plasmid pWWO

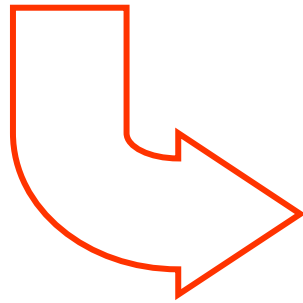
# Our interest site

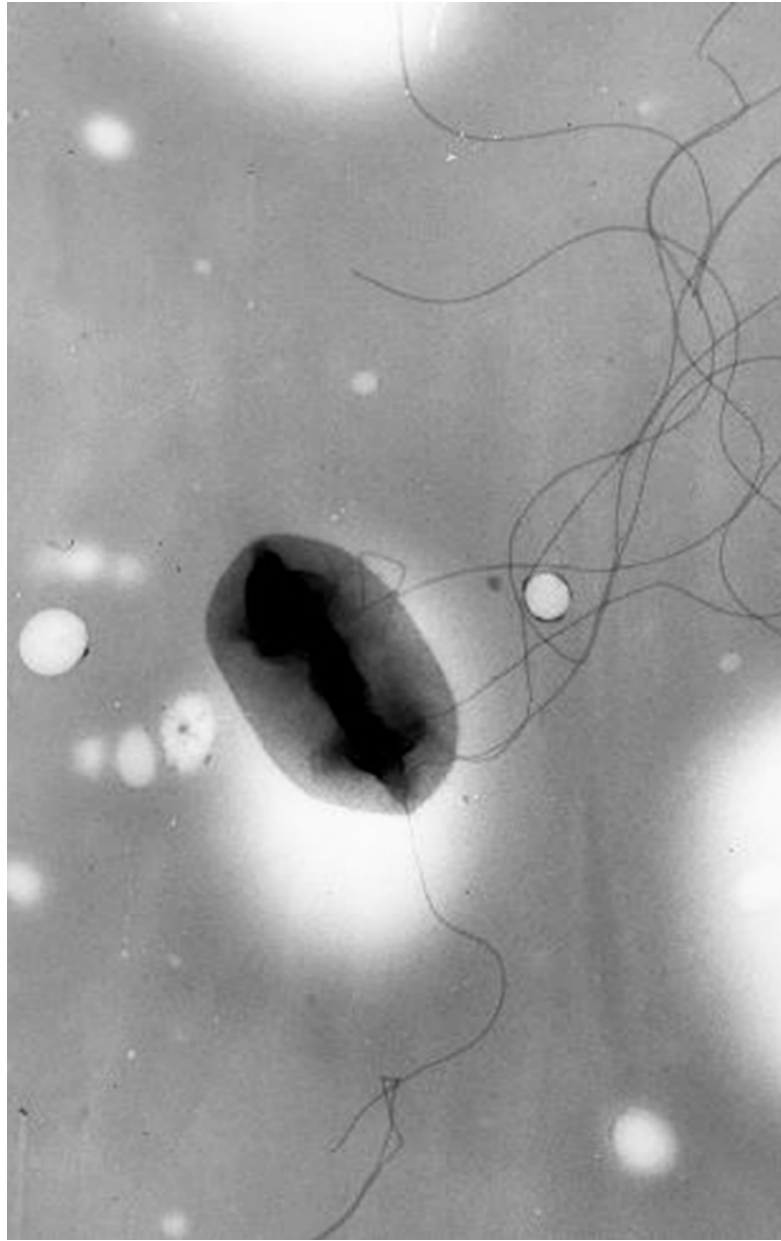






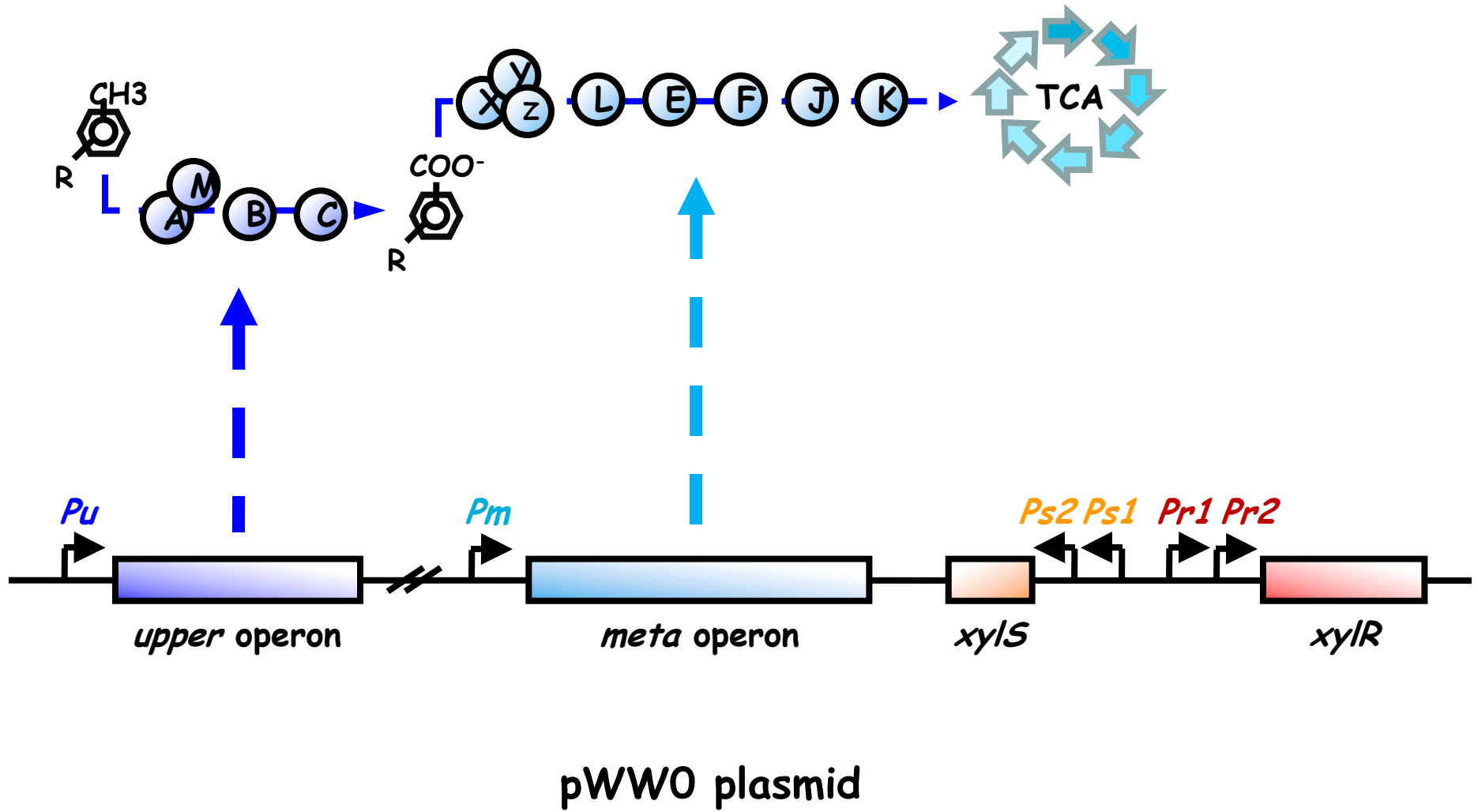
Toluene degradation



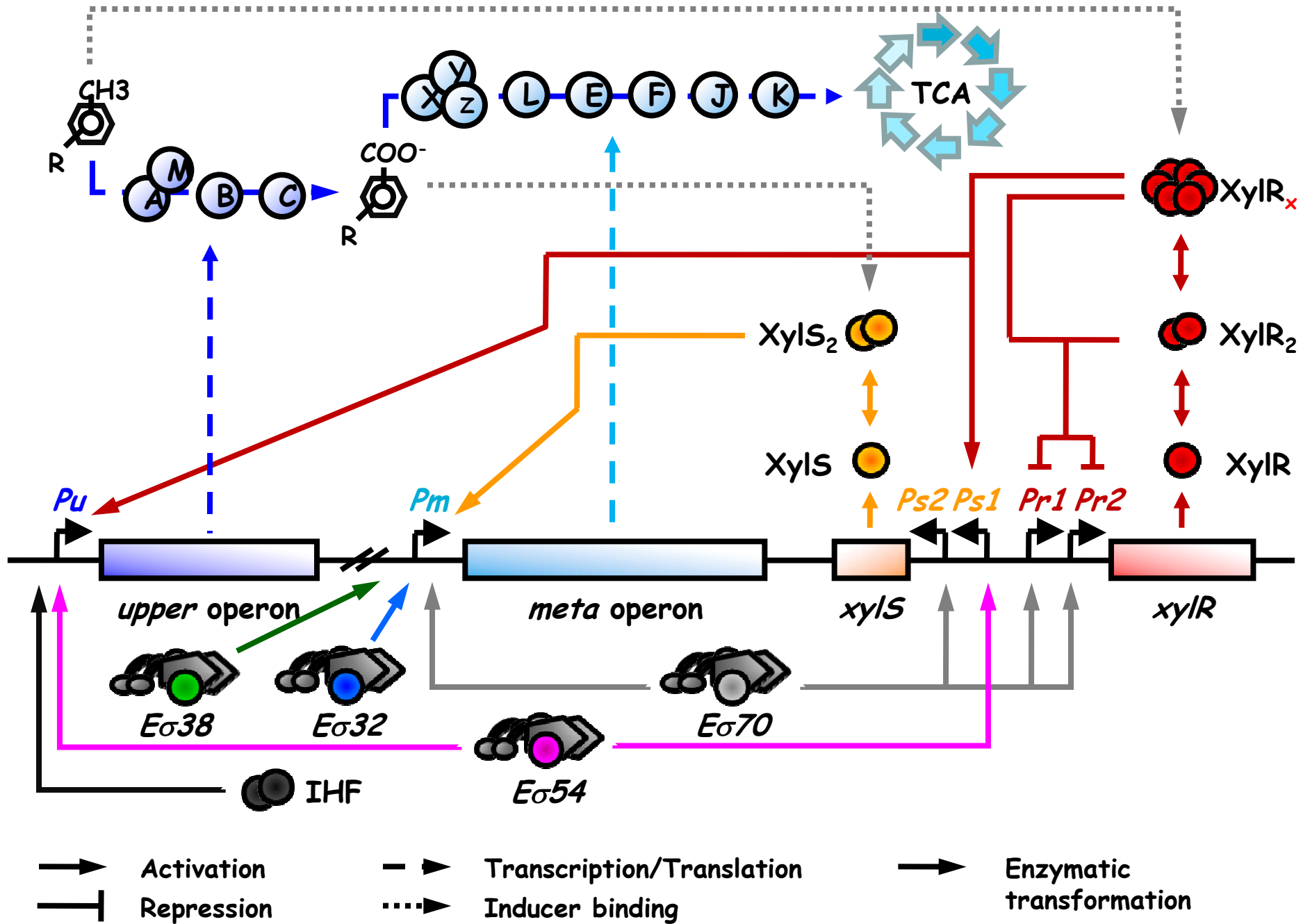


*Pseudomonas putida* mt-2

# The TOL pathway



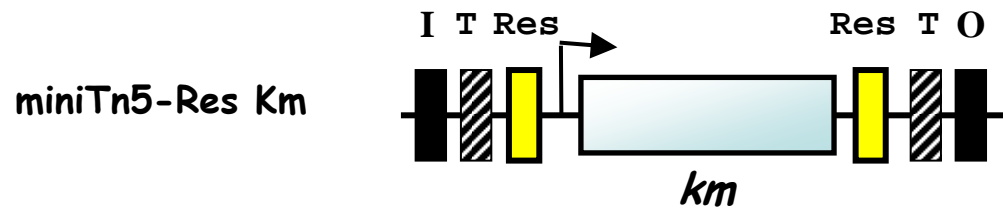
# The TOL Circuit



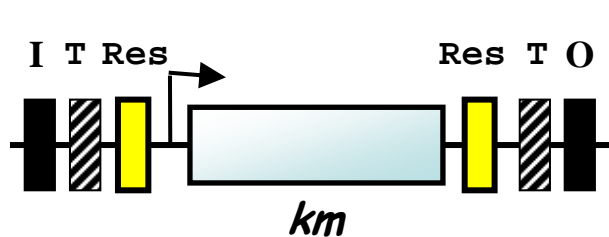
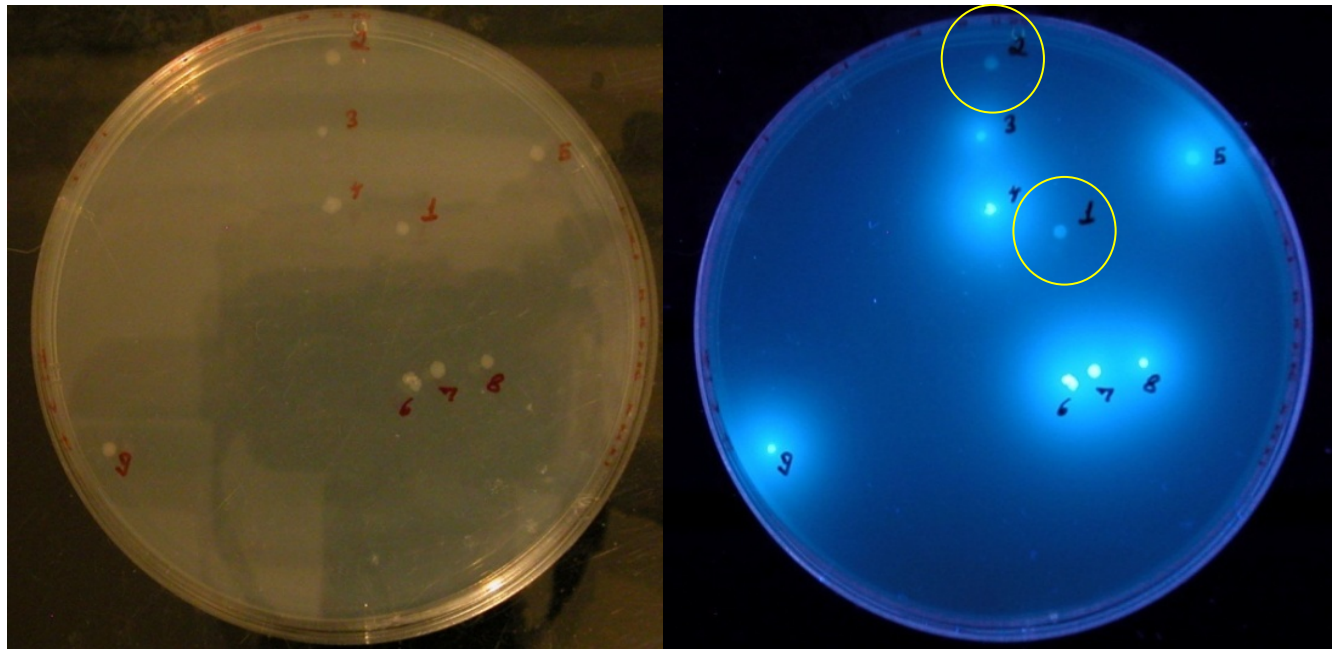
# *P. putida* SB part I:

- *P. putida* for laboratory
  - Create a non-fluorescent *P. putida* strain

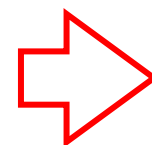
# Random mutagenesis in *P. putida* KT2440



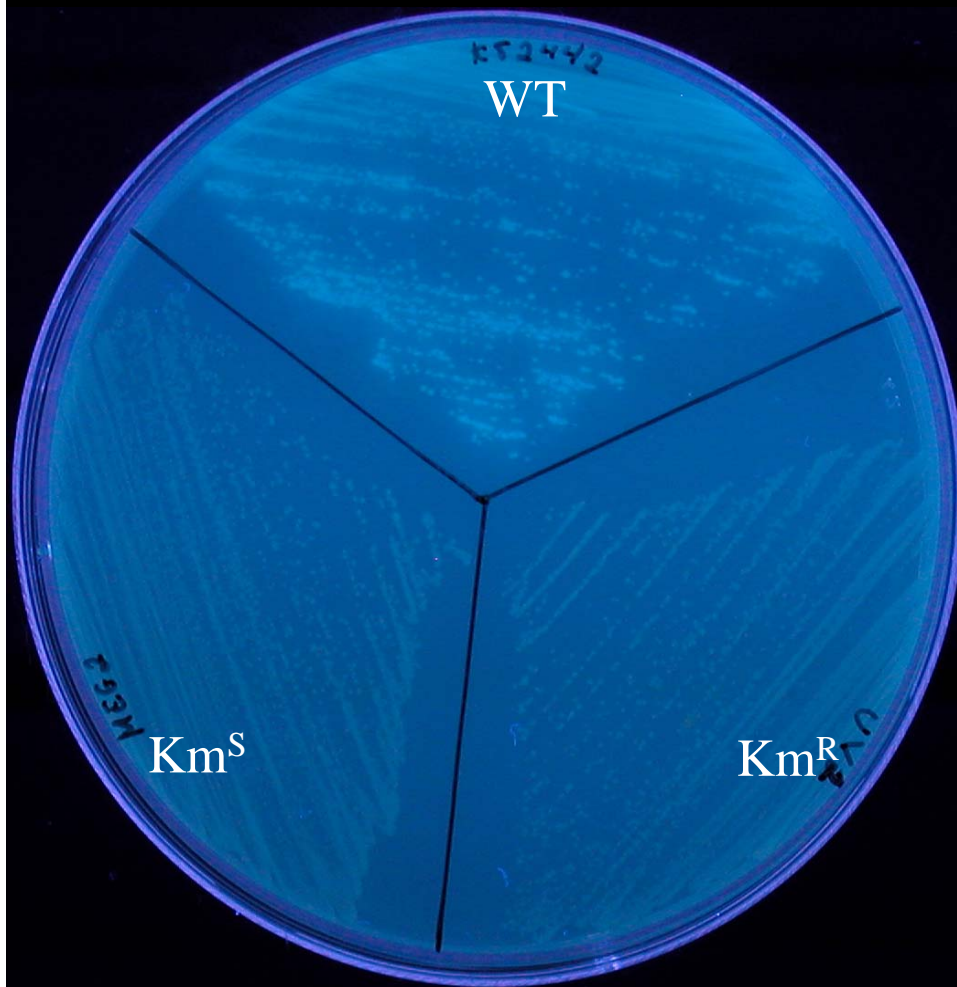
de las Heras *et al* 2008



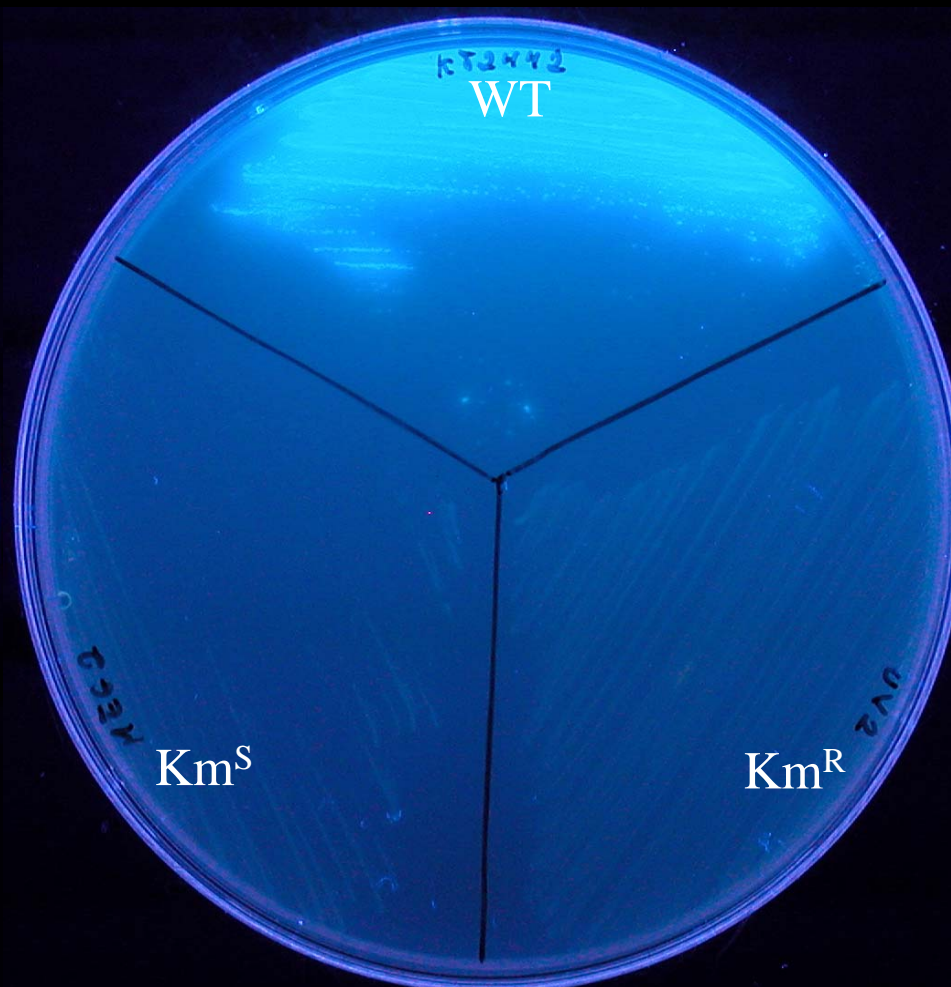
ParA



LB



MM

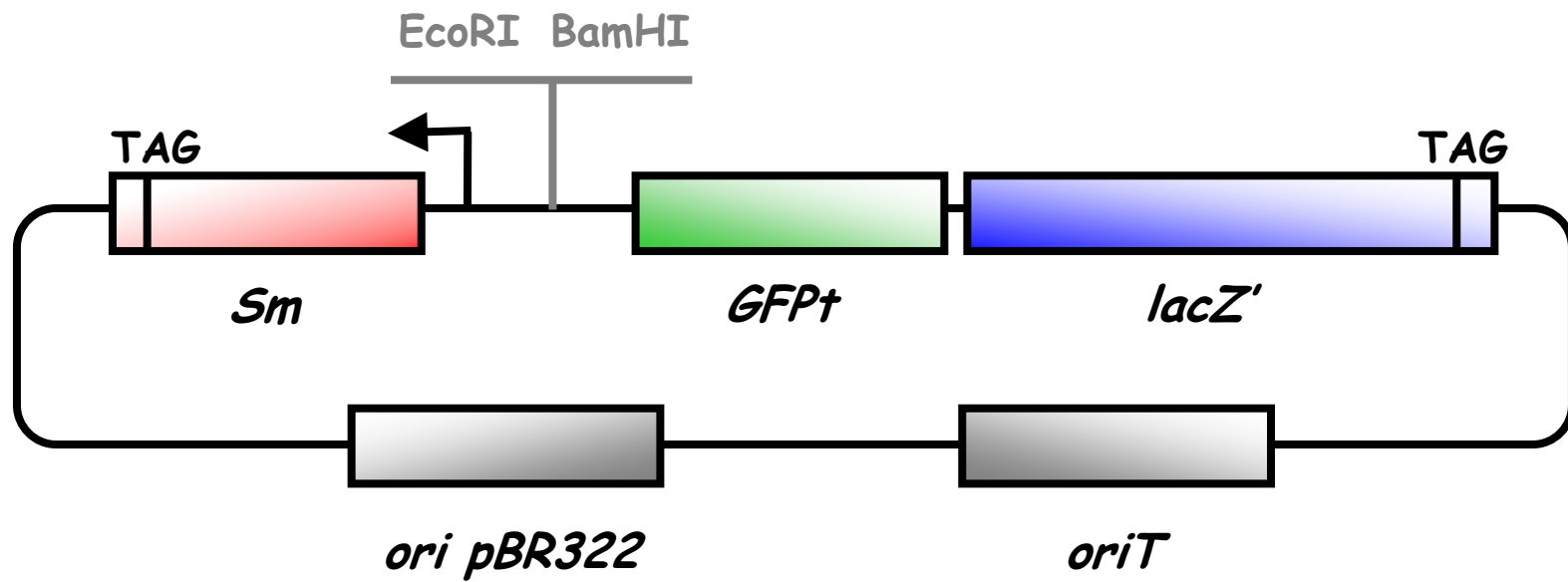


# *P. putida* SB part II:

- Standardization of Promoters
  - Create a system for *P. putida* promoter quantification
  - Monocopy promoter measurement
  - High-throughput screening (GFP)



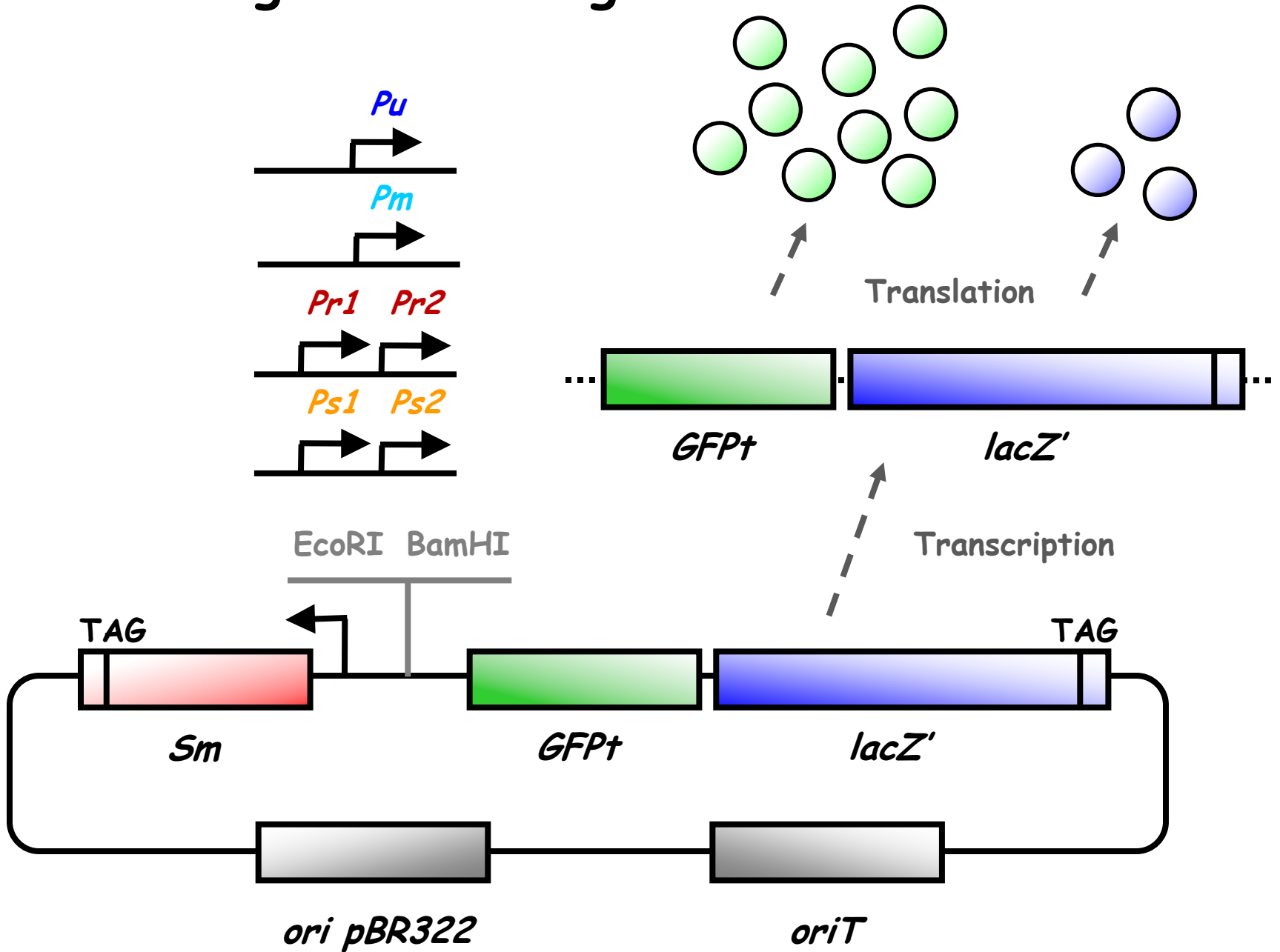
# The pRV1 system



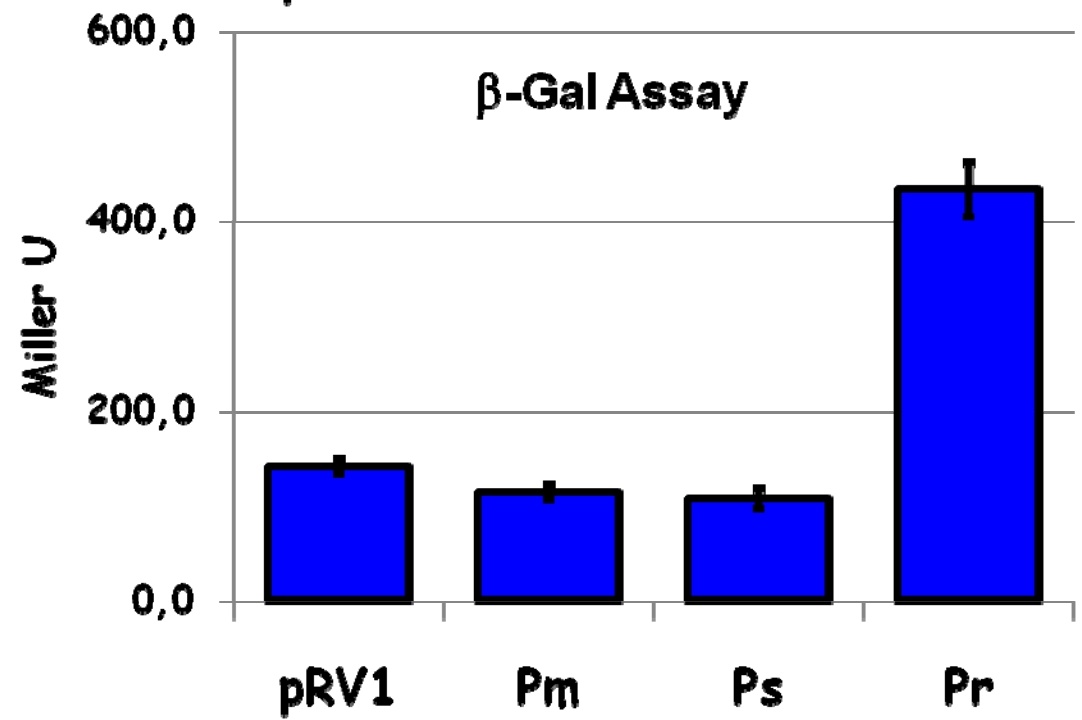
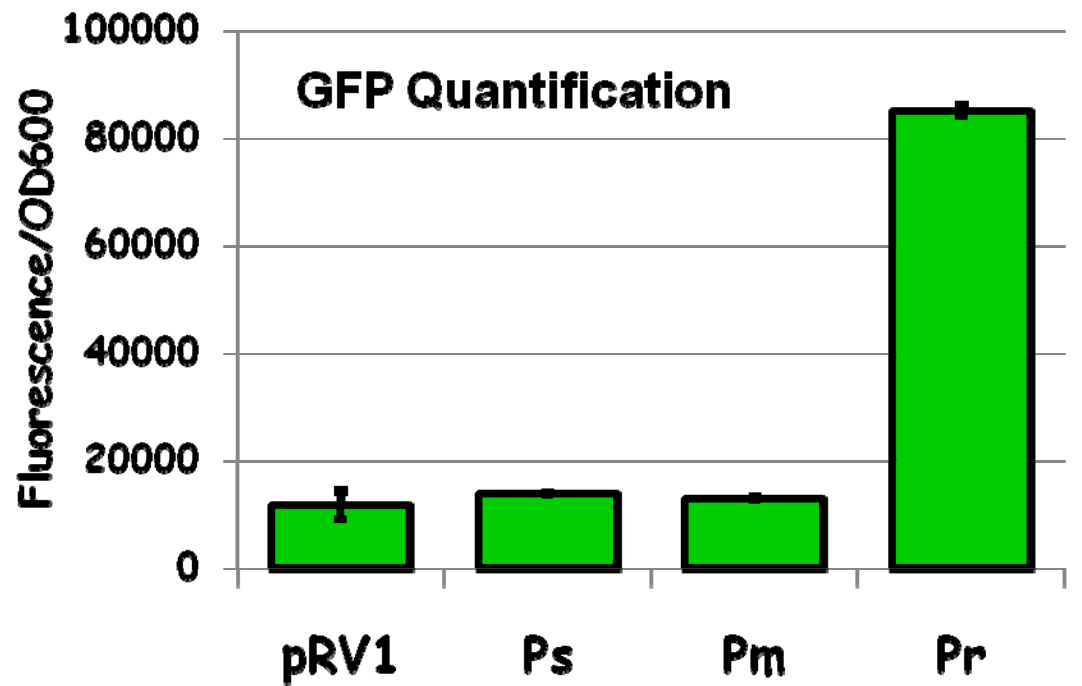
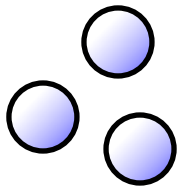
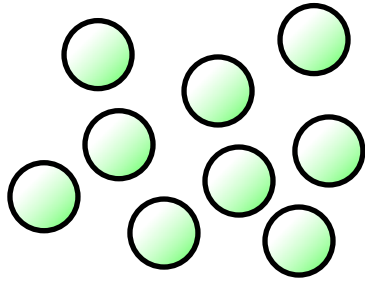
**pRV1**  
8.2 Kb

*E. coli* CC118supF

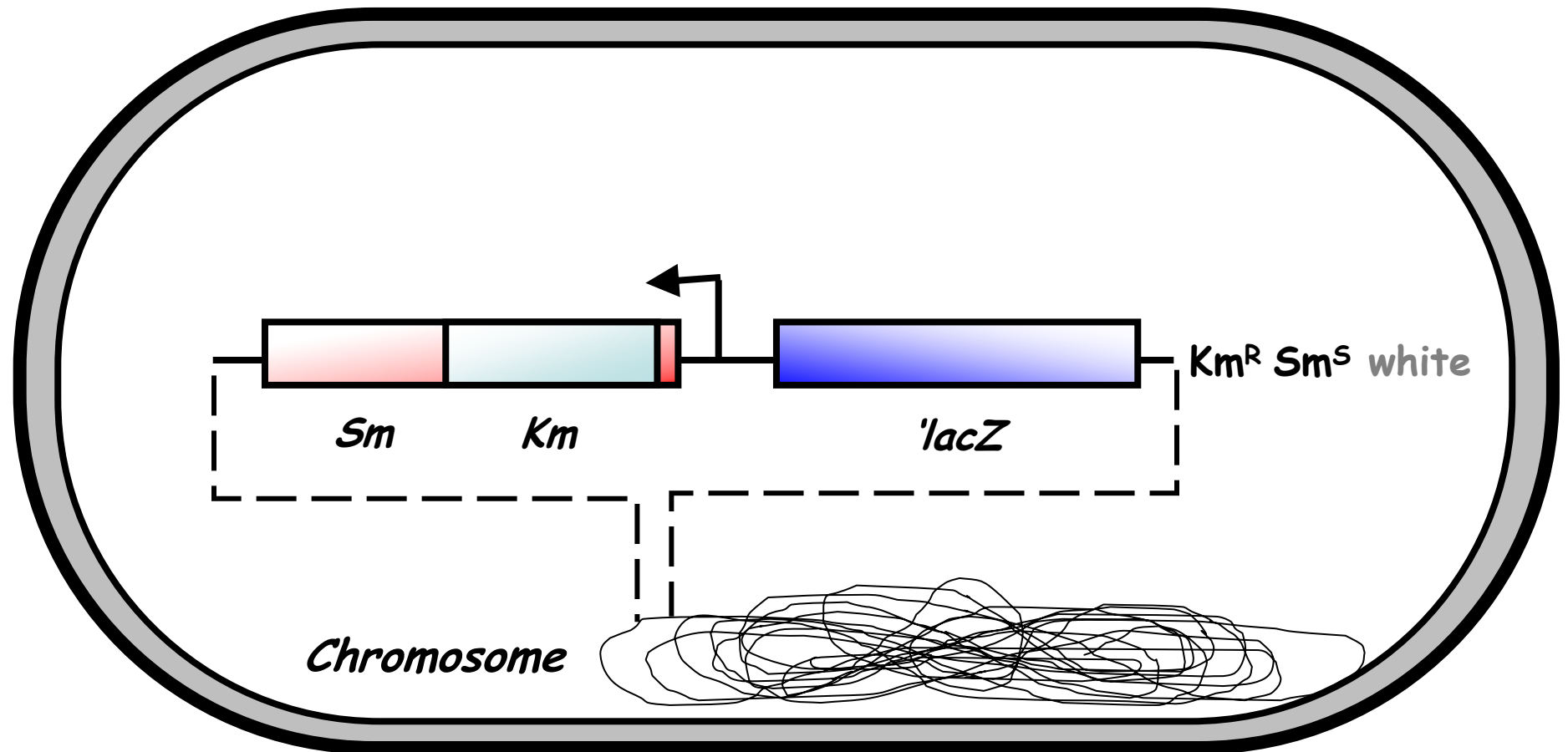
# Standardizing the building blocks



# Bicistronic reporter

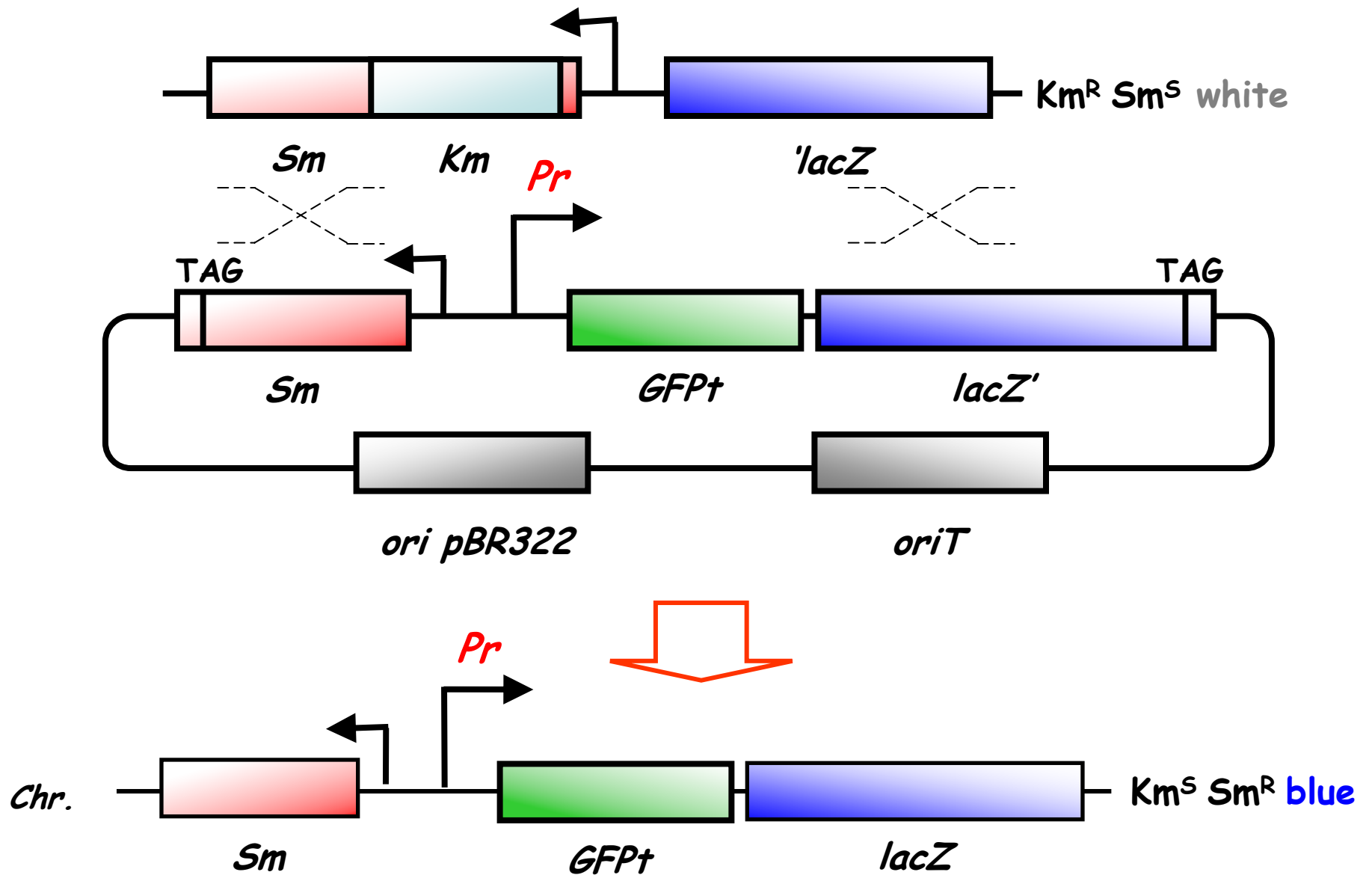


# Chromosomal homology fragment (*P. putida* KT2440)

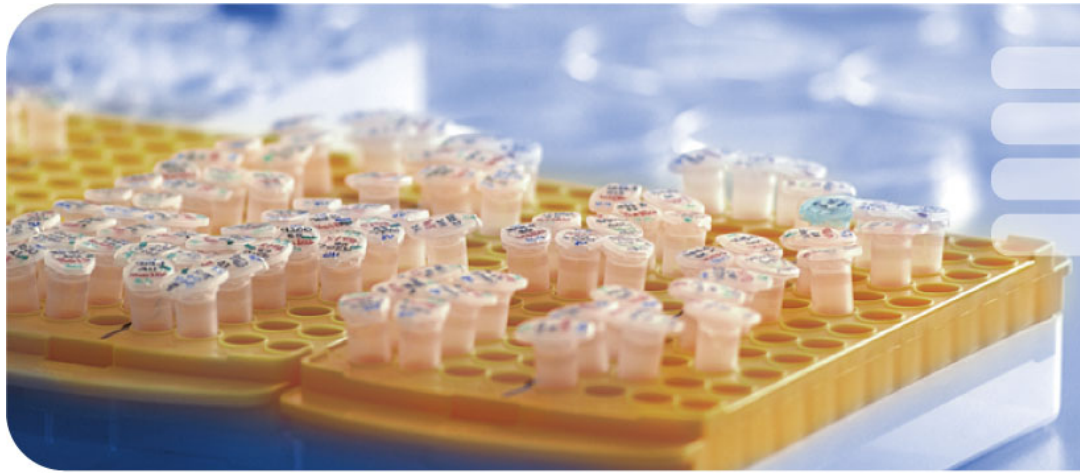


pLOF -hom.fg. (miniTn10), Kesser *et al* 1992.

# Homologous recombination



## Questions WP4



## **EMERGENCE Meeting Hong Kong - October 2008**

### **Workpackage 5: Building the Academia-Industry interface**

Frank Notka, Ralf Wagner, October 2008

## Workpackages 3 and 5: Deliverables

Deliverable		Progress
3.4	Document describing the proof-of-concept study exploiting the integrated workflow for genetic circuit design	In progress
5.1	Reports on two industry workshops <ul style="list-style-type: none"> <li>– to define the priorities of the European industry in the field of synthetic biology, and</li> <li>– to evaluate the fit of the European synthetic biology projects with the industry needs</li> </ul>	Delay (involvement in 10/07) 1. report in preparation
5.2	Reports on two workshops (associated to industry-relevant scientific conferences) to teach the industry in synthetic biology concepts and tools	SynBio 4.0 session on Industrial Biotechnology
5.3	Position paper on the priorities of the European industry in the field of synthetic biology, evaluation of fit with current EU synthetic biology projects, and decision on how to address the potential gaps	In progress
5.4	Intermediate and final report on status of discussion regarding IP strategy in the field of synthetic biology, originating from company internal assessments and summarizing the ideas on IP-management (same workshops as in D5.1)	Delay 1. report in preparation

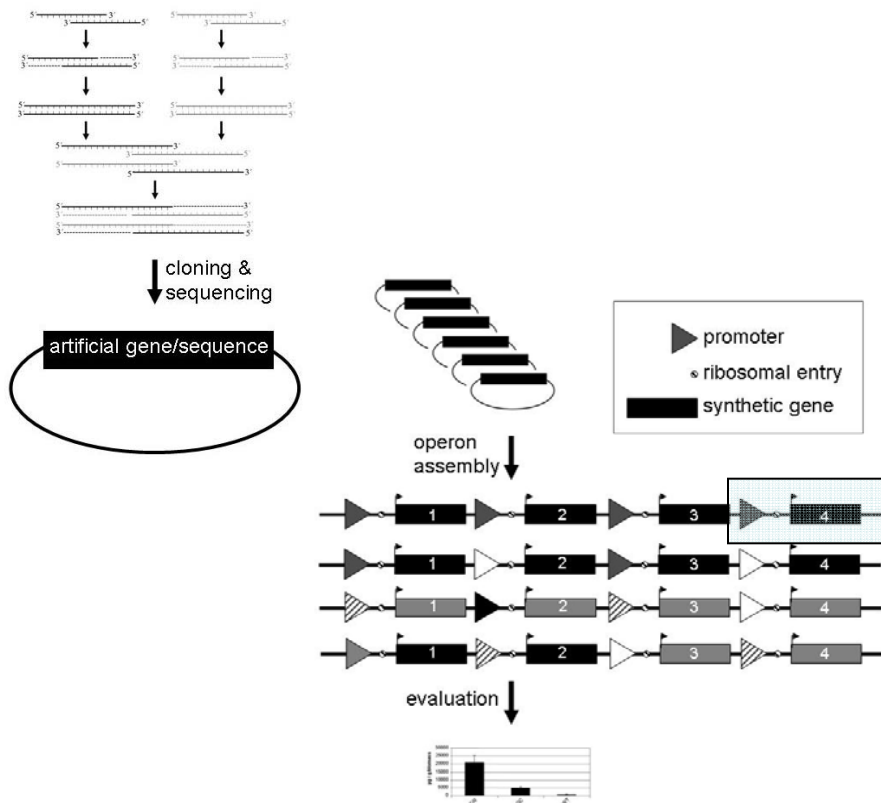


# Workpackage 3

## European IT Infrastructure for SB

### Strategies and tools for gene synthesis and assembly:

*Gene sized segments can be assembled from synthetic oligonucleotides allowing maximum freedom for rational operon design. Differently designed elements in operons can be evaluated and optimized*



#### I) Gene-design

- high flexibility
- adaptation to host
- interchangeable parts

#### II) Synthesis capacities

- up to 2 mio bp/month
- expanding automation platform
- introduction of Laboratory Information Management System (LIMS)

#### III) Variants of coding/regulatory elements

- epigenetic control
- metabolic control

#### IV) Functional circuit design

- cooperative task

## Workpackage 3

### European IT Infrastructure for SB

#### **Strategies and tools for gene synthesis and assembly:**

Provide a strategy to evaluate parts in regard of biosecurity in order to avoid miss-use

*Bioinformatics @ Geneart: Providing highest biosecurity level*

#### **Initial check of gene synthesis:**

- (1) Country of customer (K-List, Embargo states)
- (2) Nature of customer (HADDEX List)
- (3) Nature of sequence (Internal data-base, blast)

**Involvement of regulatory authorities/guidelines (BAFA and Australia group)**

**Check for associated pathogenicity/toxicity (dual-use components)**

**Based on these information a Go/No-Go decision is made**

## Workpackage 5

### WS IP issues (16.06.2008)

#### Objectives:

- Discuss open source policy and role of patents
- Provide a basis for discussion in Industry WS

 **Provide ideas for an IP-strategy that would promote integration of the European industry into the development of Synthetic Biology**

#### Participants

Experts from different IP related disciplines:

- Technology and innovation management (J. Henkel, TUM)
- Patent - industry (K. Schwander, DSM; C. Ludwig, Geneart)
- Patent - public (B. Rutz, EPO)
- Development (S. Panke, ETH; L. Pasamontes, DSM)
- Technology provider (R. Wagner, F. Notka, Geneart)

## **Workpackage 5: IP WS**

### **Take-home messages:**

**The realization of an European Registry involving the European industry is possible**

**IP-relevant parts should not be excluded**

***What we should think about:***

Standard MTA

Information management system

Involving funding agencies

## Workpackage 5

### WS Define needs and interests of Industry (25.06.2008)

#### Objectives:

- Definition SB
- Attract Industry to European SB
- Link Academia & Industry
- Address IP issues

 **Promote the Integration of Industry into the European SB development**

#### Participants

Experts from leading European industries covering:

- Chemistry (Lonza, Novozymes, DSM)
- Pharma (AstraZeneca, F. Hoffmann-La Roche )
- Environment/Biomaterials (Metabolic explorer, Heurisco)
- Biotechnology (Lifewizz) and

European academic Synthetic Biology exponents (Helmholtz-Allianz Systembiologie, Helmholtz-Zentrum für Infektionsforschung)

## **Workpackage 5: Industry WS**

### **Take-home messages:**

**Gain more visibility by presenting successful and relevant applications**

**Strategic top down approach recommended**

Push the buttons of politicians and investors

**A clear bias in development**

Prokaryotic development much more advanced:

Metabolic pathways, Biofuels & fine chemicals, Biodetectors

**Big Pharma: Too early for our engagement**

Prefer small cooperation strategies

Slow process due to extensive negotiations

**Redirect contacts**

Address smaller companies

Include regulatory and IP manager

Involve other types of Industries

**Open Source policy**

Clear tendency towards non-open solutions

IP regulation a major issue

End of WP5

## **Planned activities in the second period:**

2009:

- Continue work on showcases, promoter formatting (V. de Lorenzo, L. Serrano), IT infrastructure (A. Valencia)
- 2nd Academia/Industry workshop
- IP-strategy development
- Summer school 1 (EMERGENCE)
- Scientific workshop on formatting transcription (Gourse, Busby, Aiba, Buck), Mallorca, Spain (V. de Lorenzo)
- Promoting EU-Asia exchange

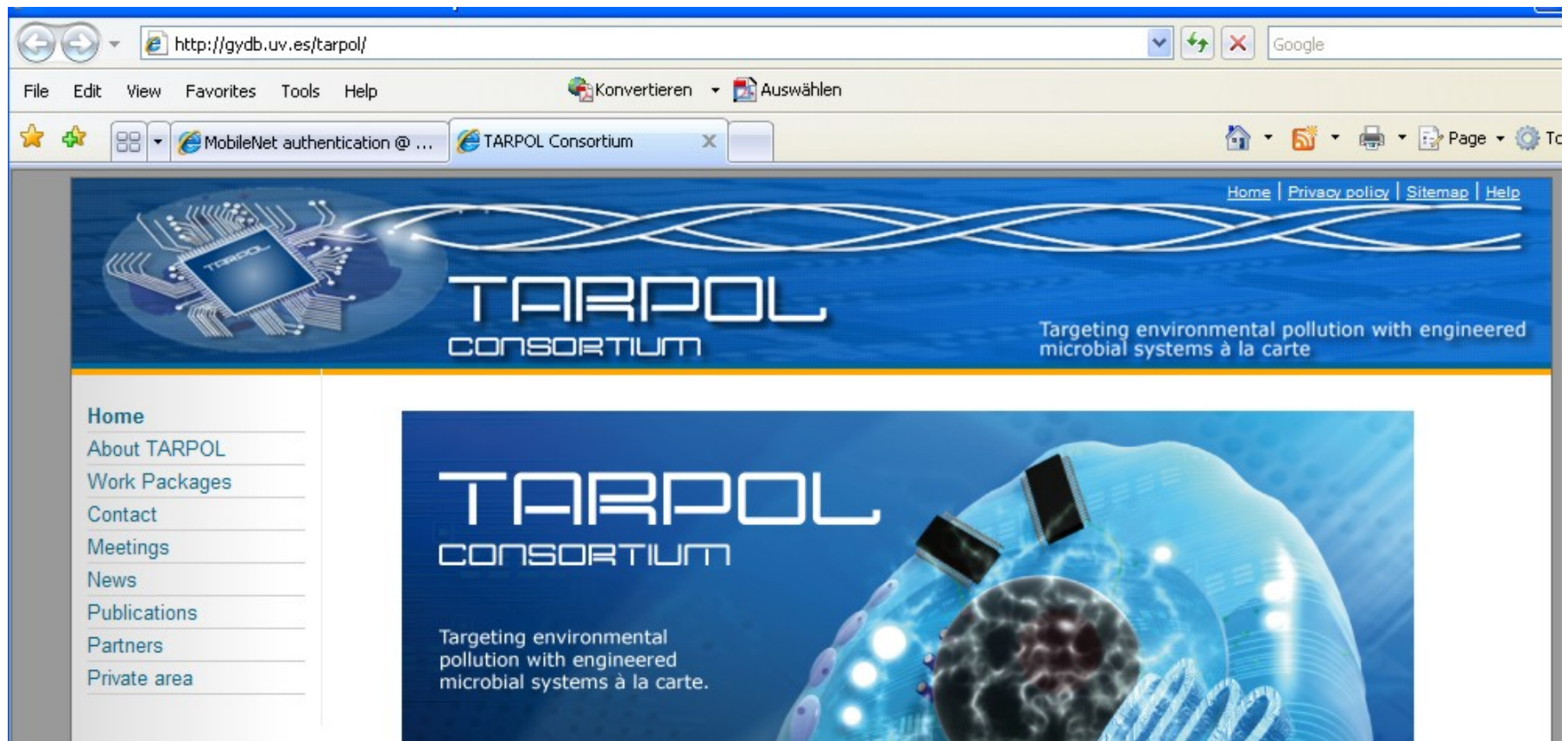
2010

Summer school 2 (TARPOL)

**And... your workshops and other activities!!**



www.gydb.uv.es/tarpol/

A screenshot of a web browser displaying the TARPOL Consortium website. The browser's address bar shows 'http://gydb.uv.es/tarpol/'. The website has a blue header with a DNA double helix graphic and the text 'TARPOL CONSORTIUM' and 'Targeting environmental pollution with engineered microbial systems à la carte'. A navigation menu on the left lists: Home, About TARPOL, Work Packages, Contact, Meetings, News, Publications, Partners, and Private area. A large banner image at the bottom shows a glowing blue cell-like structure with a globe inside, with the text 'TARPOL CONSORTIUM' and 'Targeting environmental pollution with engineered microbial systems à la carte.' repeated.

# Topics on the European SB Agenda: Funding



## *Current opportunities 1*

EU FP7:

*Area 2.3.6 Emerging trends in biotechnology*

**KBBE-2009-3-6-05: Synthetic biology for biotechnological applications**  
**Call: FP7-KBBE-2009-3**

**Collaborative Project (small or medium-scale focused research project)**

# Topics on the European SB Agenda: Funding



## *Current opportunities 2*

**EMERGENCE** submitted a theme proposal to the ESF EUROCORES Program beginning of June:

***Synthetic Biology: Engineering Complex Biological Systems  
(EUROSYNBIO)***

*(Coverage of (essentially) the entire field of European SynBio)*

**EUROCORES: Similar to EU projects (international projects) but funded by national funding agencies, typical projects: 5 PIs, 3 years, total volume of all accepted projects: up to 10 Mln € (depends on how many national agencies participate)**

**Proposal EUROSYNBIO got selected in September**

**Final DRAFT CALL submitted to ESF two days ago – Call goes out to national funding agencies TODAY**

**IMMEDIATE NEXT STEPS: YOUR FUNDING AGENCY NEEDS TO DECIDE WHETHER IT WANTS TO PARTICIPATE IN THE PROJECT!**

**NEXT STEPS:**

- a) **You are in a country which has participated in the original proposal: Contact your national co-proposer to strengthen his case in talking to the national agencies**
- b) **You are not in a country that did not participate: Find out who is in charge for ESF contacts at your national funding agency and start convincing them that there is a case for your country to participate (preferably by pointing out many of the scientists in your country that might be interested).**
- c) **Next deadlines (tentative):**
  - a) **Mid December, agencies decide**
  - b) **March/April: deadline for proposal submission**



**To learn more about EUROCORES:**

**<http://www.esf.org/eurocores>**

**To study the Draft Call: go to EMERGENCE website**

**[www.emergence.ethz.ch](http://www.emergence.ethz.ch)**

# Topics on the European SB Agenda: Community

## Discussion



# Topics on the European SB Agenda: Research Agenda

## Discussion



# **Topics on the European SB Agenda: Knowledge Transfer**

## **Discussion**





# Topics on the European SB Agenda: iGEM

## Discussion



# **Topics on the European SB Agenda: Outreach US-EU-Asia**

## **Discussion**



**Thank you for your input!**

**[www.emergence.ethz.ch](http://www.emergence.ethz.ch)**