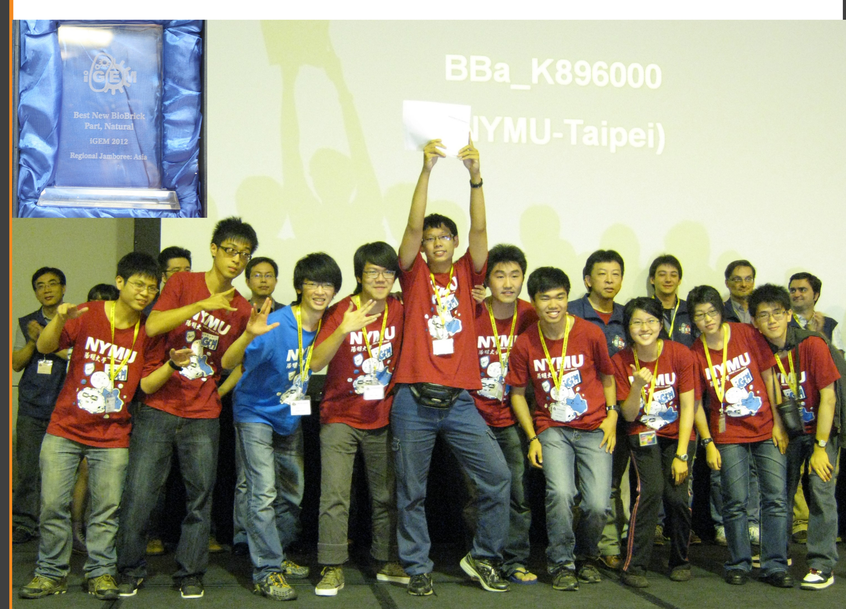
2012



VENUS MARVEL

IS IT POSSIBLE TO BE A VENUSIAN?

Nowadays, pollution spreads through the world and our environment is deteriorating day by day. As a simulation of severely contaminated environment of Earth, Venus may provide us some ideas to solve the problems.

The project of NYMU 2012-iGEM team is mainly about the removal of several pollutants, including nitrogen oxides, sulfur oxides and carbon oxides, from exhaust air and waste water. The NYMU 2012-iGEM team planned to cultivate a special strain of genetically engineered cyanobacteria. With reductases metabolizing nitrogen, sulfur and carbon oxides, the designed organisms reduce three major pollutants in the modern day. Furthermore, the team also focused on the removal of cadmium ions from soil. The team tried to engineer E.coli to gain better capability of collecting cadmium ions. In fact, this engineered E.coli could stay inside of Dictyostelium discoideum, allowing us to build a biosafety system to make sure the GMOs wouldn't become another threat to the environment. Combining the engineered cyanobacteria and the concept of endosymbiosis, it grants Eukaryotes, ultimately human beings, the ability to resist the environment unsuitable for livings, such as Venus. Maybe one day, colonizing Venus and expanding our territory will not be just a dream.

Award — Gold

- **Best New Natural BioBrick Part**

2013

BEE. COLI

TO BEE OR NOT TO BEE

Honey bee is a social insect and can be divided into several classes – queens, drones, and workers. The worker bees can further be classified into field bee and house bee. However, a single bee may fall ill to Colony collapse disorder (CCD) when it intakes water or food contaminated by Nosema ceranae spores. What's worse, CCD may in turn spread to other bees through exchanging substances via mouthparts or feeding food to sacbroods.

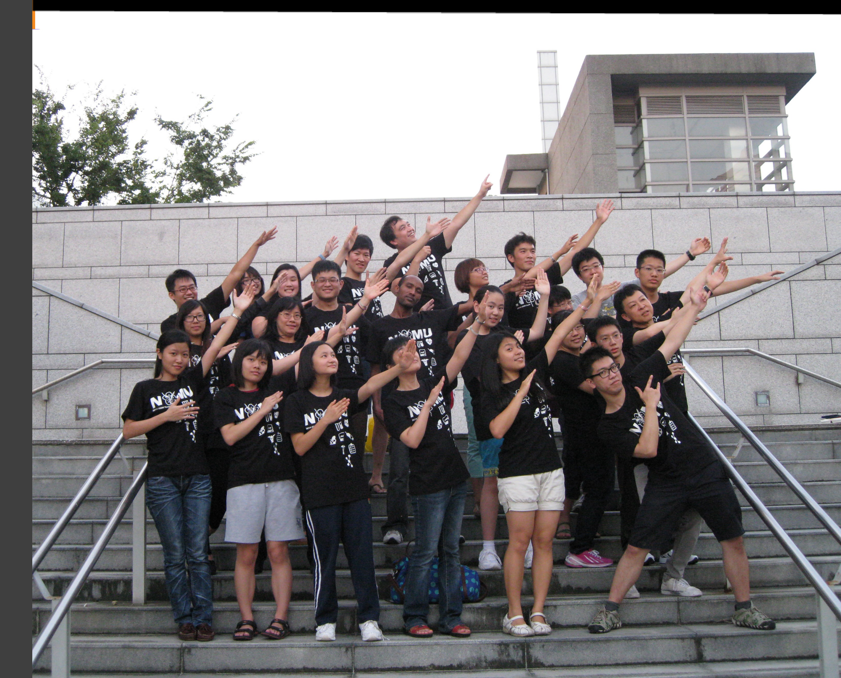
To save bees from Nosema ceranae infection, the NYMU 2013-iGEM team created the so-called Bee. coli from E.coli MG1655, which naturally resides in bees. The Bee. coli is designed to work successively as follows: (1) Bee. coli continuously secretes mannosidase to inhibit the sprouting of N. ceranae spores. (2) If the bee is infected with N. ceranae, the fungus-killing-circuit with a positive feedback design will be turned on to wipe out N. ceranae. (3) If these designer weapons should fail to conquer N. ceranae, a bee-suicide-operon will be activated to kill the infected bees but save their companions.

Besides, a light-inducible lysis system is created and the Bee.coli was sent by encapsulation method to ensure the Bee. coil only lives inside of the bee.

Award — Gold

- **1st runner up**
- **Best Presentation**
- **Best Parts Collection**
- **Most Improved Registry Part**
- **Best New BioBrick Part or Device, Engineered**

2014



HUMAN ORAL PROTECTION for EVERYONE

Nearly 100% of adult suffer from tooth decay. The only way to prevent tooth decay is to brush your teeth every time you eat. However, there are people who have difficulty doing that on their own, such as the elderly, the disabled, and long-term-care patients. For others, there are further difficulties, including poor dental coverage, heavy financial burden, and lack of time. HOPE (Human Oral Protection for Everyone) offers a comprehensive, easy-to-use, self-sustaining system.

The NYMU 2014-iGEM team aims to lower the amount of cavity and biofilm causing bacteria in the mouth with synthetic biology. This project has three components:

1. It is used to control the number of Streptococcus mutans, instead of killing it completely off, which would not help the matter. When the number of S. mutans exceeds the threshold that causes cavities, a designer circuit will then be activated, thus killing the excess S. mutans.
2. Biofilm formation is part of the reason that S. mutans is so devastating to oral health. Therefore, two genetic circuits were designed by the team to treat the biofilm formed by S. mutans.
3. An alert system was developed to detect tooth decay as the above components failed, or were overwhelmed, and to send out a warning message to the HOPE's users.

Award — Gold

2015

FIGHT THE BRIGHT

A POTATO DEFENSE SYSTEM

Potato late blight costs an annual loss of 6.7 billion USD. To control late blight, fungicides are frequently used, up to once every 3 days. These fungicides have enormous costs financially, at $200 per acre of farmland. Moreover, these chemicals often seep underground or escape to nearby streams and contaminate water sources.

In modern agriculture, the use of fungicides and genetically modified potatoes are inefficient in fighting against potato late blight. Most strains of P. infestans (which cause potato late bright) have developed resistance against fungicides used nowadays. P. infestans secretes some enzymes and form high turgor pressure inside its cell to penetrate and colonize in potato cells. P. infestans infect potato leaves and tubers; eventually the entire plant rots and dies.

The NYMU 2015-iGEM team aims to prevent potatoes from being infected by this devastating disease and ensure global food security. There are three parts of this designed potato defense system :

1. Prevention
2. Detection
3. Cure

Award — Gold

2016

INTEGRATED ORCHARD SAFEGRARD

Biopesticides, including insecticidal plant extract, bacteria and fungi, are some of the more popular alternatives to chemical pesticides. Currently, the biopesticides that are the most widespread, in terms of usage, are the entomopathogenic-fungi insecticides. Certain species of entomopathogenic fungi are capable of targeting a small range of hosts, making them the ideal solution to many regional insect pests. However, these biological control agents come with highly variable outcomes due to the variation in environmental (e.g. temperature and humidity) and host (e.g. nutrition and immune response) conditions .

The lack of biosafety development for genetically engineered fungal insecticides hinders its commercialization and public acceptance. To address this problem, the NYMU 2016-iGEM team designed a light-induced kill switch aimed to reduce the dispersal and horizontal gene transfer of genetically engineered fungal insecticides. Using an entomopathogenic fungus, Metarhizium anisopliae, that is applied as an insecticide around the world as our chassis, the team had constructed a genetically modified M. anisopliae with wildtype lethality and the additional ability to self-terminate after killing its host.

Award — Gold

2007

GLUC OPERON

Diabetes mellitus is a significant problem especially in developed countries and leads to several severe long-term complications. Compared to well-known type 2 diabetes mellitus, manifested with different degrees of insulin resistance, type 1 diabetes mellitus is caused by insulin deficiency following destruction of the insulin-producing pancreatic beta cells. Controlling blood sugar in a reasonable level and avoiding severe emergency as diabetes ketoacidosis (DKA) are very important clinical issues.

Thus, the NYMU 2007-iGEM team designs a biological system to sense environmental glucose concentration and decrease the level of glucose by releasing insulin. Besides, life-protection functions for removing toxic ketoacids produced during DKA and preventing hypoglycemia status is also established. This system may be a convenient and safe design for those patients with diabetes mellitus, and further improve their quality of life by avoiding them from diabetes-related morbidity and mortality.

For the iGEM 2007 project, NYMU team focused on the development of a prokaryotic system to

1. Express insulin regulated by external glucose concentration
2. Clean the ketone bodies accumulated by mamalian cells due to insufficient intake of glucose
3. Balance between glucose and insulin to stablize glucose level and prevent low blood glucose condition

Award

Gold

2008

BAC TO KIDNEY

TOWARD A BETTER QUALITY OF LIFE.

Approximately 1.3 million people globally have chronic kidney failure that requires either renal transplantation or dialysis - for such patients, the established treatment is hemodialysis. However, the mortality rate of patients undergoing maintenance hemodialysis remains unacceptably high. An extremely high morbidity and a relatively low quality of life (due in part to a high level of dependence and unemployment) and high cost have also been observed.

The goal of NYMU 2008-iGEM team's project is to use designer bacteria to replace a hemodialysis machine to remove (filter out) toxic waste for treating kidney failure. The designed capsule, BacToKidney, split into four parts: pH Sensor, Attachment, Timer and Removal of the waste products such as Urea, Guanidine and Phosphate.

Ideally, after the BacToKidney is ingested, it passes the through stomach without taking any action, nor being digested, and proceeds to the small intestine. Once in the small intestine, the pH Sensor detects the change in pH and activates the clearance processes of Urea, Phosphate, and Guanidine from the body. To allow itself more time to perform its tasks, the pH Sensor also activates the Attachment process, making the capsule attach itself to the small intestine. After a pre-selected amount of time has passed (controlled by Timer), the capsule detaches itself from the small intestine and exits the body.

Before animal or human trials, the Simulator of the Human Intestinal Microbial Ecosystem (SHIME) can be applied as a semi-realistic environment for tests including estimation of toxicity and immune response and dosage control.

Award

Silver

. **One of Six Finalists**

2009

VIRO CATCHER

WANT TO BE VIRUS-FREE ?

Nowadays, people have been using different methods to fight against viruses, including using nonliving molecules or particles, such as vaccines or nano particles and living cells. The 07Ljubljana iGEM team has been devoted to modify human cells to fight against HIV, others also try to use erythrocytes to trap coxsackievirus.

The NYMU 2009-iGEM team decided to use living cells because they can be regulated. Rather directly modifying human cells, the team chose bacteria to use as the host of the design because bacteria cannot serve for viral propagation and they are easy to culture. The design was split into 4 parts: Chassis, Receptors to catch the virus, Signal Transduction after viruses attaching and Removal of the ViroCatcher itself and the virus.

The goal is binding viruses to designer ViroCatcher cells that cannot support viral replication to diagnose, attenuate, and prevent infection. The team made some effort to the following aspect:

1. Make the designer cell safe
2. Express specific cell surface receptors and antibodies to catch the virus
3. Transduce the signal after viruses attached for feedback control
4. Remove the viruses along with ViroCatcher itself.

Award

Bronze

2010

SPEEDY BAC

A NOVEL ASSAYING SYSTEM OF SYNTHETIC BIOLOGY

Some emergent needs in the development of synthetic biology are the following :

1. Detailed design rules for large-scale genetic circuit design.
2. Comprehensive information of the interactions among genetic parts in vivo.
3. Exploring gene expression mechanisms using traditional methods takes too much time.

Yet, the current iGEM trend is to create larger and larger circuits but the circuits have less and less chance of working together. It makes difficult finding similar design rules in synthetic biology.

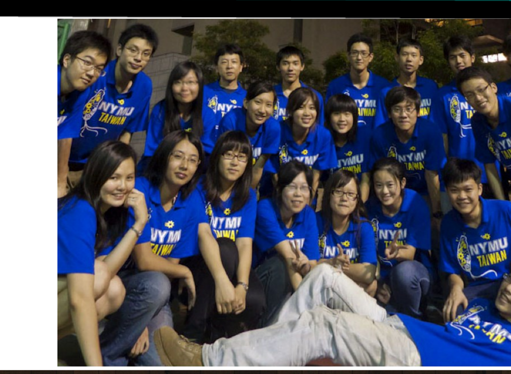
For 2010-iGEM, the NYMU team created a system, SpeedBac, which can speed up the expression detection of a gene flow and reveal the location and quantity of both mRNAs and Proteins. Between the mRNA level and protein level of gene expression cycle, a riboswitch that allows the translation of proteins to be stopped, started and controlled was integrated. By using this switch, people can study mRNA and its protein(s) in one cycle without the interference of one on the other. The speedy degradation device included in the system can also stop the gene expression quickly and cleanly.

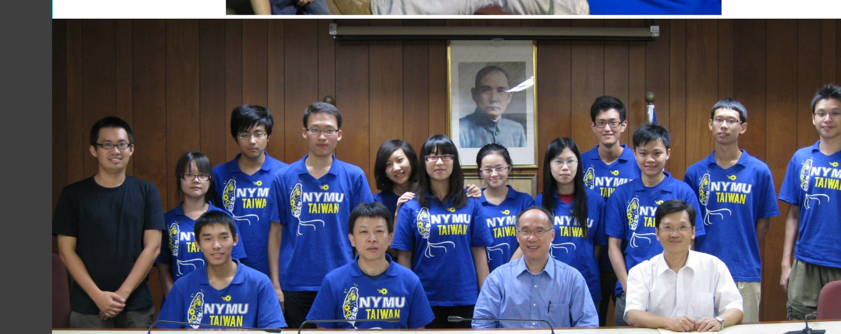
This designed system contains three devices: Speedy switch, Speedy reporter and Speedy protein degrader.

Award

Silver

2011





TAILORING YOUR AVATAR

The goal for NYMU 2011-iGEM team is to create a wireless neuro-stimulator, focusing on achieving remote neuro-stimulation to minimize invasion and damage to the neuron. It was similar to the concept of Avatar, which was the most popular movie in 2009.

The team develop an opto-magnetic probing platform on Magnetospirillum magneticumAMB-1. It functionally couples to channelrhodopsins (opsins that are ultra-rapidly reactive to light beams of certain wavelengths) to enable activation of neuronal circuitry in a totally wireless, spatially and temporarily accurate way. Minimal invasion and 3D multi-site stimulation are also the traits of this designed system.

The designed system is composed of Magnetotactic bacteria and Optogenetics. Magnetotactic bacteria have long been regarded as an intriguing group of species exhibiting magnetotaxis with their bacterial organelles called magnetosomes. As to Optogenetics, it refers to a neuroscientific method, improving specificity for stimulating certain cell types of neurons, reversible bi-directional stimulation, and elevated spatiotemporal precision.

Award

Gold