Genetic engineering Part 3:

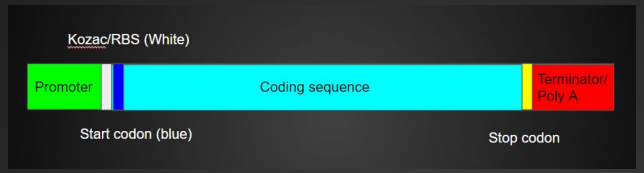
Genetic Circuits

What We'll Cover Today:

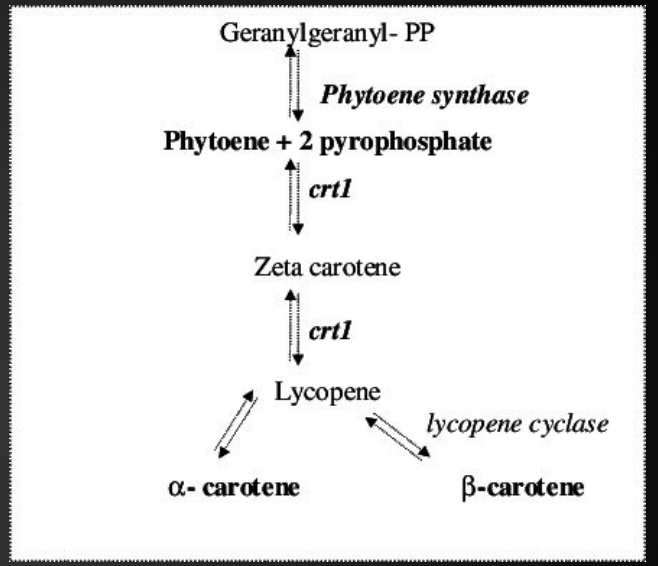
- What is a genetic circuit?
- The basic components
- Comparison to digital circuits
- Bistable switch
- Repressilator
- Diffusible elements
- Examples from nature

Learning Progression

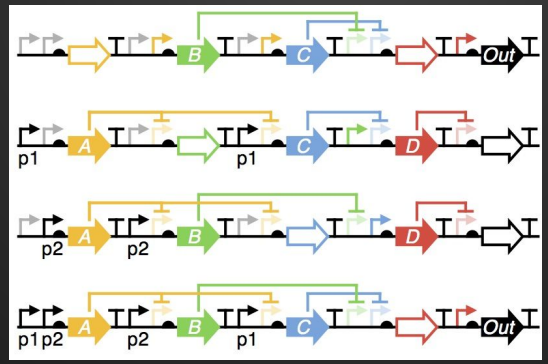
1 - Single Gene



2 - Gene/metabolic pathway

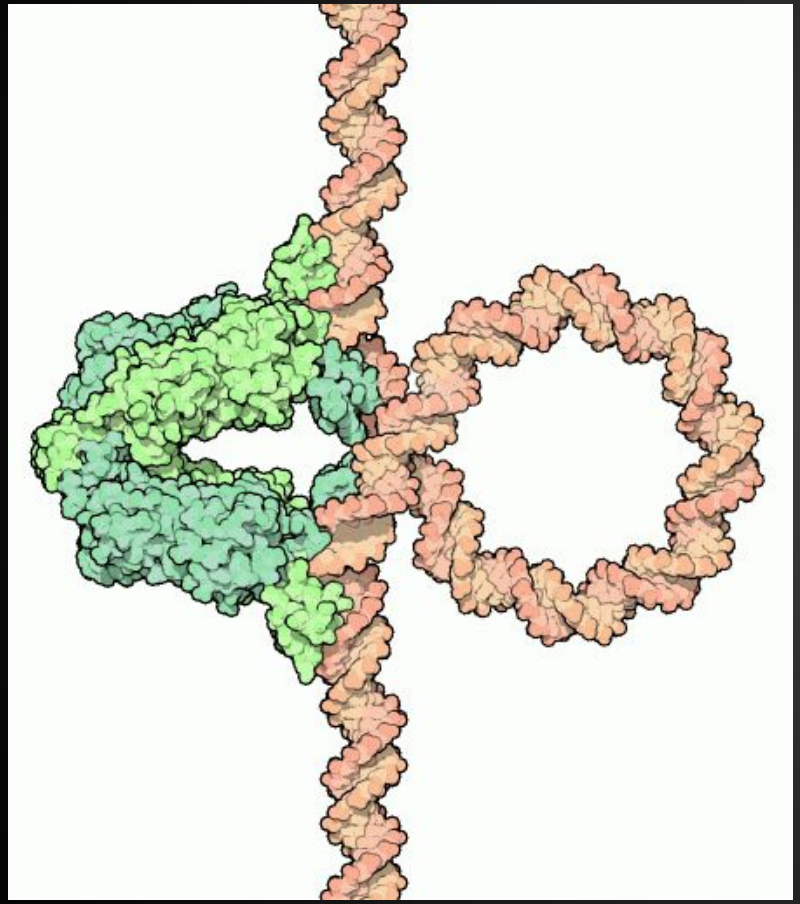


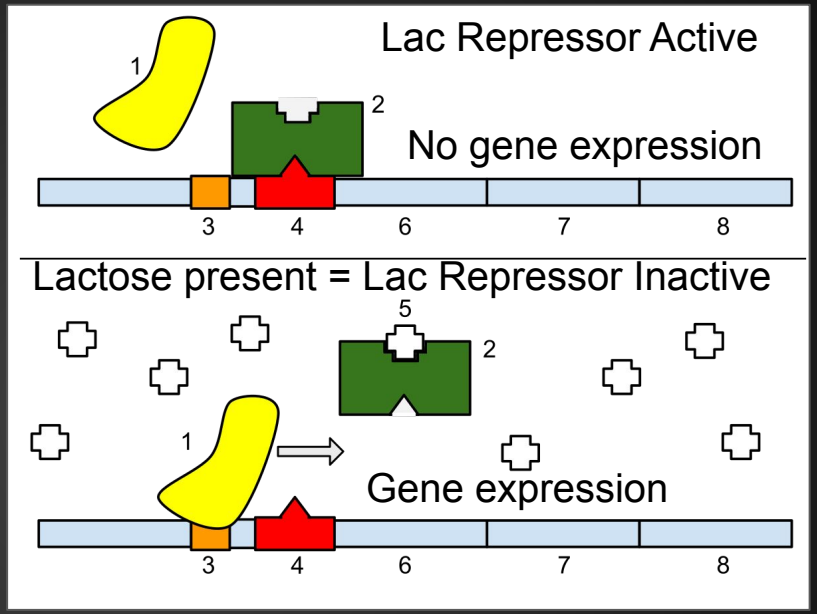
3 - Genetic circuits



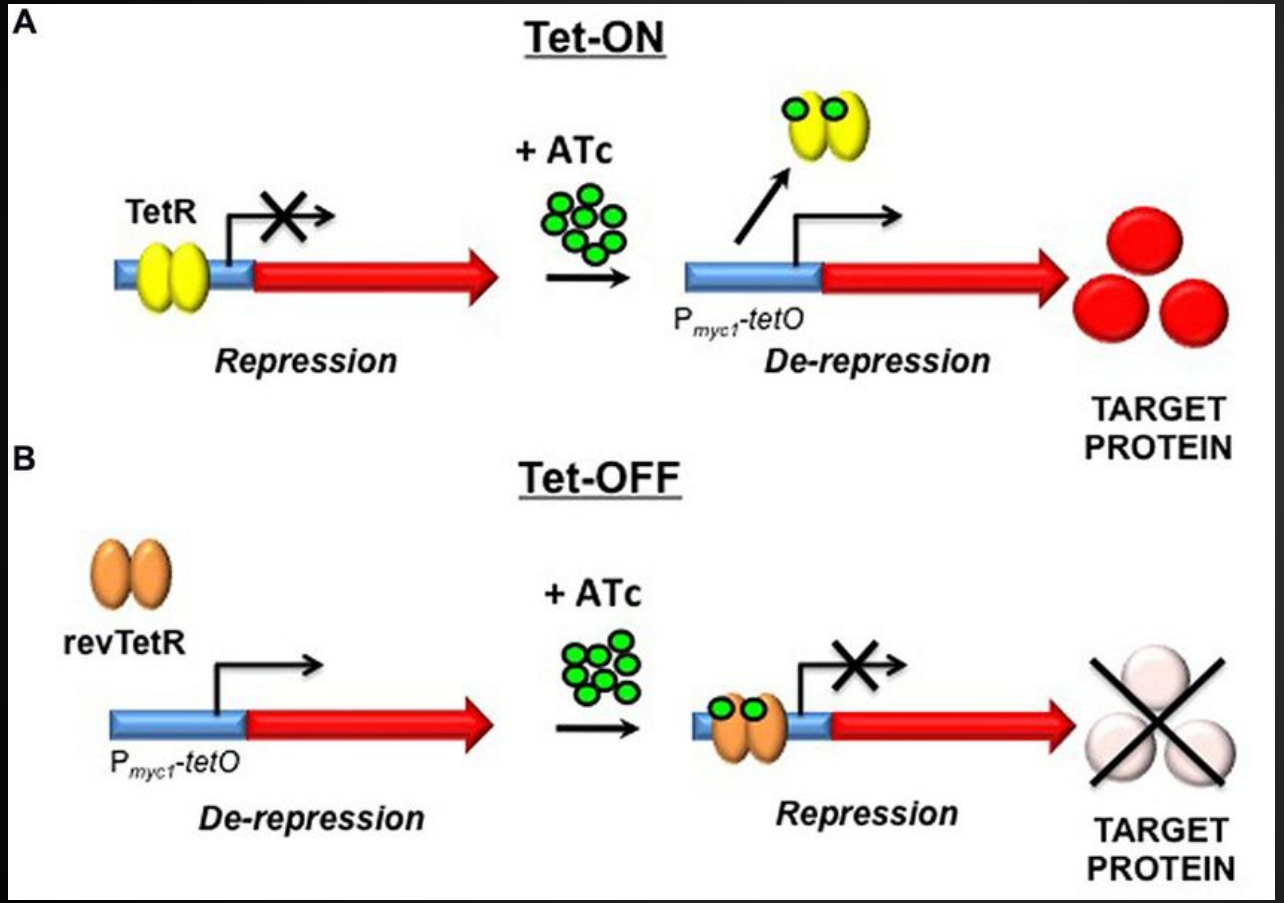
Part 1: The basics pieces

Inducible Promoters: Example 1 - The LacI repressor



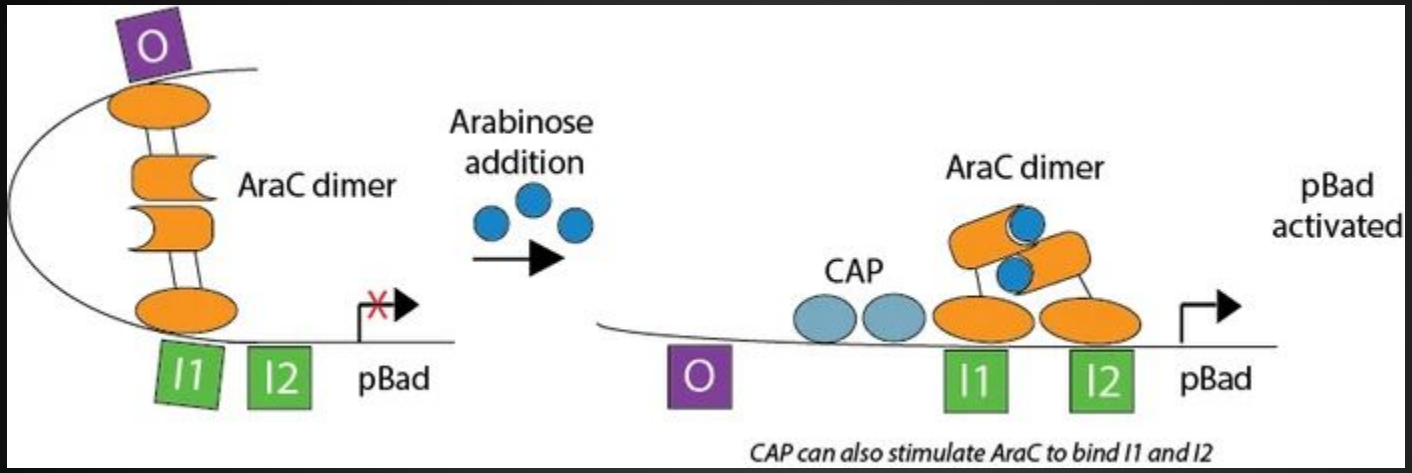


Inducible Promoters: Example 2 - Tet-ON/Tet-Off

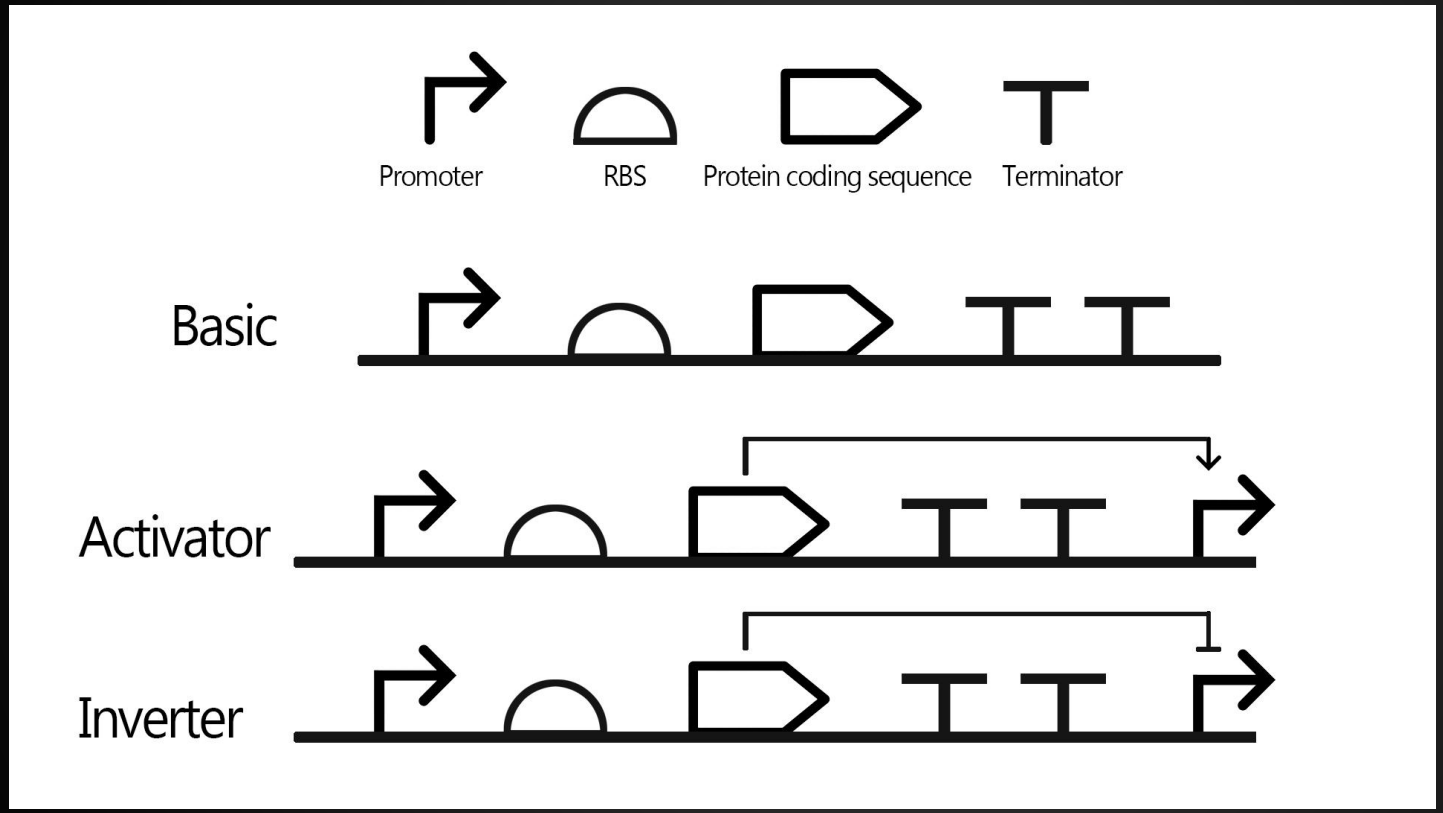


Inducible Promoters: Example 3 - pBad/AraC

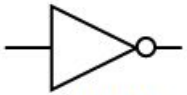
Positive induction



Gene Notation Reminder



Digital Logic



NOT

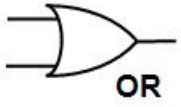
Input	Output
I	F
0	1
1	0

AND

Inputs		Output
A	B	F
0	0	0
1	0	0
0	1	0
1	1	1

NAND

Inputs		Output
A	B	F
0	0	1
1	0	1
0	1	1
1	1	0

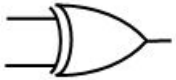


OR

Inputs		Output
A	B	F
0	0	0
1	0	1
0	1	1
1	1	1

NOR

Inputs		Output
A	B	F
0	0	1
1	0	0
0	1	0
1	1	0



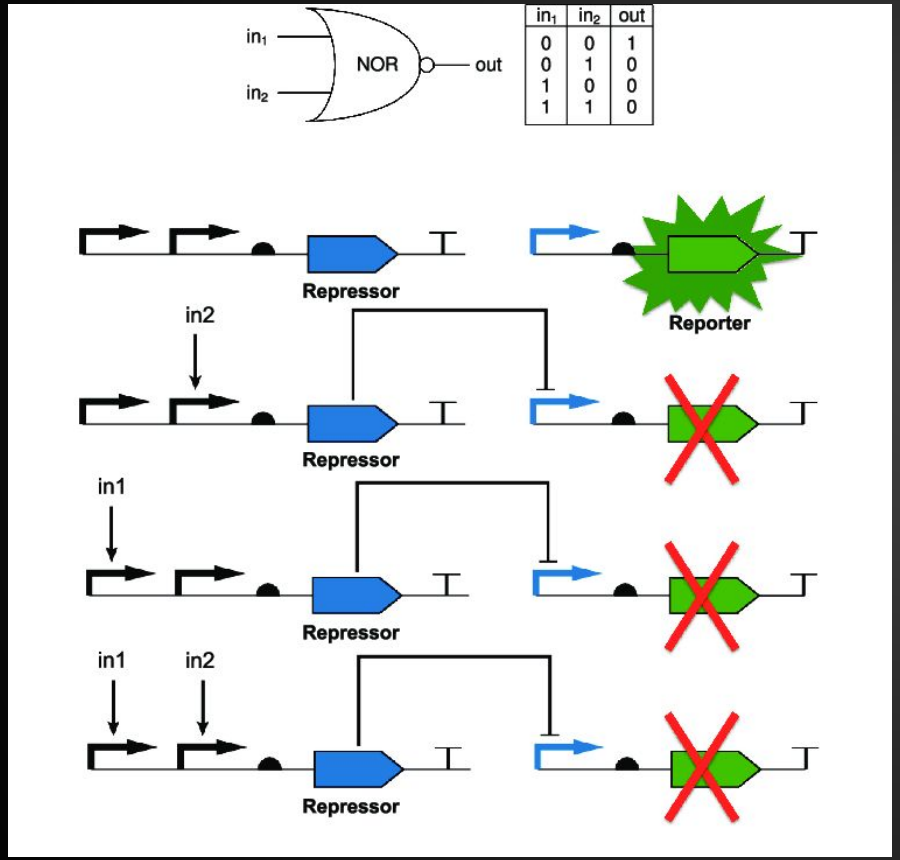
EXCLUSIVE OR

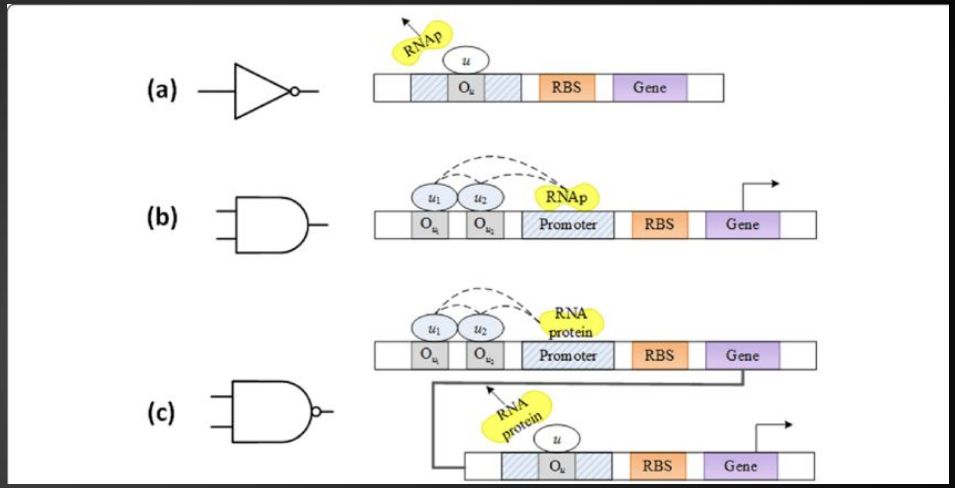
Inputs		Output
A	B	F
0	0	0
0	1	1
1	0	1
1	1	0

EXCLUSIVE NOR

Inputs		Output
A	B	F
0	0	1
0	1	0
1	0	0
1	1	1

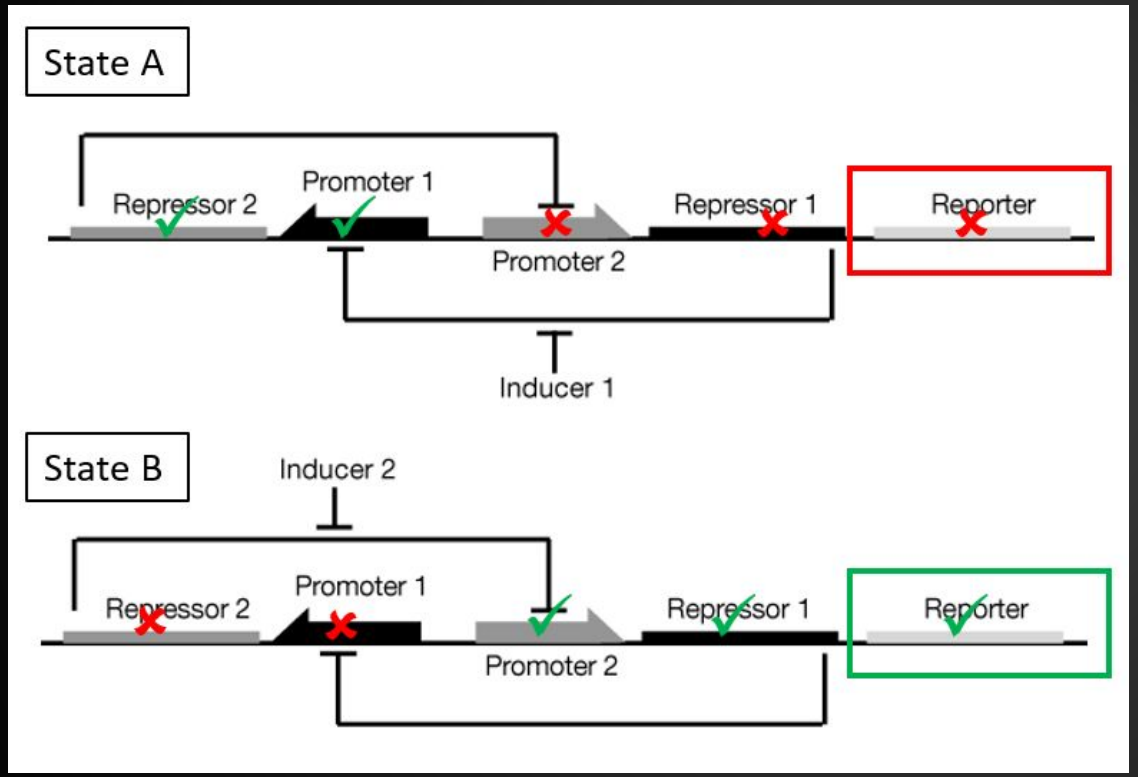
Genetic Logic Gates: Simple examples

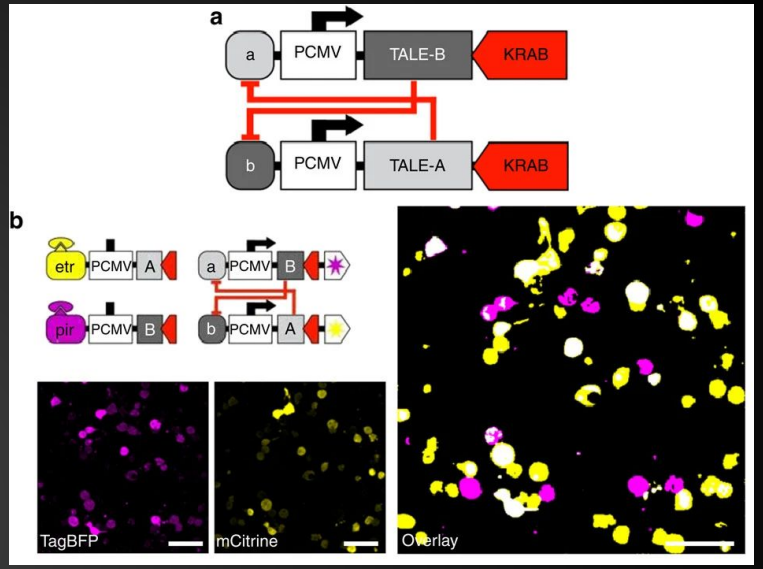




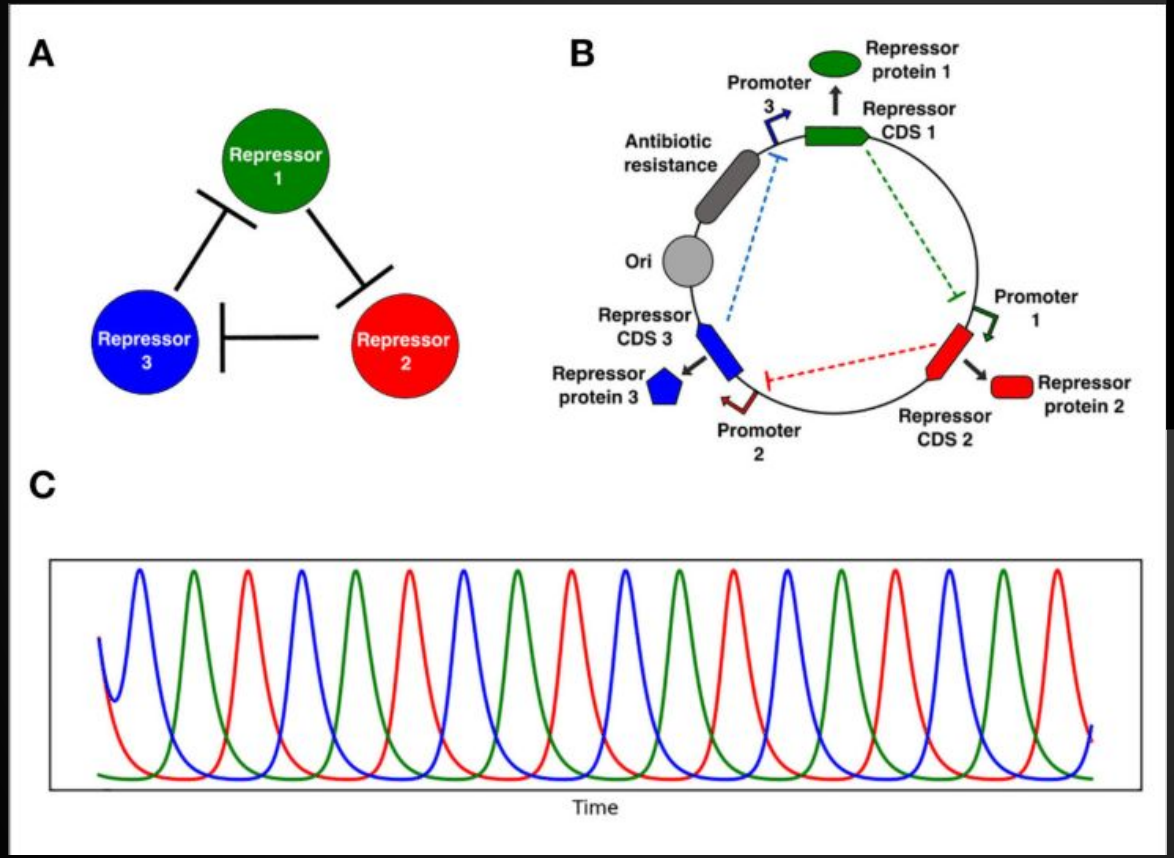
Part 2: Building Useful Circuits

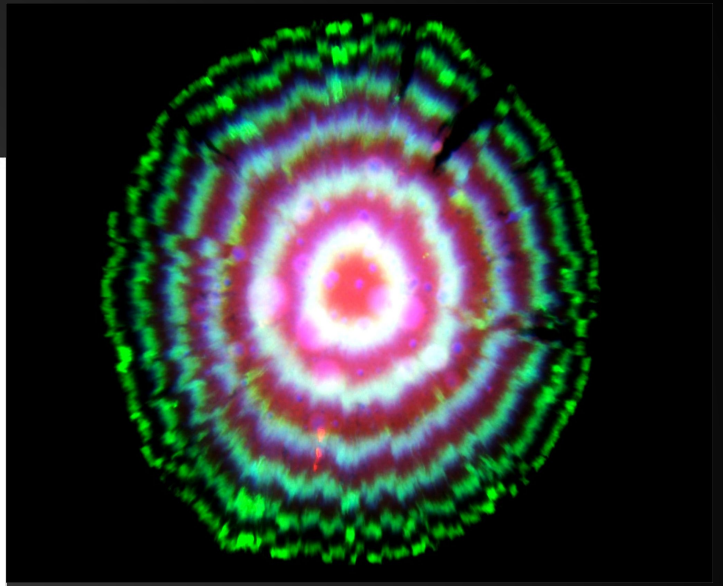
Example 1: Bistable switch



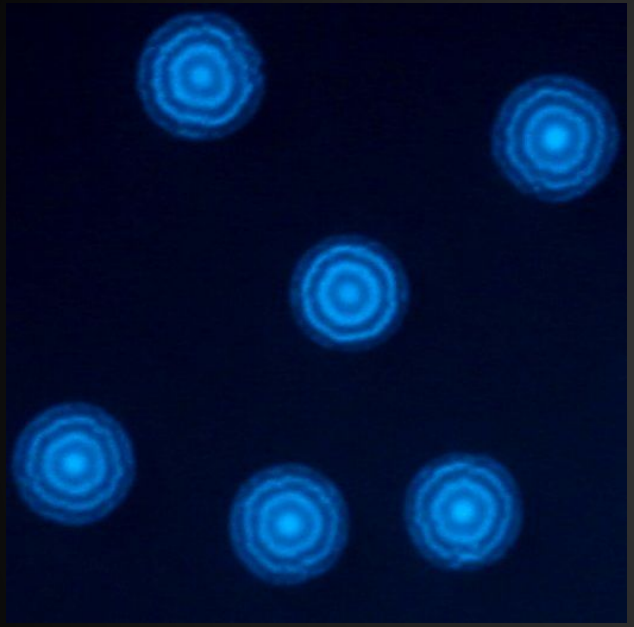


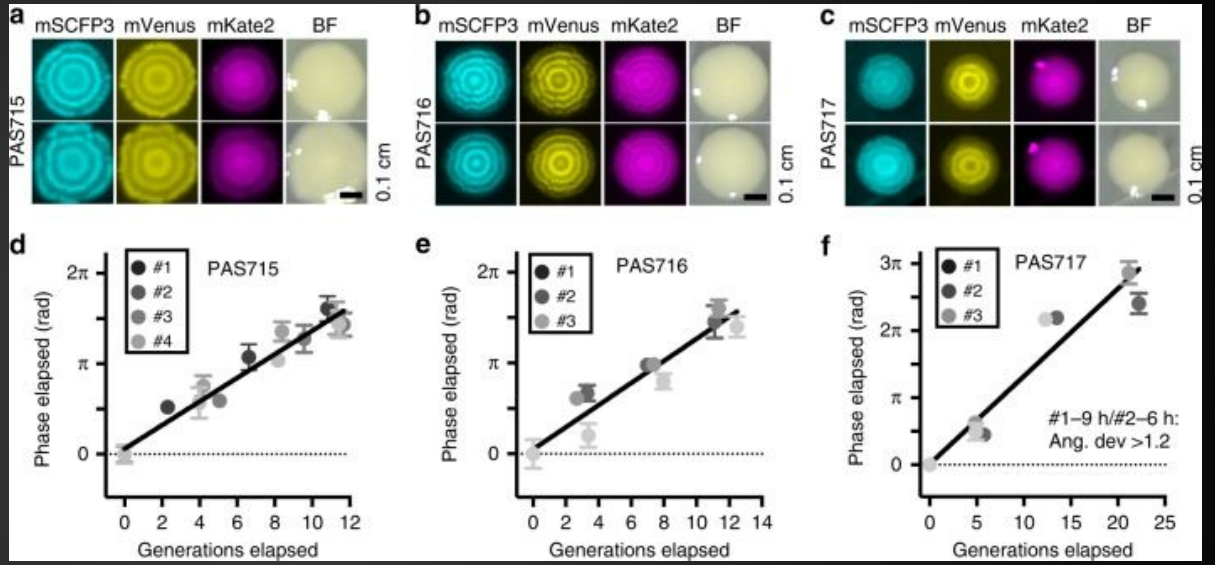
Example 2: The Repressilator





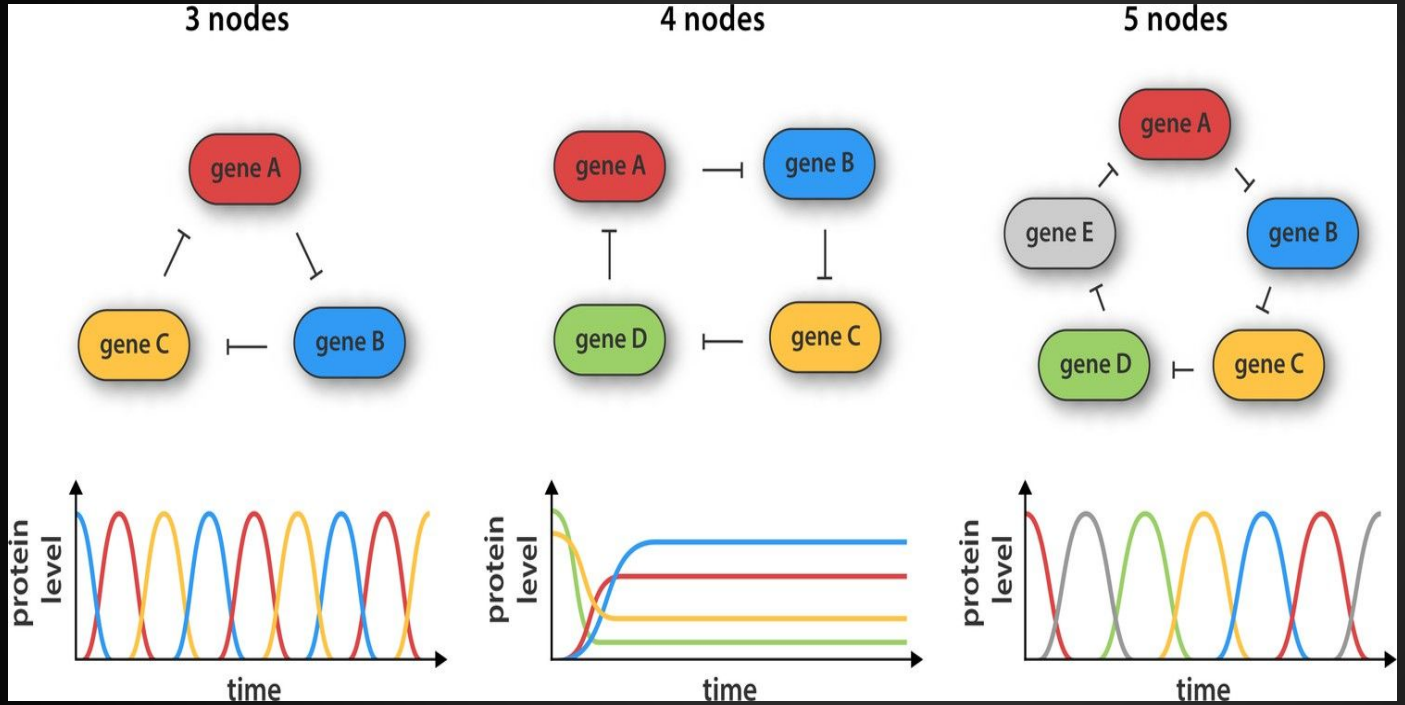
Example 2: The Repressilator



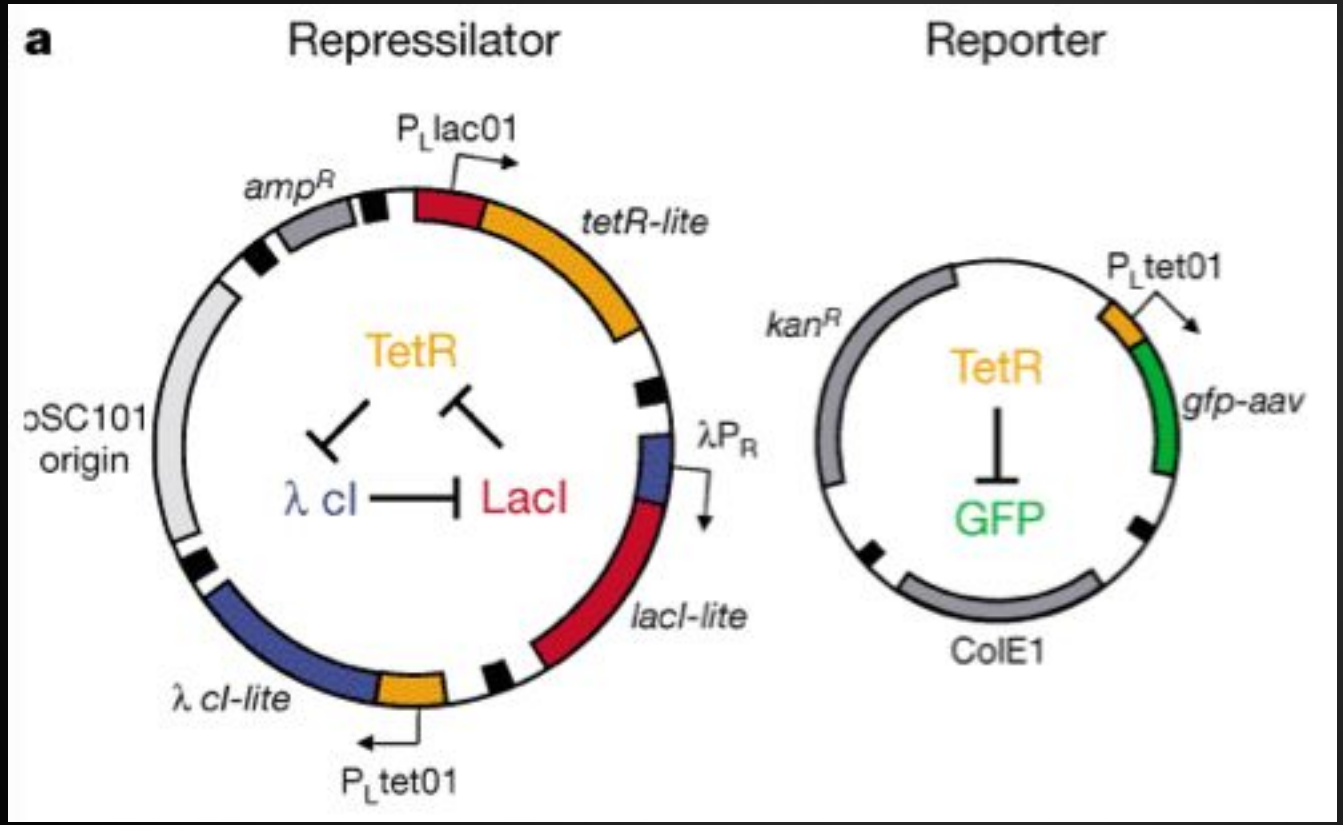


Source: David Rilger

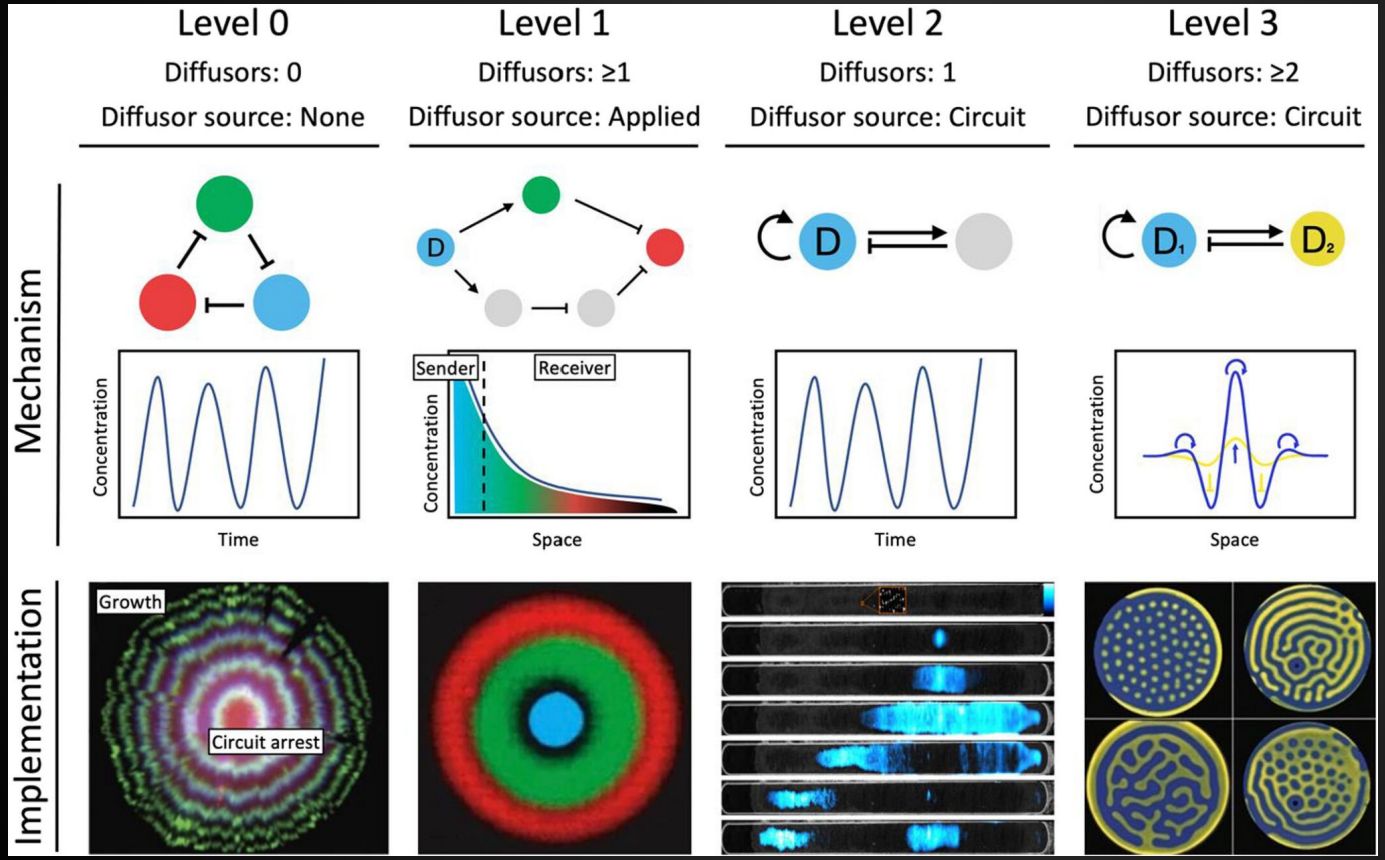
Example 2: The Repressilator



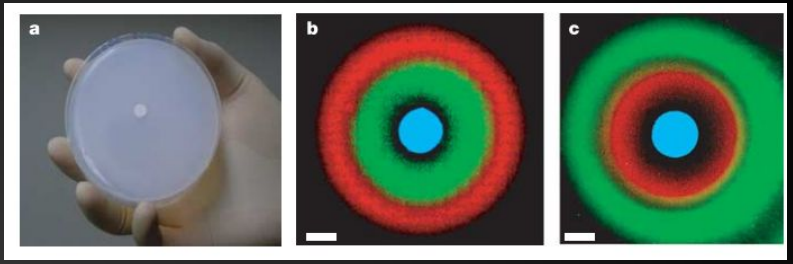
Example 2: The Repressilator

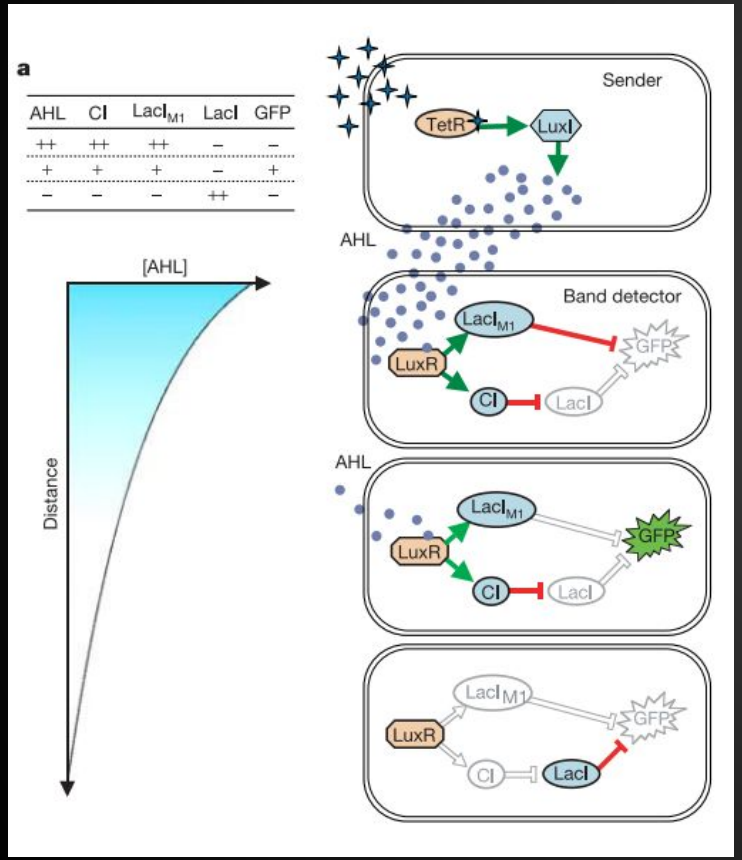


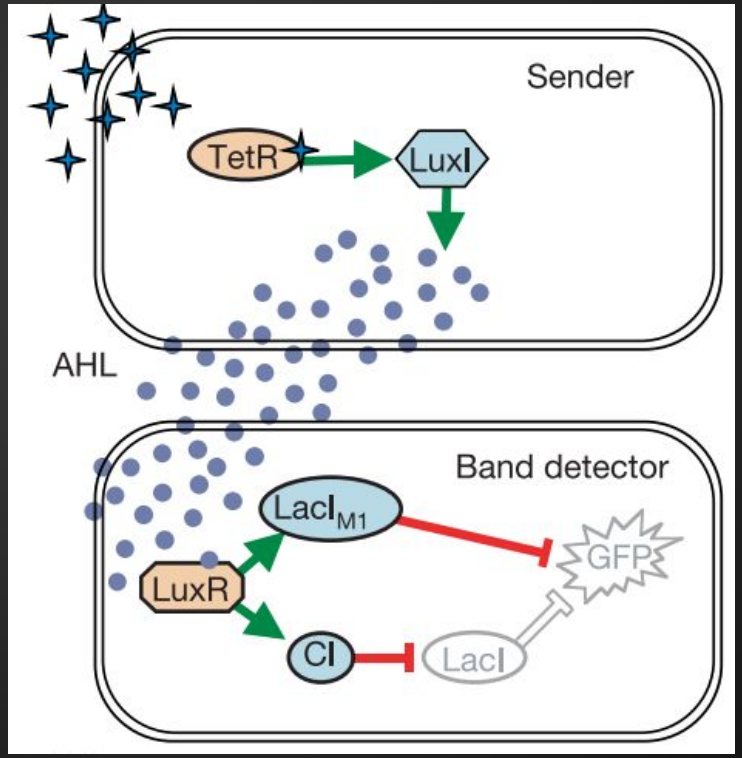
Example 3: Diffusible elements



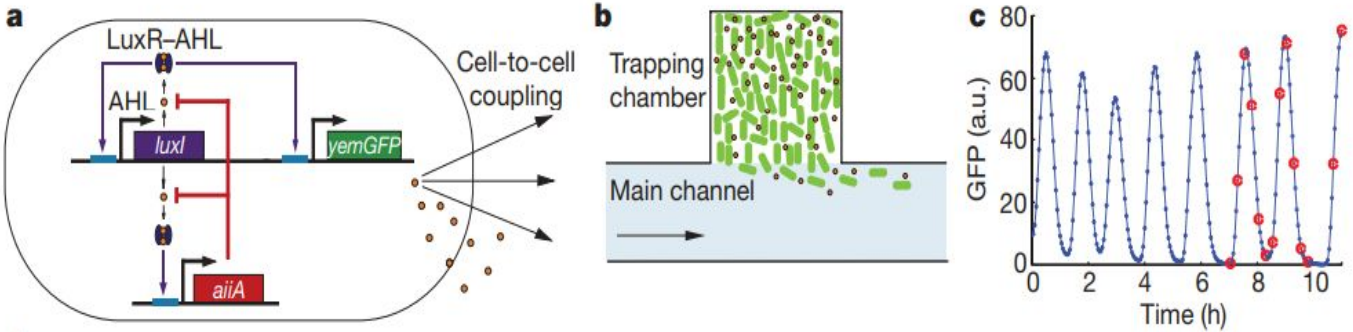
Example 3a: Diffusible elements

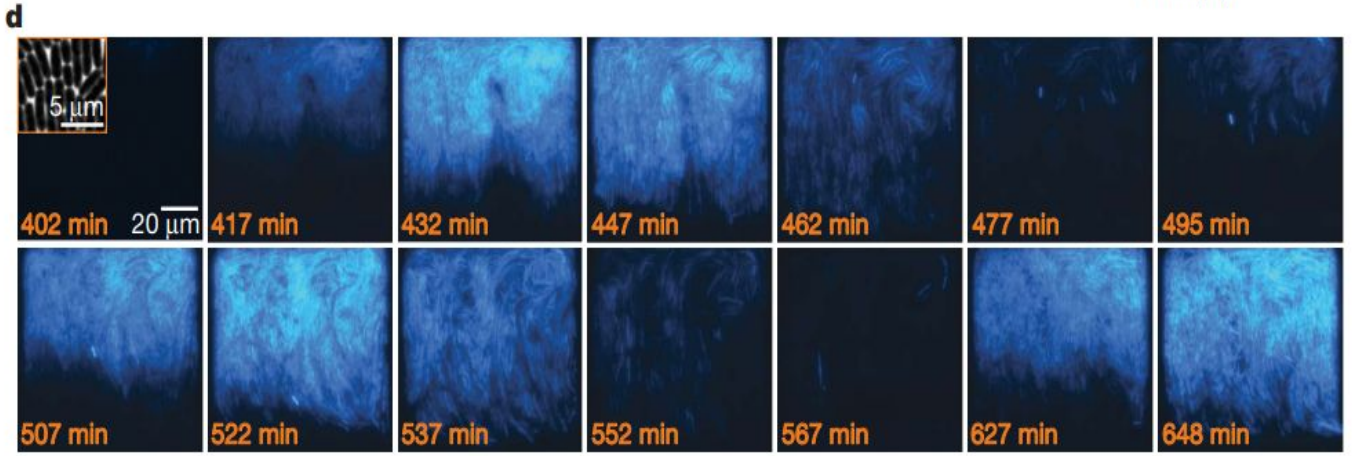






Example 3b: Diffusible elements

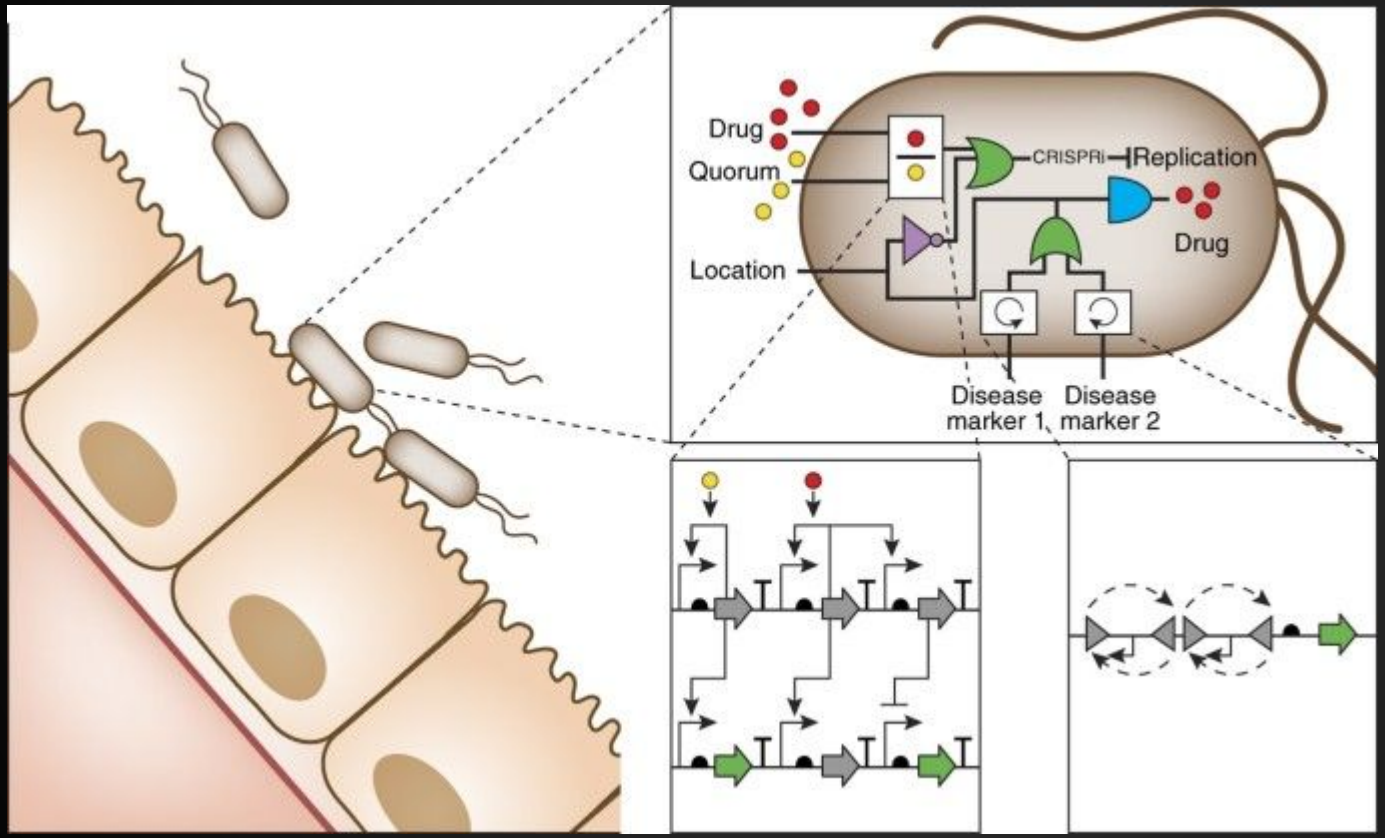




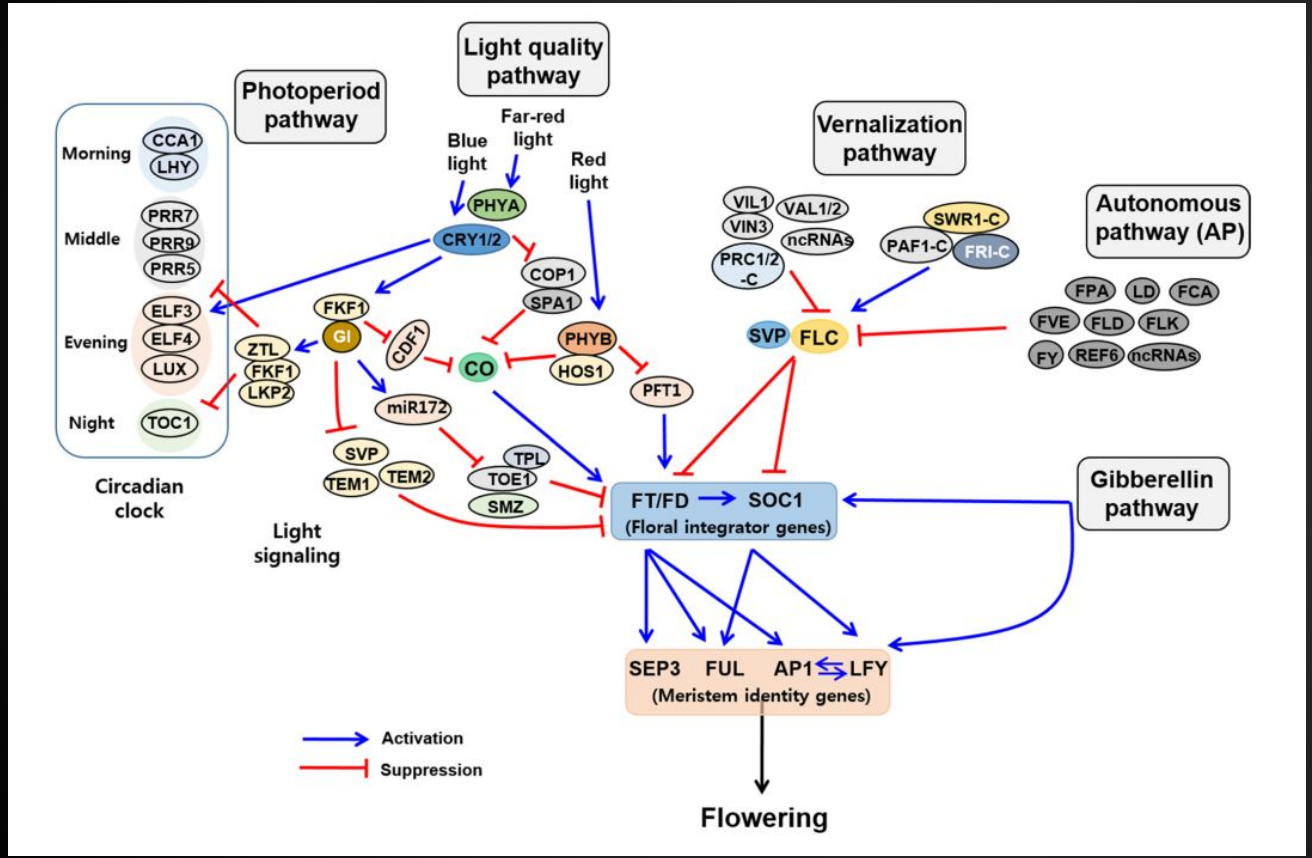
AHL= acyl-homoserine lactone

Part 3: Applications and Natural Examples

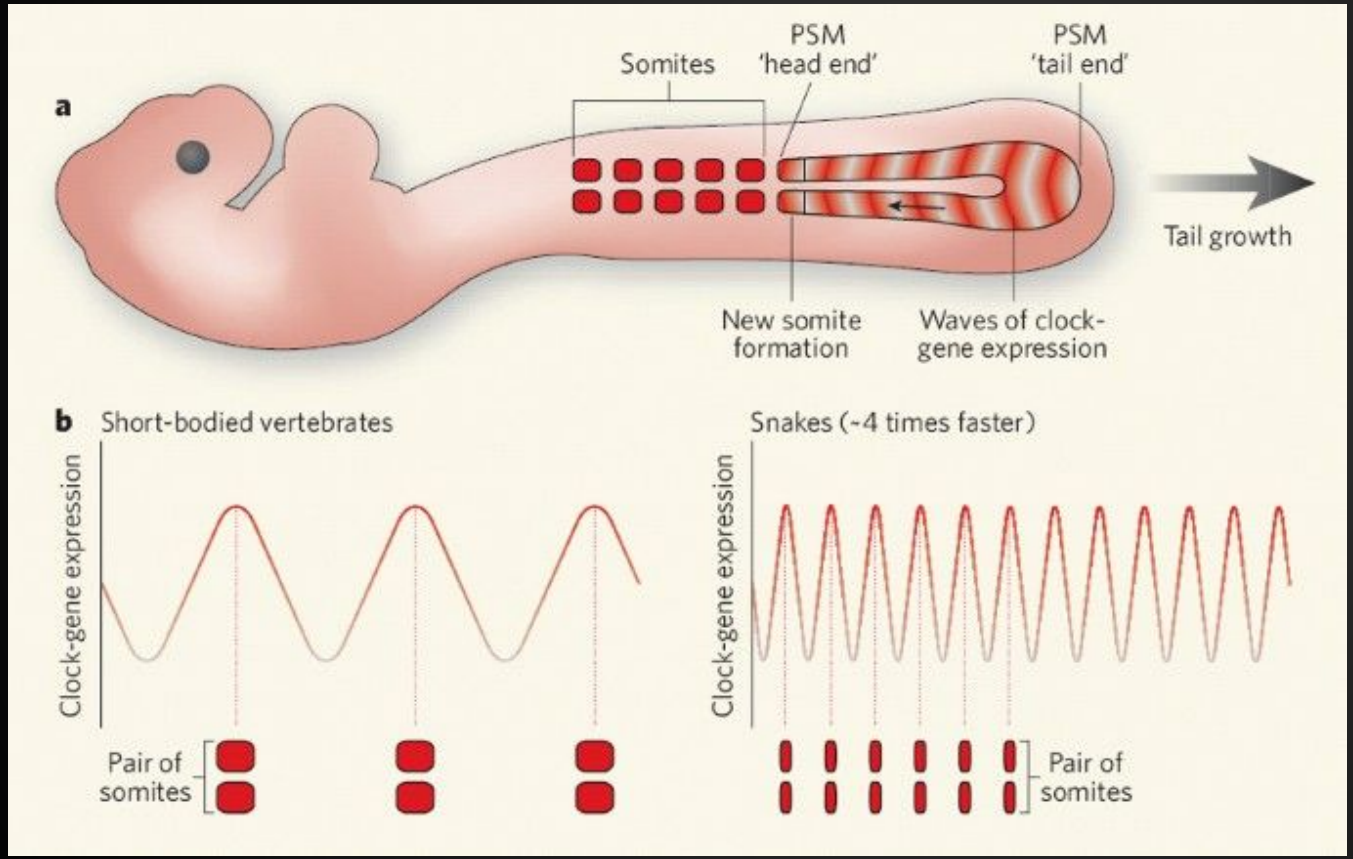
Example 1: Controlled drug delivery



Example 2: Control of Flowering



Example 3: embryology



Part 4: Questions?