



# HAFS iGEM

2018 PROJECT DESCRIPTION

# SYNTHETIC BIOLOGY

Synthetic biology integrates engineering principles to biology to create new organisms. Scientists around the world try to develop environment friendly energy, resolve contagious disease, and produce medications taking advantage of the biological system. The core value of synthetic biology is overcoming the limitation of nature by the fusion of two drastically different fields.

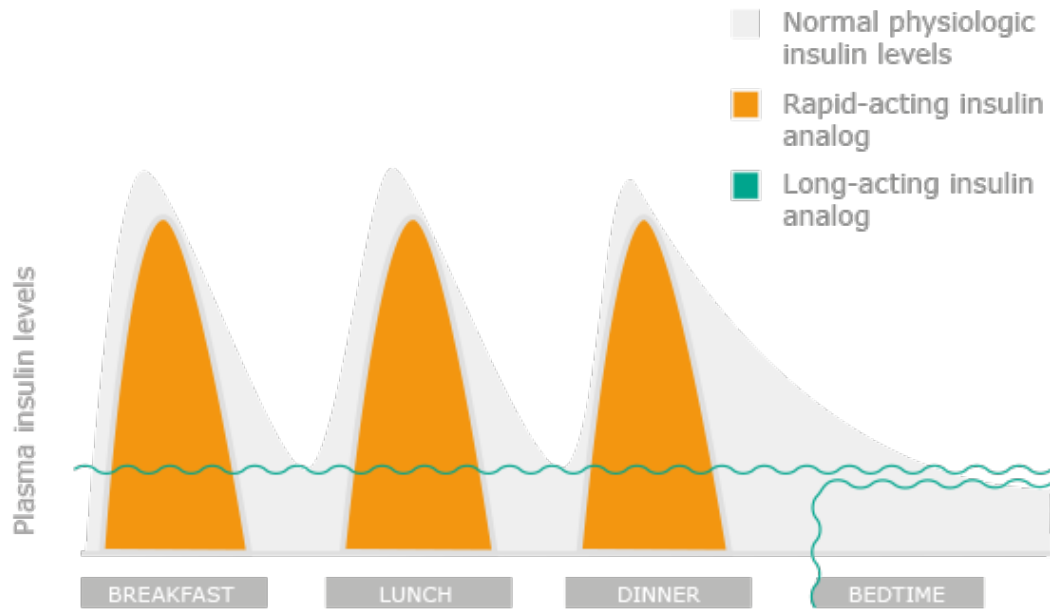
## WHAT IS iGEM?

iGEM, an abbreviation for International Genetically Engineered Machine, is the world's largest international synthetic biology competition. It started in MIT from 2003. Last year, 310 teams from 42 countries participated on the competition. Far beyond being a simple competition, iGEM aims for systematic development of engineering tools for biology, transparent and open development of synthetic biology and the social contribution for safe production and supply of biological technology.

Little doctor inside me

## ECOCO SYSTEM

Insulin therapy requires patients to inject insulin 1-4 times a day. This is a great physical, psychological burden to diabetic patients. Often, the inability of the patients to strictly follow the troublesome regimen worsens the situation. Furthermore, many patients avoid insulin therapy due to their aversion to needles.



Theoretical representation of insulin profiles

# INSULIN THERAPY

Both type I Diabetic patients and type II Diabetic patients receive insulin therapy which involves invasive insulin injections. There are many regimens, from once daily to four times daily, but basically, the therapy attempts to mimic normal insulin pattern. We have come up with two different methods each aimed for oral delivery of basal and bolus level of insulin.

# THE PROBLEM

Insulin therapy requires patients to inject insulin 1-4 times a day. This is a great physical, psychological burden to diabetic patients. Often, the inability of the patients to strictly follow the troublesome regimen worsens the situation. Furthermore, many patients avoid insulin therapy due to their aversion to needles.



70~80% of Type II diabetic patients averse insulin injections.

# BASAL INSULIN

Introduction of Insulin secreting E.coli to gut that increases basal insulin level.



## 1. Easy administration

Unlike traditional insulin therapy, insulin can be delivered orally

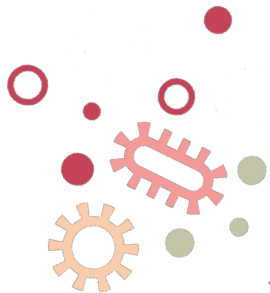
## 2. Effective survival

Contact dependent growth inhibition facilitates the colonization of gut



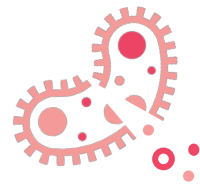
## 3. Secretion of Insulin

E. coli secretes insulin, and delivers it to blood plasma through Cell penetrating peptide



## 4. Kill switch

The cells are removed from gut in response to arabinose



1. **Easy administration** Encapsulated mini cell is delivered orally

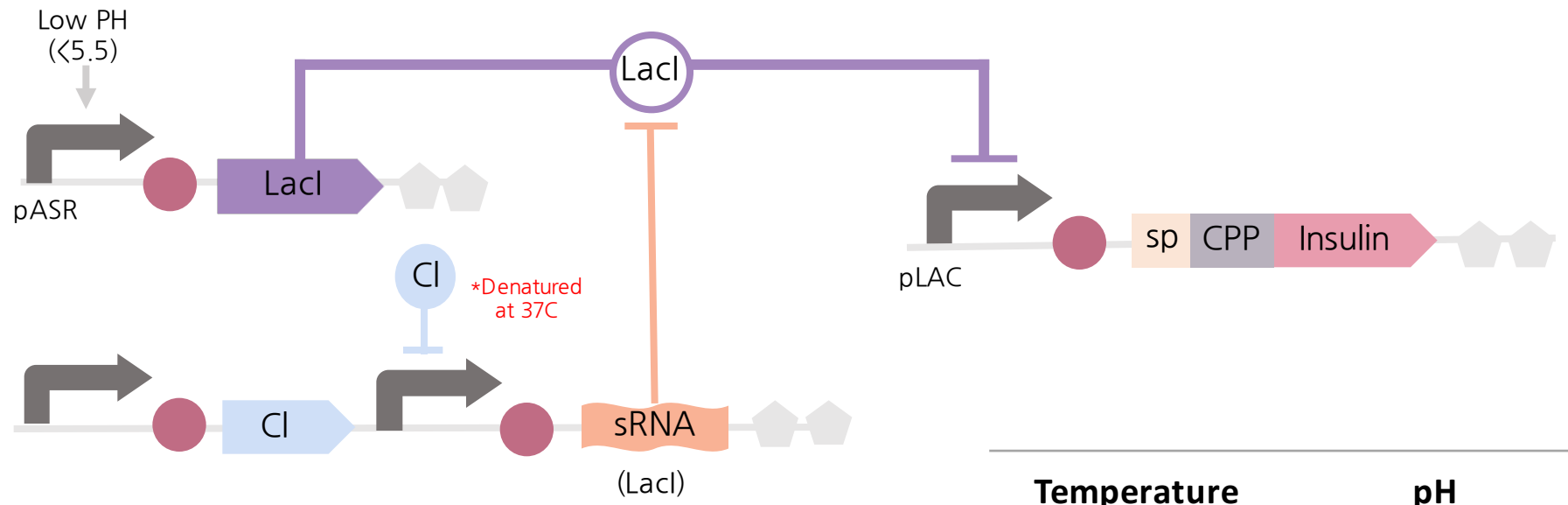
2. **Insulin secretion** Minicells secrete Insulin-peptidase complex proportional to the glucose concentration

3. **Safe removal** Once the glucose concentration in gut decreases after insulin secretion, the cells lyse

# BOLUS INSULIN

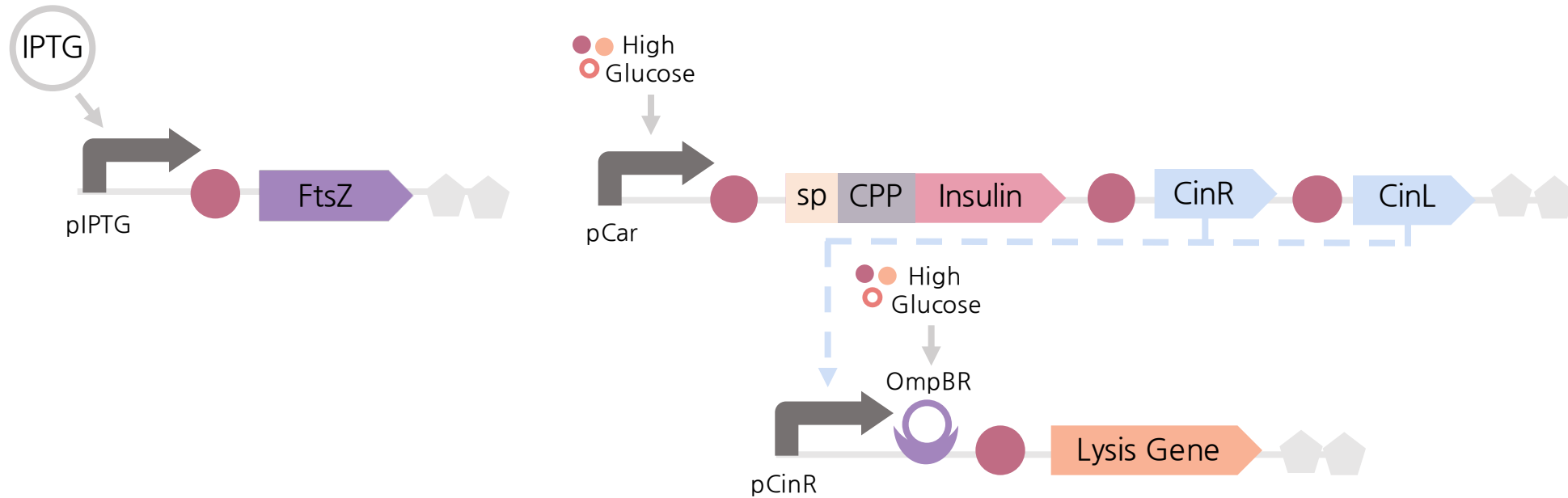
The nonpropagating minicell deliver bolus insulin in response to food intake

# 1. E.coli Coworker



Temperature	pH	Insulin Secretion
< 37	< 5.5	X
	> 5.5	X
> 37	< 5.5	X
	> 5.5	O

## 2. E.coli Courier



A. Insulin Secretion Circuit

Glucose Level	Insulin Secretion
High	O
Low	X

B. Cell Lysis circuit

Glucose Level	Insulin Production	Cell Lysis
High	X	X
	O	X
Low	X	X
	O	O