iGEM 2012

The bacterial Eyespot

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The 2012 Bordeaux Team

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Plan

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• Chapter 1: The project
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• Conclusion: The prospect
INTRODUCTION

THE IDEA

Where our project came from?

When I went to school, they asked me what I wanted to be when I grew up. I wrote down ‘happy’. They told me I didn’t understand the assignment, and I told them they didn’t understand life. “John Lennon
Introduction
Various pattern can be observed in nature.
Eyespots can be observed on some butterflies' wings.
A bacteria strain drawing concentric circles on a Petri dish.
CHAPTER 1
THE PROJECT

How to make it real?

“A man who is no longer able to marvel at practically stopped living” Albert Einstein
• Bacterial Lawn (One engineered strain)
• 3 colored states (Operon-based differentiation)
• Quorum-sensing signalisation
3 operons with:
- A visible phenotype (LacZ/mCherry/GFP)
3 operons with:
• A quorum-sensing activated Promoter
3 operons with:

• A quorum-sensing signalling molecule producer
• 3 different types of quorum-sensing
• 3 different types of quorum-sensing
• 3 different types of quorum-sensing
• 3 different types of quorum-sensing
• The necessity to use repressors to avoid signalisation conflict
Operon-based cell Differentiation

3 operons with:

- A repressor of the 2 other operons
- Two repressing sites in the promoter
Regulation within the bacteria
Operon I inhibits operons II and III
Operon I activates operon II in the neighboring bacteria
Operon-based cell Differentiation

Active operon 1
CI  LuxS  Op 2 et 3

Active operon 2
LacI  LuxI  Op 1 et 3

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Active operon 1
- LuxS
- Op 2 et 3
- CI

Active operon 2
- LuxI
- Op 1 et 3
- LacI

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Active operon 1
- CI
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Active operon 2
- LacI
- LuxI
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Active operon 3 -> Tet R | Op 1 et 2 | LasI

Active operon 1

Active operon 2

LacI | Op 1 et 3 | LuxI

Cl | Op 2 et 3 | LuxS
CHAPTER 2
THE SIMULATION

What can computer teach us?

“They didn't know it was impossible, so they did it.” Mark Twain
Models our genetic regulatory network
Includes eventual promoter leakage, mutation, etc...
Python programming language
The simulation

Everything is fine
Operon I not signaling
The simulation

Everything is fine

Operon II not signaling
The simulation

Everything is fine

Operon III not signaling
And promoter leakage
CHAPTER 3

THE LABWORK

Where are we now?

“Science, my lad, is made up of mistakes, but they are mistakes which it is useful to make, because they lead little by little to the truth” Jules Verne, Journey to the Center of the Earth
Assembly

• Operon I: 3 assemblies left
- Operon II complete
Assembly

- Operon III: 2 assemblies left
• Operon IV: 3 assemblies left
• What is left?

10/20 assemblies completed.
• Moving to a simpler system: 2 colored state (3 operons)
CONCLUSION

THE PROSPECT

What could came out of this project?

“You should aim higher with your fantasies” Lem, Veridian Dynamics
The prospect

Constitutive expression driven by biobrick J23100 aka « Pink Promoter »

• Multiple Quorum-sensing Responsive bacteria
Enabling bacteria to have multiple functionnality

The prospect

Naive state

- Enabling bacteria to have multiple functionnality
E. Glowli Project (2010 Cambridge)

• Enabling bacteria to have multiple functionality
Enabling bacteria to have multiple functionality

Eau d’E.coli Project (2006 MIT)

E. Glowli Project (2010 Cambridge)

• Enabling bacteria to have multiple functionnality
Enabling bacteria to have multiple functionality

- E. Glowli Project (2010 Cambridge)
- Eau d’E.coli Project (2006 MIT)
- Coliroid Project (2004 UCSF)
Enabling bacteria to have multiple functionality

E. Glowli Project
(2010 Cambridge)

- » Reboot » function:
  Allow dedifferentiation

Naive state

The prospect
1X signal

If number of ring/circles dependant of the amount of initial signal:

- Easy-to-read visible readout for chemical input
The prospect

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Coupling with other iGEM project: 
Arsenic biosensor project (2006 Edinburgh)
Annexe

Image source:
http://www.thelensflare.com/imgs/eyespot-butterfly_47484.html
The sponsors
Thank you for your time!

*The world is my country, science is my religion.* – Christiaan Huygens, Dutch Physicist (1629-1695)