



iGEM Project 2007

University of Peking

Towards Bacterial Assembly Line

Maximilian Hörner

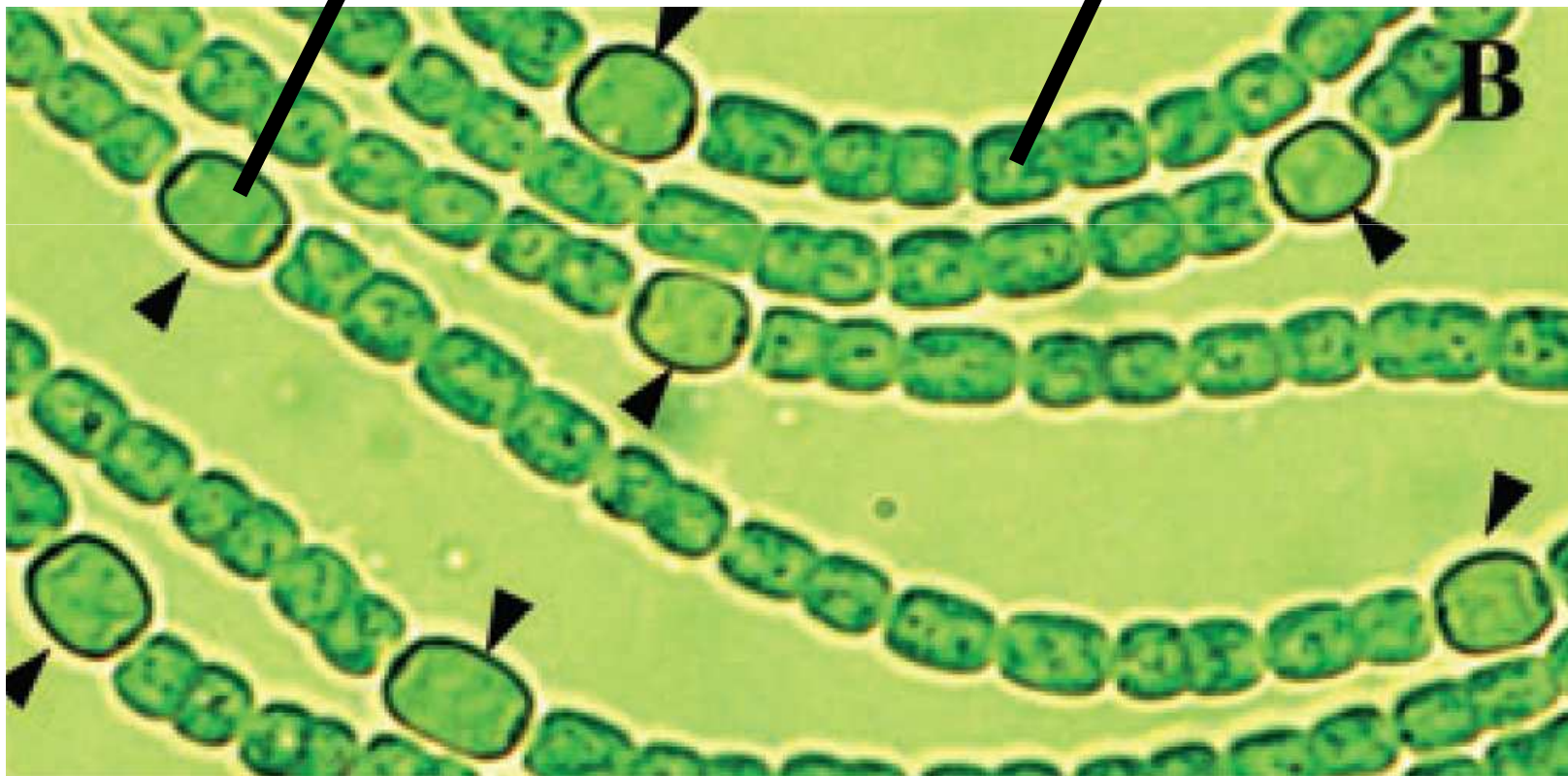
Molecular Biotechnology (Bachelor), 6th Semester

University of Heidelberg

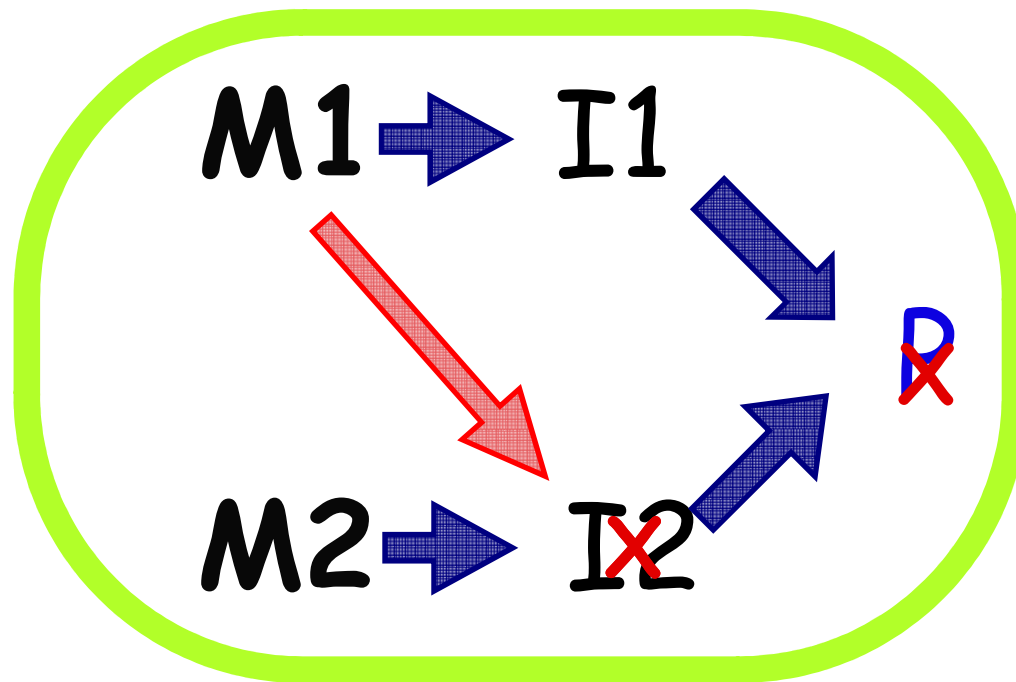
A Cyanobacteria Example

Heterocyst: nitrogen fixation

Vegetative Cells: photosynthesis

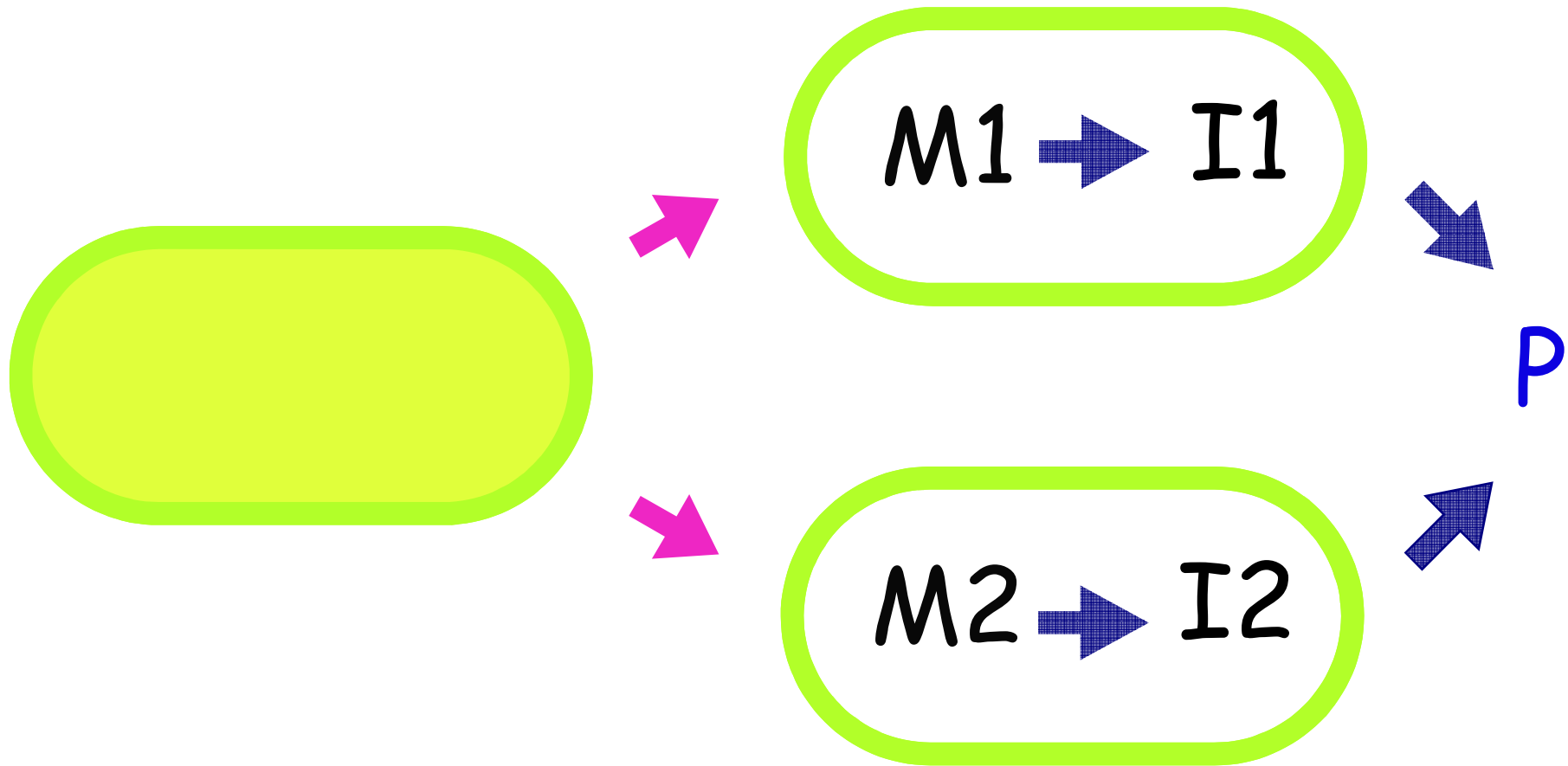


Zhang C et al, 2006. *Heterocyst differentiation and pattern formation in cyanobacteria - a chorus of signals*. Mol. Microbial. 59(2), 367-375.



→ The two pathways can't work together in one cell

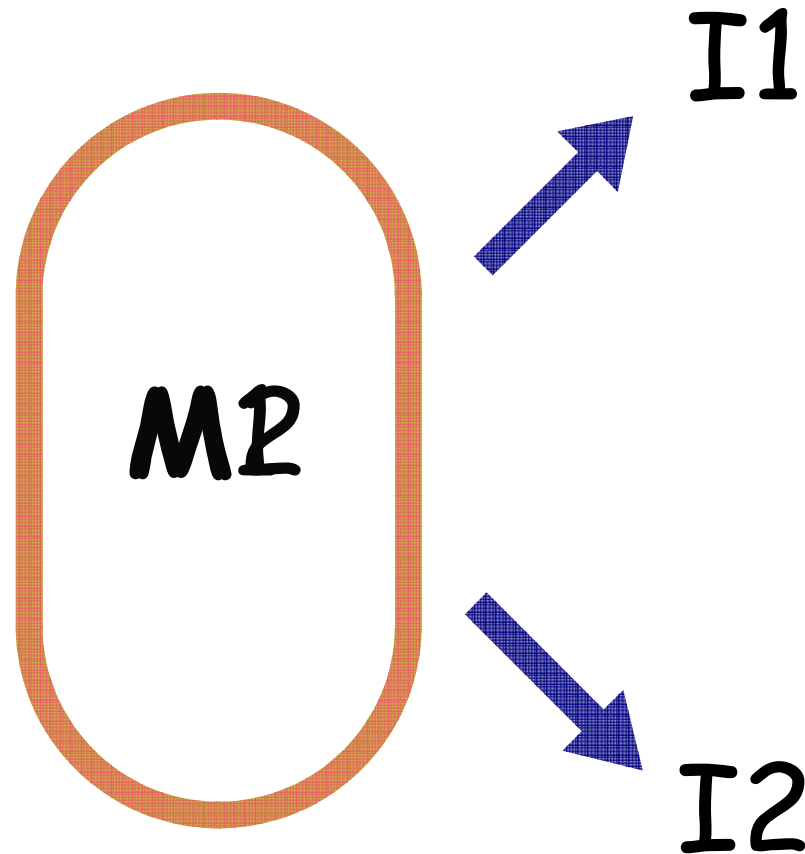
Give me Product - Signal





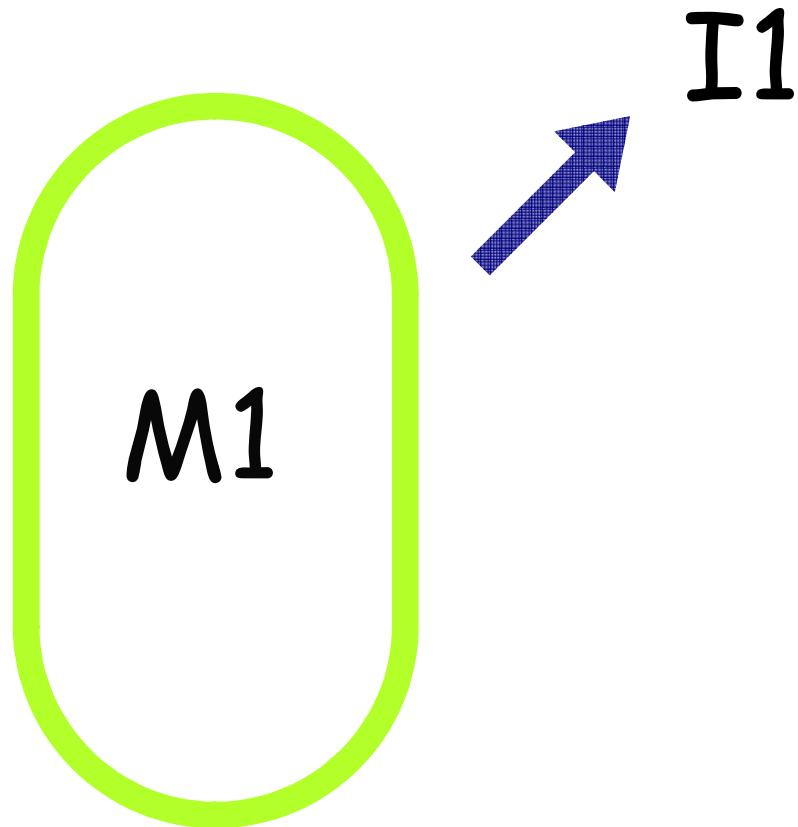
Temporal separation

Give me Product - Signal





Temporal separation



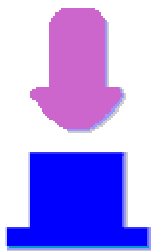
Push-on-push-off Switch

Hop Count

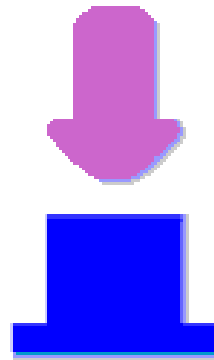
Temporal separation

Spatial separation

→ Homogenous genetic background



Ultraviolet
Light (UV)



E.coli

- Memory
- Same input, different outputs

- Bistable switch

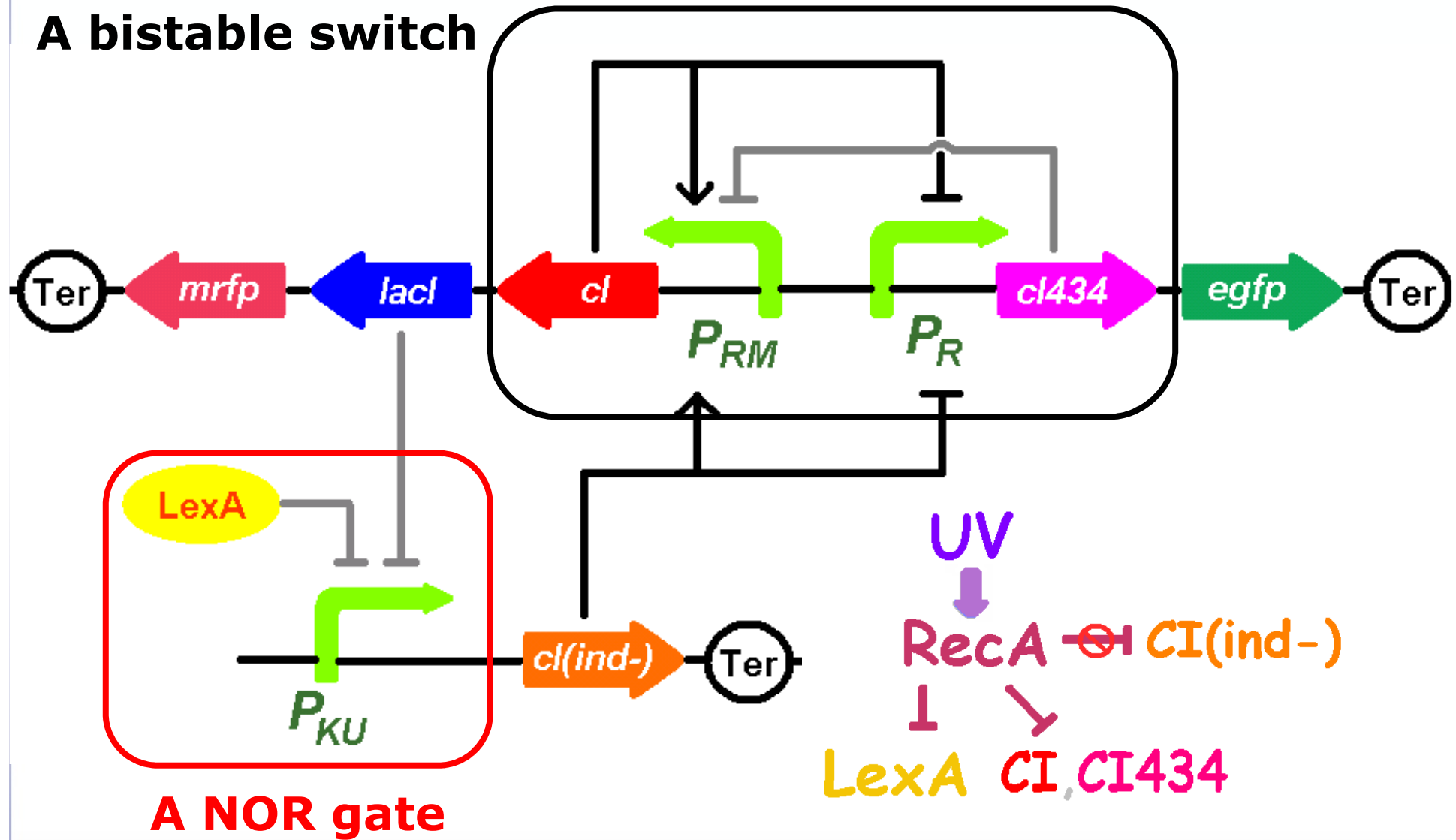
- two stable end positions between which can be switched
- e.g. standard mechanical pen

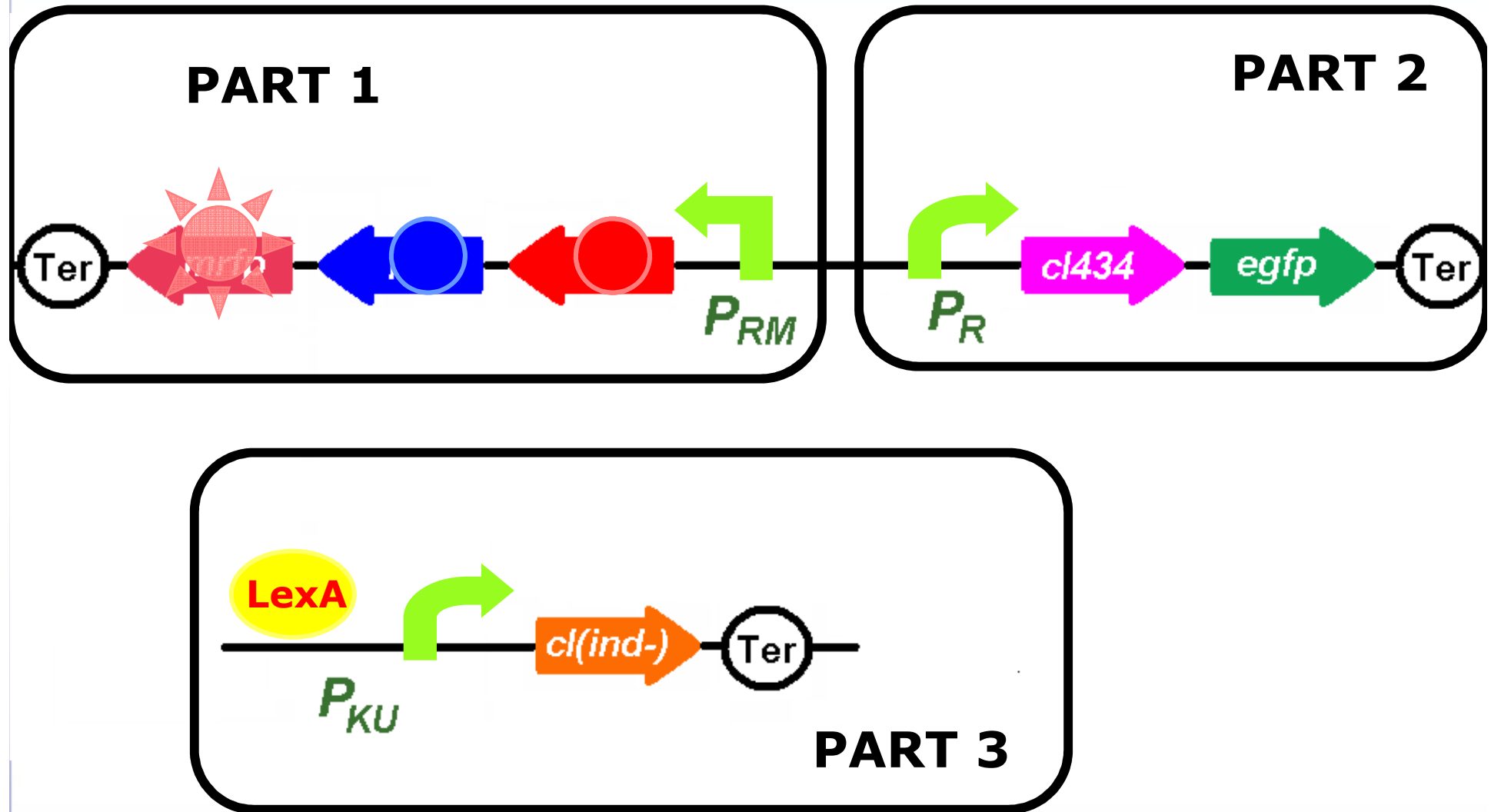
- NOR gate

- truth table

A	B	A NOR B
0	0	1
0	1	0
1	0	0
1	1	0

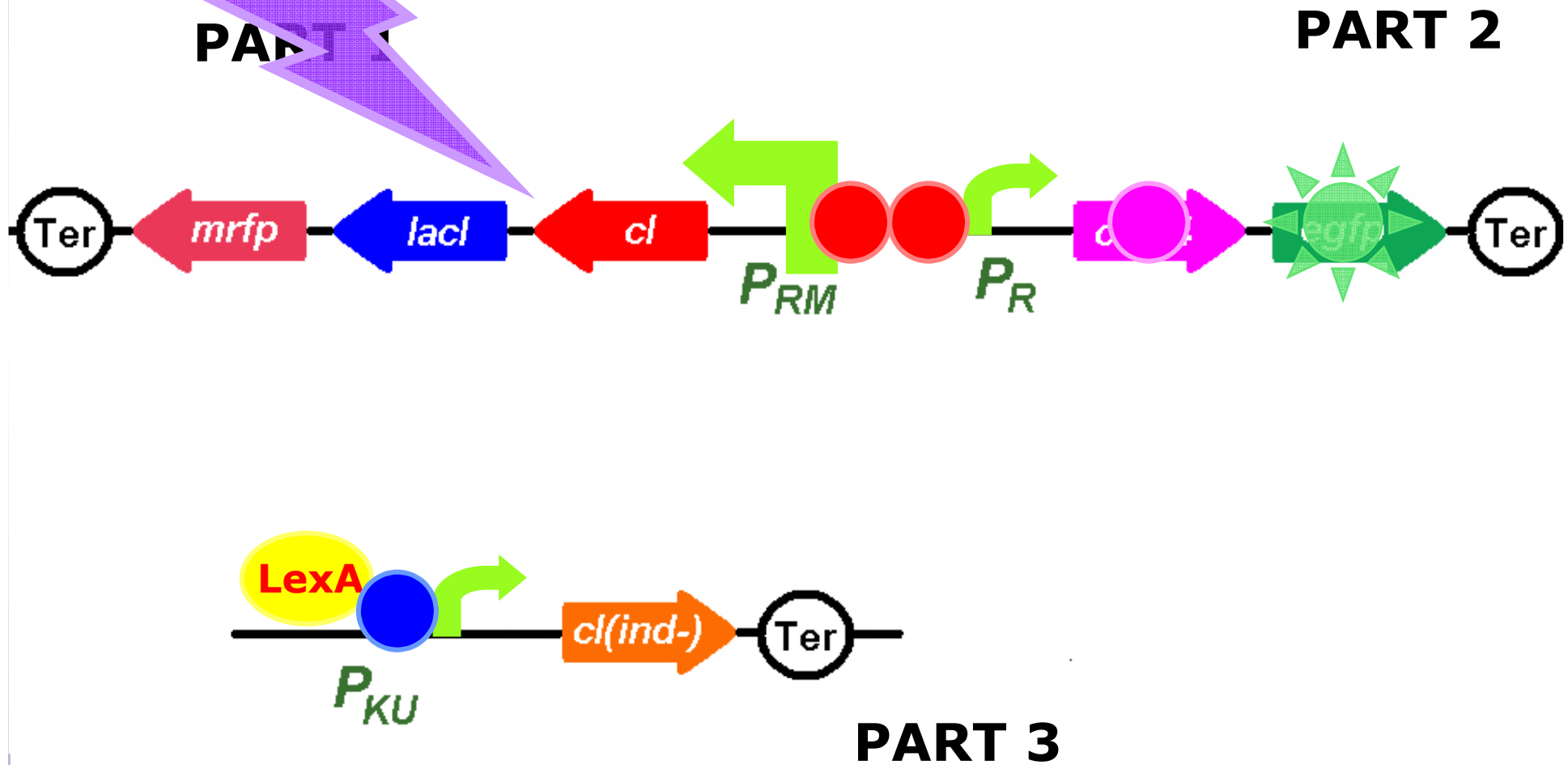
A bistable switch

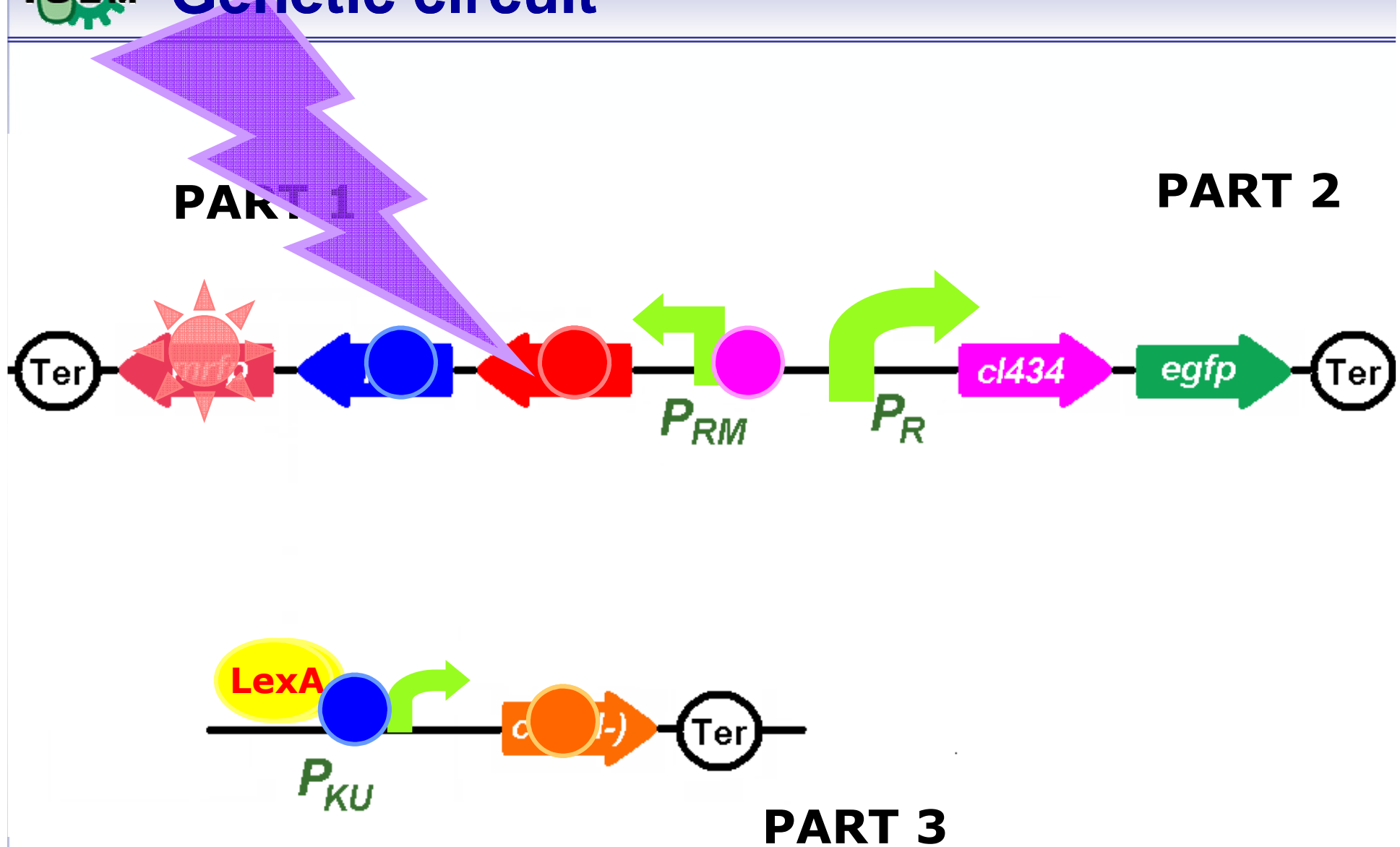






Genetic circuit





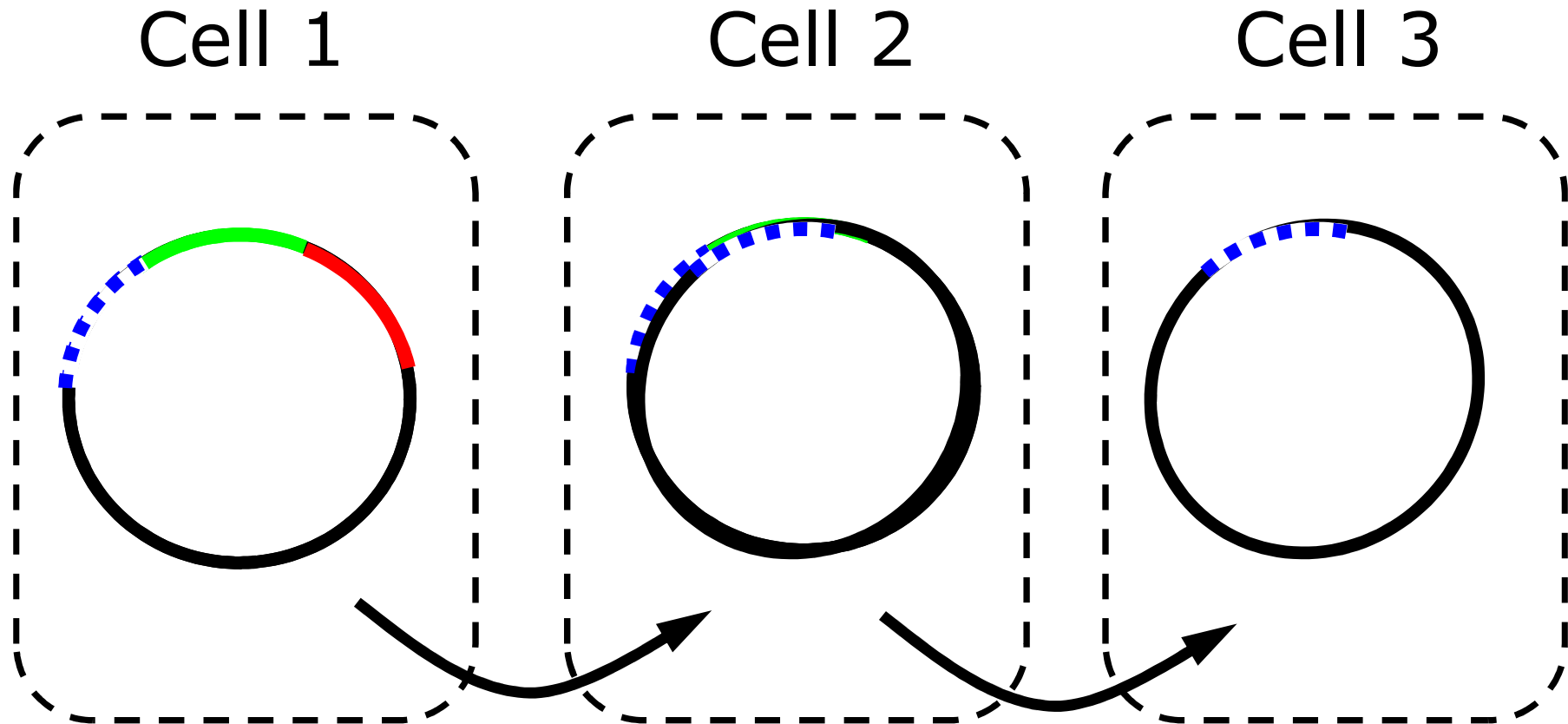


Summary of the experimental results

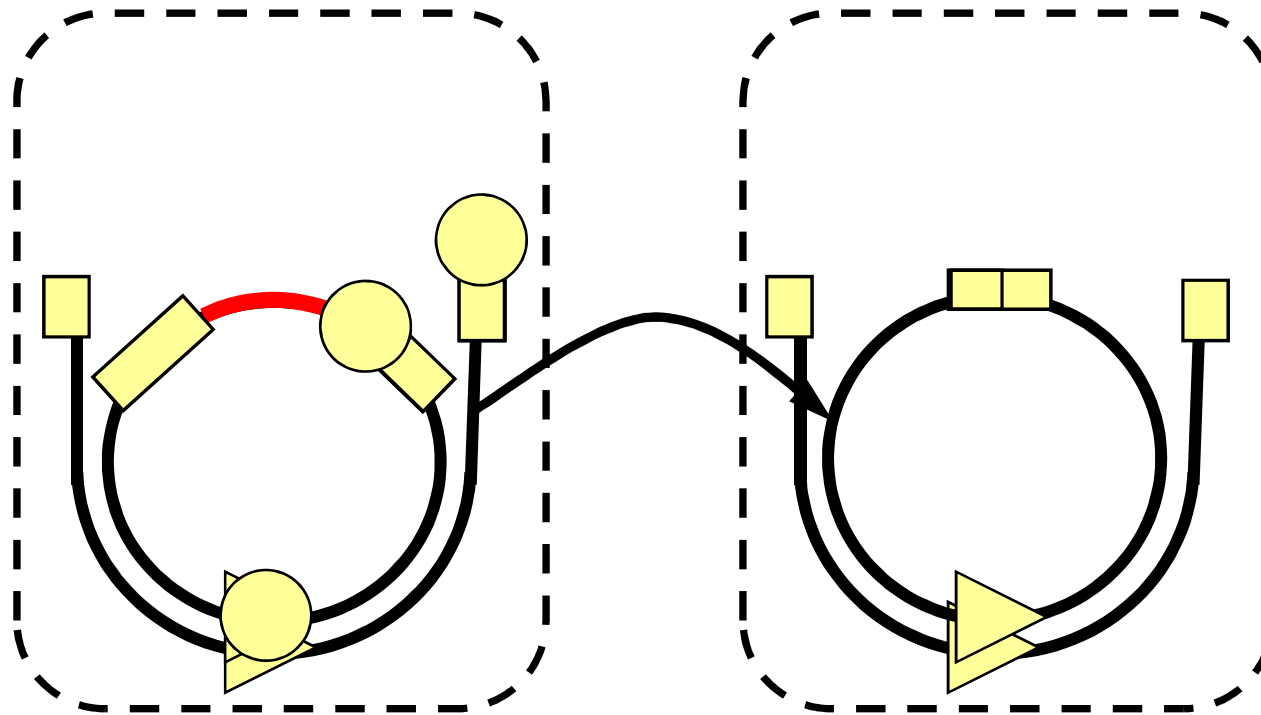
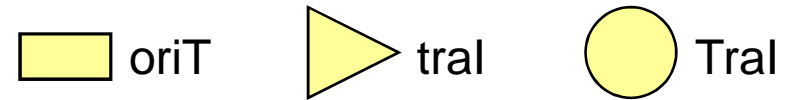
- Modelling with ordinary differential equations
 - shows that it is possible
- Bistable switch and NOR gate were constructed and tested independently
 - several candidates, at least one of each part works
- Future work
 - combine the two parts and realize an integrate system working as expected

- A device of spatial separation

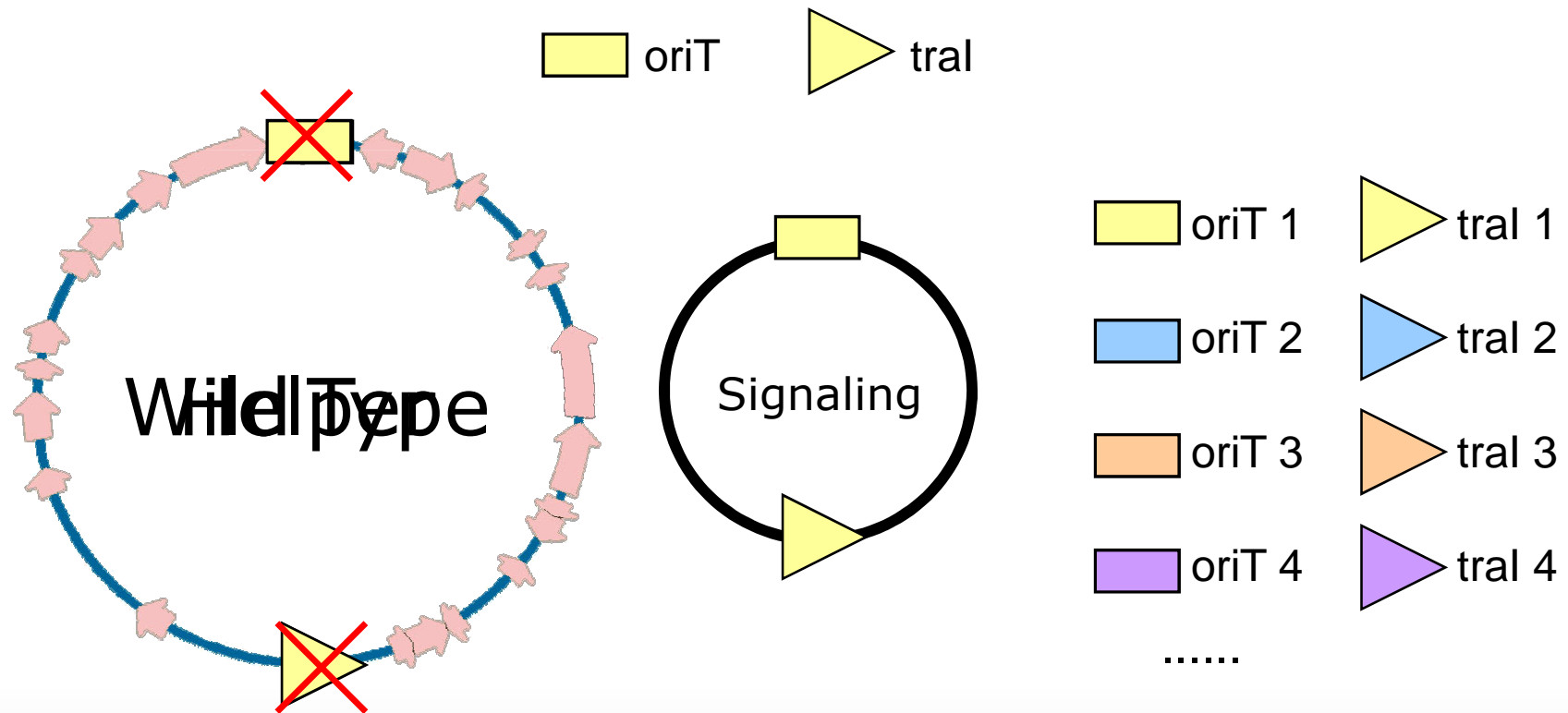




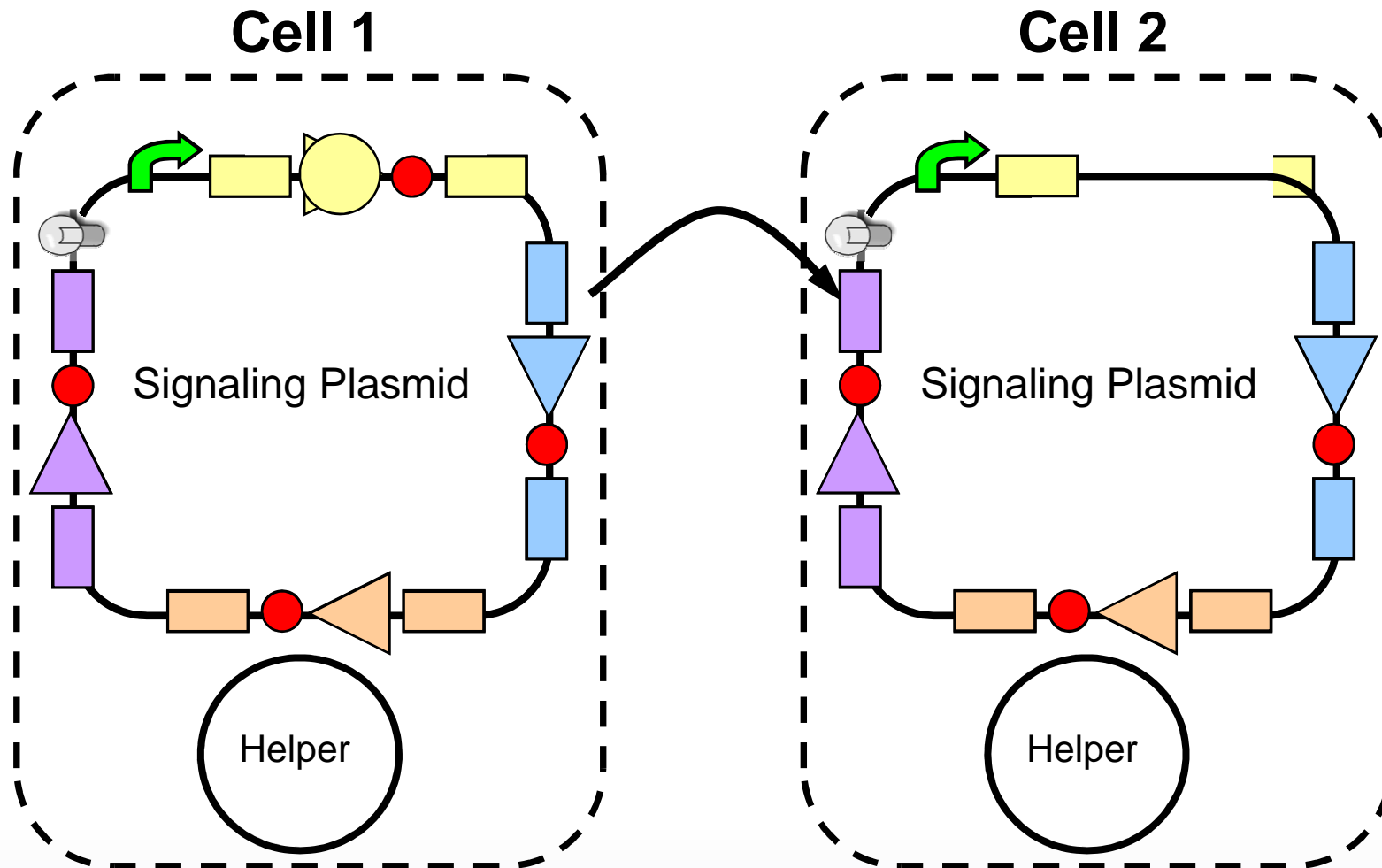
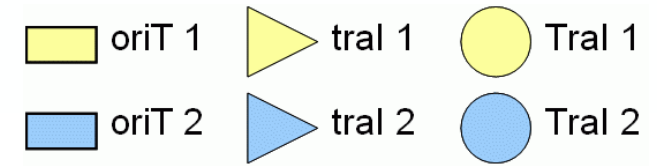
Conjugation with tandem oriT deletion



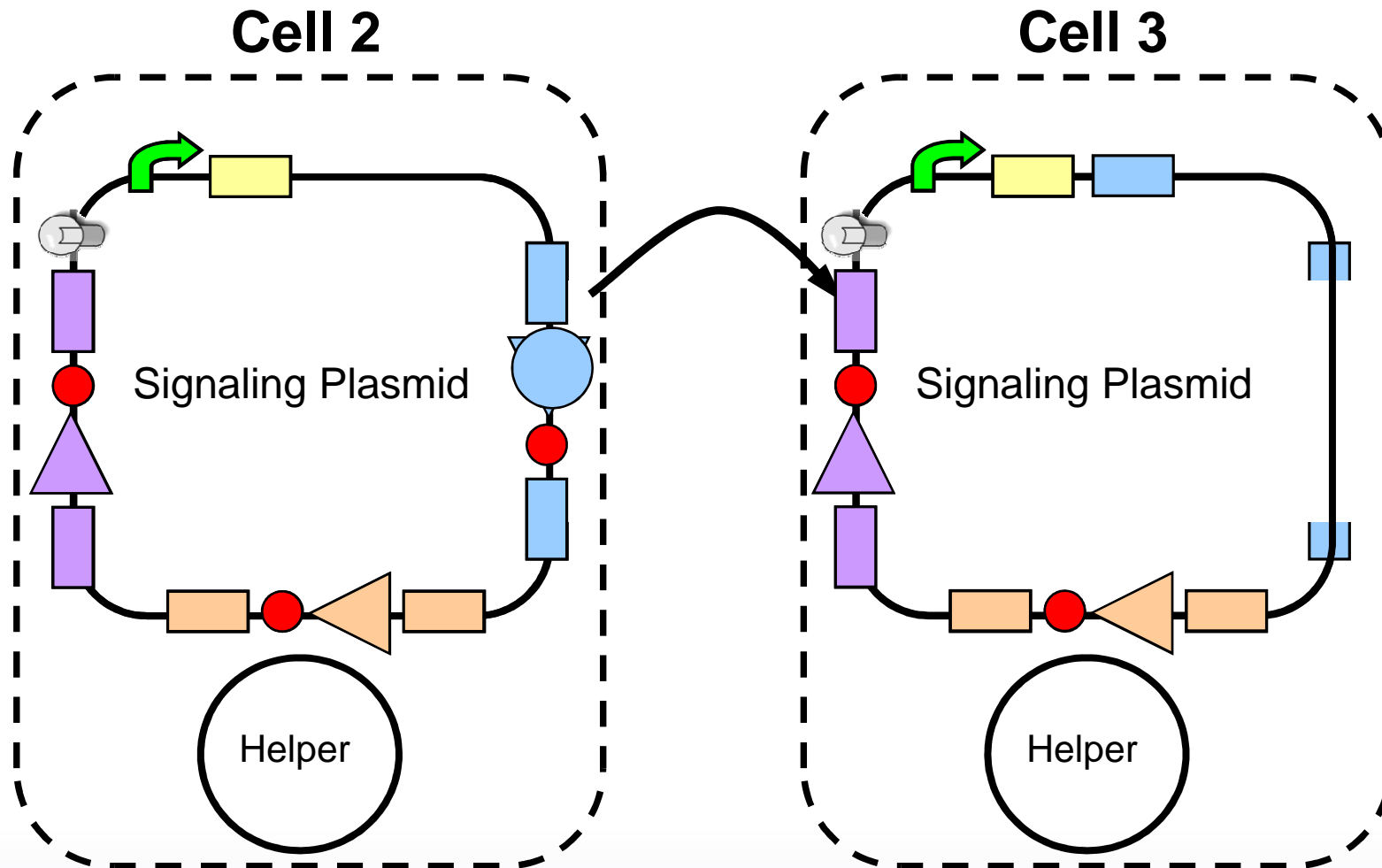
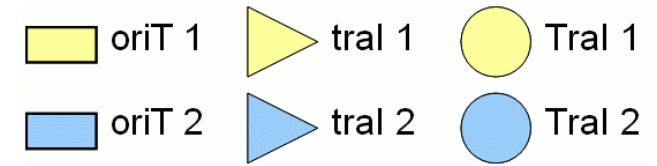
- Tral initiates conjugation
- Helper = Wild Type – tral – oriT
Signaling = tral + oriT



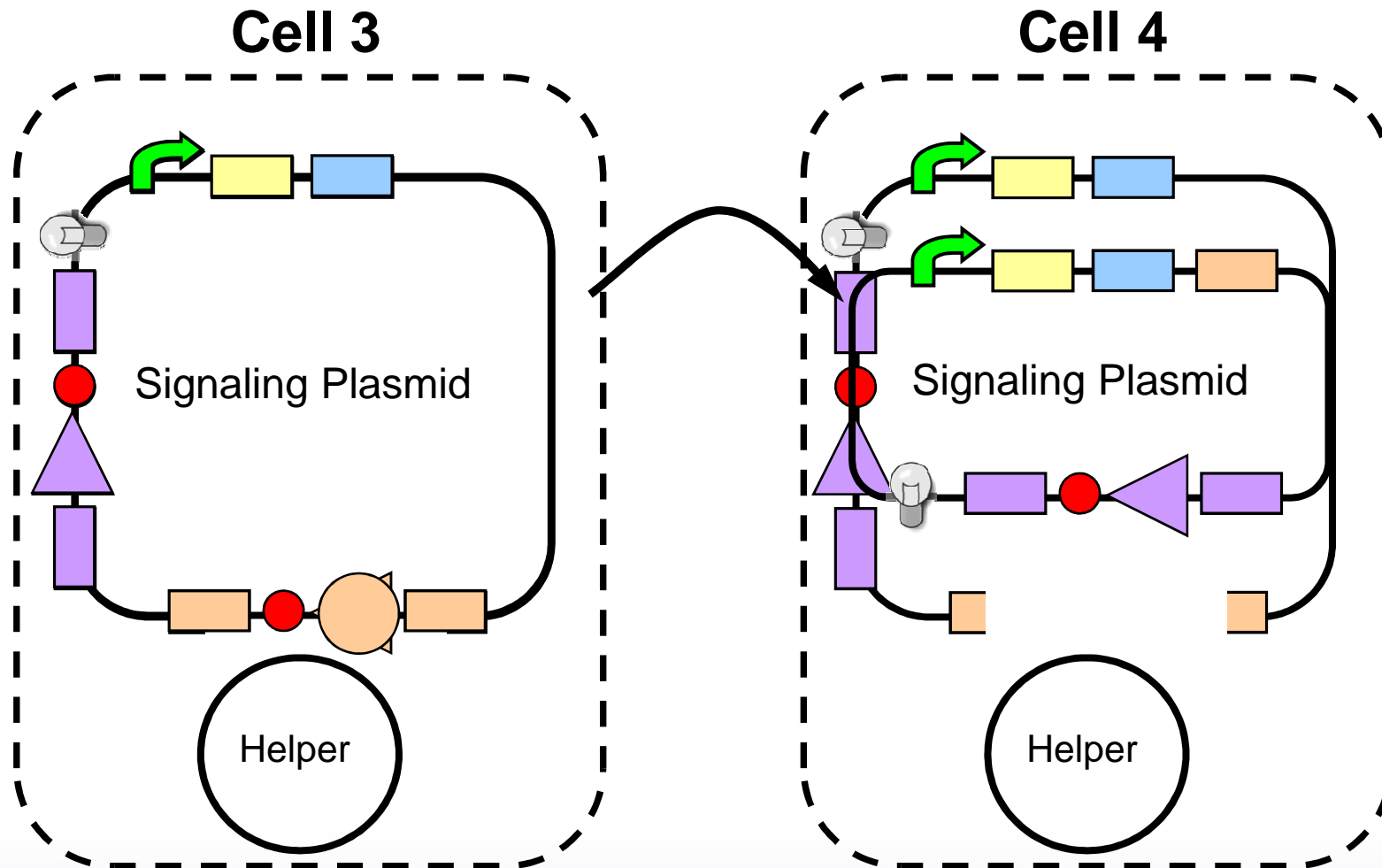
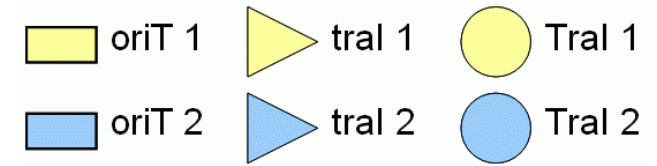
Design of hop count device



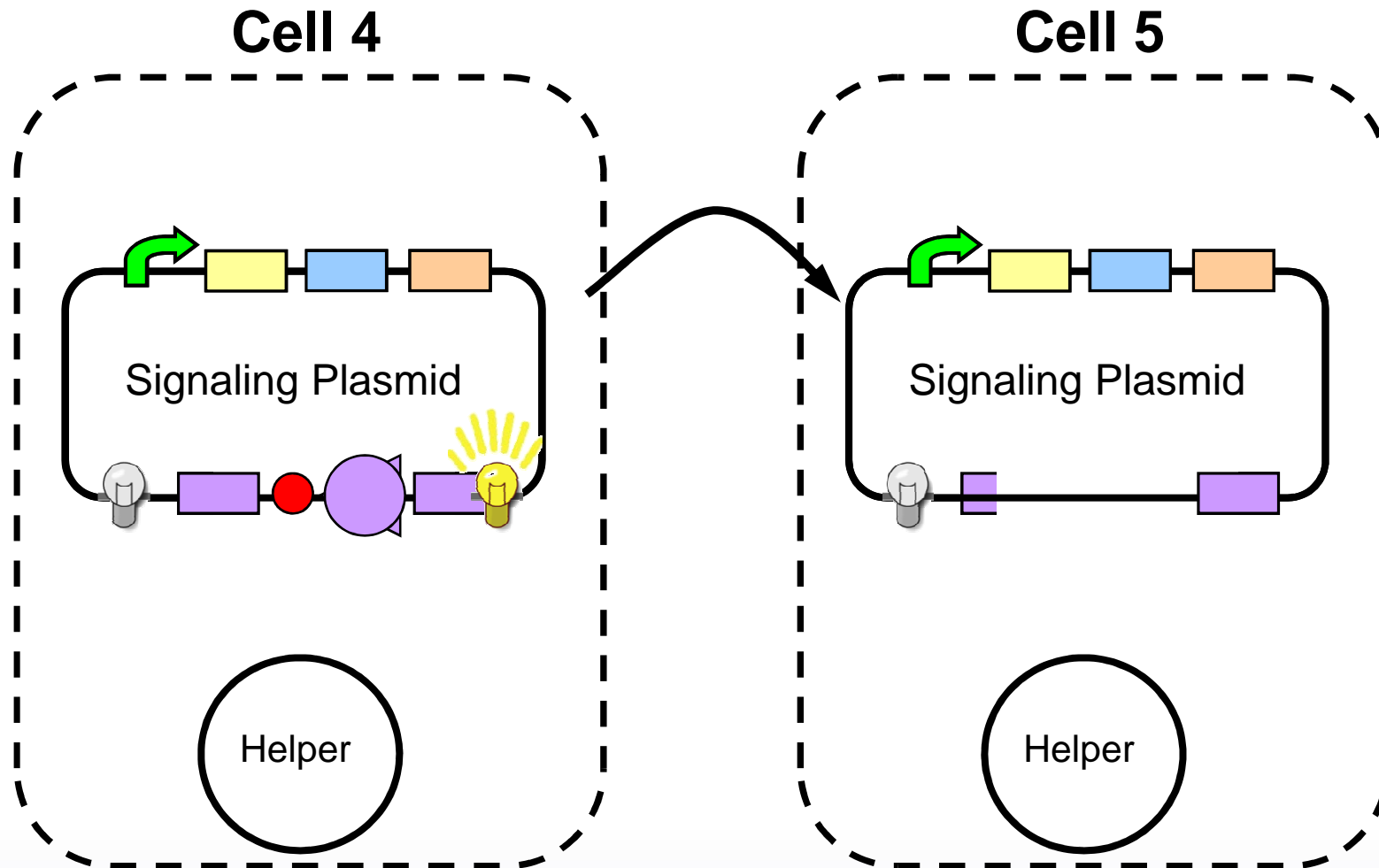
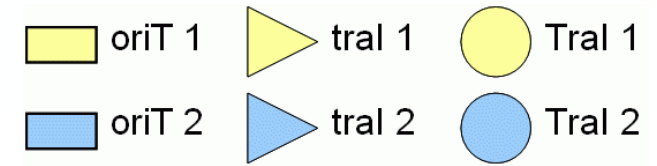
Design of hop count device



Design of hop count device



Design of hop count device





Summary of the experimental results

- Experimentally proved two key steps of hop count:
 - Successfully showed conjugative deletion
 - Deletion of TraI inhibits conjugation totally

- Future work
 - Signaling plasmid construction



Summary of the project

- Awards
 - Grand Prize
 - Information Processing
 - Gold Medal
- Registry of Standard Biological Parts
 - Construction of 89 parts of which 47 work
- Team
 - 12 undergraduates, 6 graduate advisors, 3 faculty advisors



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Thank you for your attention!