



FROZEN by E.coli

CAU China



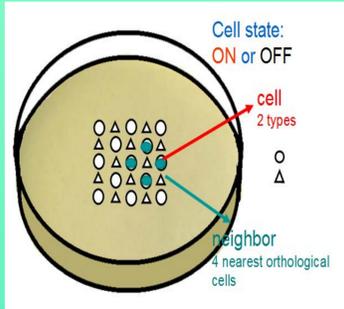
Introduction

In the popular musical fantasy Frozen, the magical power of creating snow and freezing everything impressed the world. We aim to take the power from the fairy tale to our cool *E.coli*. Specifically, our project has created a cell-cell communicated multicellular system by simulating Cellular Automaton, letting *E.coli* emit red fluorescence in the way a snowflake grows up from a point.

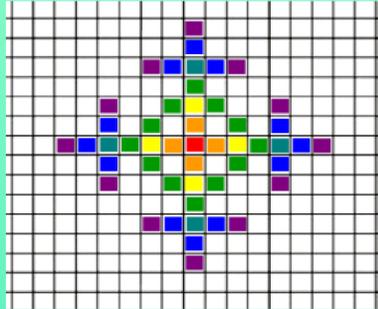
Methodology

Simulation of Cellular Automaton with *E.coli*

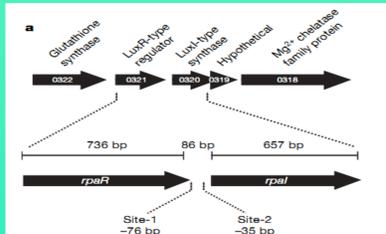
Evolution Rule: When a cell is on, it remains; When off, the cell can turn on only when an on neighbor present.



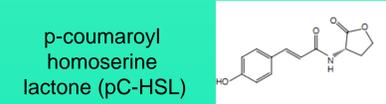
At initial State, all cells is off except for central on cell. After 7 steps' iteration; cells of the same color in picture turn on simultaneously at one step. From inside to outside, a growing snowflake comes into being.



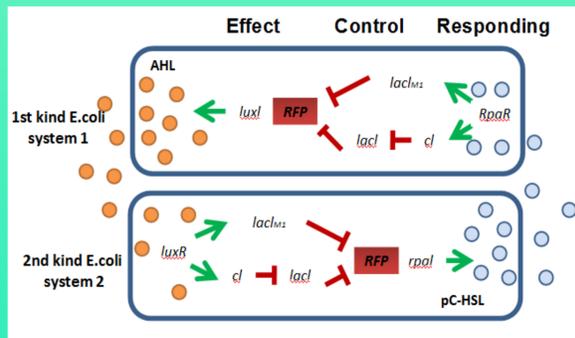
RPA Quorum-sensing (QS) system in *Rhodospseudomonas palustris*



Schaefer et.al, Nature, 2008



Genetic pathway



*The control device is based on Ron Weiss 's work-medium concentration pathway: GFP is produced only when medium concentration of signal molecules in environment .

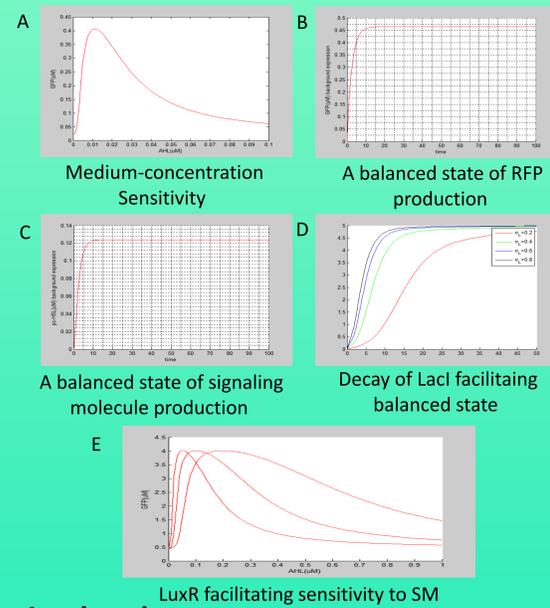
Model

- Basic Assumptions: 1.*E.coli* aggregates don't profligate; 2. Genetic pathways work steadily and parallelly; 3.Molecules' diffusion on plate obeys fick's 1st law.

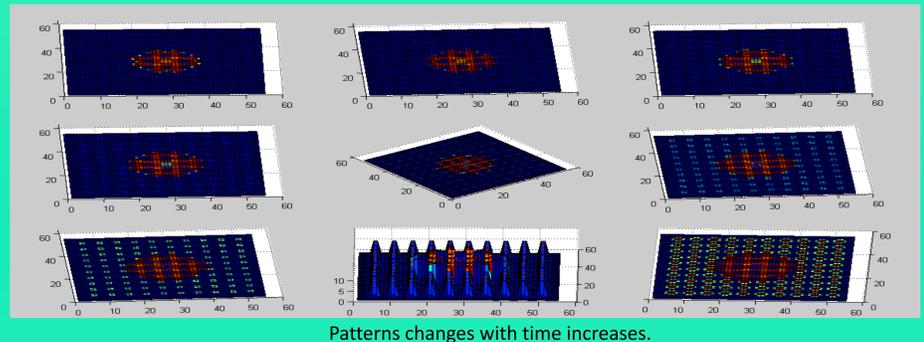
System of Ordinary Differential Equations

$$\begin{aligned} \frac{dG}{dt} &= \frac{\alpha_G}{1 + (L/\beta_L)^{n_1}} - \gamma_G G \\ \frac{dL}{dt} &= \frac{\alpha_{L1}}{1 + (C/\beta_C)^{n_2}} + \frac{\alpha_{L2} R^{n_3}}{(\theta_R)^{n_3} + R^{n_3}} - \gamma_L L \\ \frac{dC}{dt} &= \frac{\alpha_C R^{n_3}}{(\theta_R)^{n_3} + R^{n_3}} - \gamma_C C \\ \frac{dR}{dt} &= \rho_R [LuxR]^2 A_{in}^2 - \gamma_R R \\ \frac{dB_{in}}{dt} &= \frac{\alpha_B}{1 + (L/\beta_L)^{n_3}} - \gamma_{B_{in}} B_{in} - k_B (B_{in} - B_{en}) \\ \frac{dA_{in}}{dt} &= -\gamma_{A_{in}} A_{in} - k_A (A_{in} - A_{en}) - 2 \frac{dR}{dt} \\ \frac{dB_{en}}{dt} &= k_B (B_{in} - B_{en}) - \gamma_{B_{en}} B_{en} + D_B \nabla^2 B_{en} \\ \frac{dA_{en}}{dt} &= k_A (A_{in} - A_{en}) - \gamma_{A_{en}} A_{en} + D_A \nabla^2 A_{en} \end{aligned}$$

Numerical Simulation Results

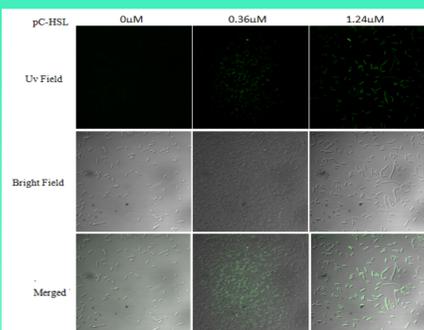


A dynamic snowflake pattern simulated in computer



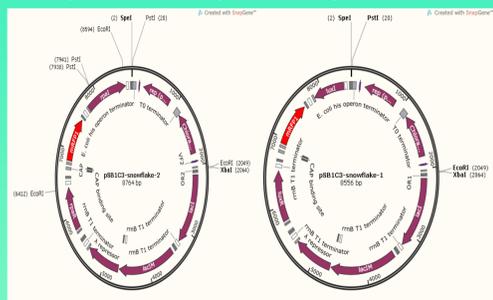
Results

Experimental verification of function of RPA QS system



Green fluorescence in *E.coli* with or without induction of pC-HSL using Confocal laser scanning microscopy.

Plasmid Construction: We have constructed these two plasmids for two genetic systems respectively.



5 Composite Parts

Part Number	Elements
BBa_K1421001	pluxR+RBS+LacIM1+2TE
BBa_K1421002	plux R+RBS+cl+2TE
BBa_K1421008	pCI+RBS+LacI+2TE
BBa_K1421004	pluxL+RBS+luxR+2TE
BBa_K1421009	plac+RBS+RFP+luxI+2TE

3 Basic Parts

Part number	Element
Part:BBa_K1421005	pRPAl
Part:BBa_K1421006	RPAl
Part:BBa_K1421007	pRPAl+RPAl

1 Construction Intermediate

Part Number	Elements
BBa_S05255	LucI+TE

Human Practice



iGEM-Help with Gene: A mutual information-sharing platform for plasmids, genes and strains. Welcome you join us!

- Open day for high school: welcome high school students in our lab and treated with introduction of iGEM competition, past brilliant projects and a fascinating experiment: forming a heart shape with DNA Gel electrophoresis.
- E-periodicals: Created and published e-periodicals monthly by ourselves; introducing cut-edging advances in Synthetic Biology.
- CCiM: gave a presentation on 1st China Community iGEM Meet up in Wuhan, China, on August 2014.
- Help NJAU-China iGEM team: offered a protocol about gene synthesis by oneself.



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