iGEM 2012 High School Jamboree

Program Information

AUC Turkey
FreshEcoli

Track: Environment
Presentation: Blue and Gold Room, 11:00AM, Session 2

Trimethylaminuria is a health disorder caused by the lack of the enzyme FMO-3. This disease ruins the social lives of people born with it. It causes the excretion of a disgusting fish odor.
With our genetically modified E.coli, we would like to pursue the solution of this problem. By implementing the necessary system, we will offer a synthetic solution.

Our system is based on the removal of the disturbing odor caused by this disease. Also, the usage of the products of this process to make the bacteria release geraniol (which is the chemical that provides the rose its aroma) is also something else that we wish to do.

With FreshEcoli project, we will get rid of bad odor and make a bacteria produce a nice fragrance. This will allow us to benefit from the good smell released, and also, remove the belief that bacteria smell unpleasant.

BioscienceDragons AZ
Biopanels

Track: Information Processing
Presentation: Blue and Gold Room, 1:30PM, Session 3

Exploring new alternative energy sources in modern society has become a high priority in scientific research. The recent increases in energy costs have inspired and pushed scientists and engineers to continue to search for more efficient ways of powering our future. We plan to explore the field of synthetic biology to search for new sustainable methods of renewable energy production. Our approach involves using the protein Proterohodospin to test whether or not light can be a viable method for fuel production. Proterohodopsin(PR), used by cells when deprived of oxygen, exhibits the process, similar to photosynthesis, that converts ultraviolet light to an alternative energy source for the production of ATP to power the cell. One application of the PR protein is to use it on cells that produce ethanol/butanol and change their original food source to light to produce biofuel that can be used. Our approach is to alter the genetic structure of E.coli, using our understanding of synthetic biology, to mimic the cells that produces the ethanol/butanol and express the PR protein by using Azide to stop the cells from consuming oxygen, thereby forcing the cell to use light as a food source. The goal of our research is to create a "BioPanel" that will use the PR induced cells to produce ethanol/butanol that can be tested later for feasibility and future commercial applications. The success of this research will suggest whether or not using light to create fuel is a viable alternative energy source for the future.

BVCAPS Research KS
Arom-O-Clock

Track: New Application
Presentation: Media Center, 2:00PM, Session 3

The ”Arom-O-Clock” is a biologically-based alarm clock. During the day, the clock emits a strong wintergreen aroma, which stimulates the user and heightens the senses. At night, when no light is present, a soothing banana odor is produced, assisting the user in relaxing and promoting sleep. The microbial backbone of our machine utilizes parts generated by previous iGEM teams at MIT, UT Austin, and NYMU, Taipei. Our bacteria have been co-transformed with two plasmids, both containing the light sensor, cph1. One plasmid also contains a mint odor generator that is stimulated by light. The other plasmid contains a banana odor generator that is activated in the absence of light. The bacteria are contained within a sturdy, yet attractive housing that is accessible to sunlight and contains a mechanism for aroma diffusion.

CIDEB-UANL Mexico

Semi-quantitative biosensor based on sensitivity tuners

Track: Foundational Advance
Presentation: Media Center, 11:00AM, Session 2

Nowadays due to the contamination caused by pollutants such as heavy metals, it is important the implamentation of simple and complete detection methods. This project aims to create a biosensor that may detect the presence of heavy metals in water. In order to construct the biosensor, a genetic circuit was built into E. coli. The circuit represents a model, which works with Arabinose. It is a semi-quantitative biosensor. The circuit has 3 parts: High concentration, Low concentration and Stand-by state. Each part of the circuit has a different response: when there is a high concentration of Arabinose the bacteria shows a yellow fluorescent color; when the concentration is low it uses a sensitivity tunner that increases the response from the amount of Arabinose present, which makes the bacteria to appear in a red fluorescensce; and when there is no Arabinose in the sample, the bacteria shows a green fluorescence.

CSIA SouthKorea

E.coli display using repressilator

Track: New Application
Presentation: Blue and Gold Room, 9:30AM, Session 1

Based on the design of V.fischeri, we placed luxR gene under luxpL promotor and placed luxI, Aiia, and GFP gene under luxpR promotor. In this V.fischeri quorum sensing system, LuxI synthase produces an acyl-homoserine lactone (AHL), which is a small molecule diffuses extracellularly and triggers quorum sensing. When AHL binds to LuxR, it produces LuxR–AHL complex that activates luxI promoter1. This also activate GFP genes, so fluorescence can be detected. AiiA 'represses' continuing activation of luxI promotor by degrading of AHL. Therefore, fluorescence may have the cycle under right conditions.

In the world where people suffer from energy deficiency, we expect that this technology could be applied to many different areas. Among them, we think the most successful adaptation would be as an alternative for light bulbs such as those in night stand.

We got interested in synchronized oscillator while reading Team Wageningen's 2011 project. However, we modified their model a little to increase the probability of success in experiment by using only one promoter.

Dalton School NY

Creating Parts for the Synthetic Yeast Genome Project

Track: Foundational Advance
Presentation: Media Center, 11:30AM, Session 2

Students at The Dalton School are collaborating with scientists and students at Johns Hopkins University on their effort to construct a synthetic yeast genome. The short term-goals of this project are to construct large libraries of promoters, protein-coding sequences, and terminators that can be easily combined to form functional genes. Dalton students are cloning 30 promoters as part of this effort. In addition, we are also cloning the protein-coding sequences for 6 fluorescent proteins that can eventually be combined with the promoters to test the strength of the promoters. After constructing genes, the individual genes can be assembled into synthetic yeast chromosomes. The long-term goal of the Hopkins Build-A-Genome initiative is to be able to engineer yeast that can be used to solve human problems including combating world hunger, producing alternative sources of fuel, and studying human disease pathways in a simplified system.

Evansville Central

The Use of Dipeptidyl Peptidase IV to Facilitate the Metabolism of Casein and Gluten

Track: Health or Medicine
Presentation: CMR, 10:00AM, Session 1

Our project is focusing on the incomplete metabolism of casein and gluten in the human digestive tract. Individuals with dairy intolerance are unable to consume foods containing milk or any milk product that contains casein. Individuals with gluten intolerance are unable to consume foods containing gluten such as wheat/flour products. Current research on individuals with Celiac Disease indicated the possible treatment use of the dipetidyl peptidase 4 enzyme. Our goal is to research the isolation of the dipeptidyl peptidase 4 gene. Since the actual genomic sequence is over 60,000 base pairs is length, our laboratory work will be to amplify a 3000-4000 base pair region for DPP-4. Used Primer3Plus web tool to design primers for our genomic region of DPP-4. We designed 3 sets of primers which were ordered from IDT (Integrated DNA Technologies).

GreenfieldCentral IN

Biological Detector Gadgets

Track: Health or Medicine
Presentation: Media Center, 1:30PM, Session 3

Galactosemia is a disease that affects 1 in every 30,000 babies born, and affects the individual's ability to break down galactose. This build-up of galactose can cause learning disabilities, liver failure, and ataxia. There is currently no way to treat galactosemia, and no easy early detection system. Our team used the galactose-sensing Gal1/10 promoter from Dr. Fridovich-Keil of Emory University and combined it with RFP to create an early detection system for galactosemics to use.

Fish Tuberculosis is an undetectable strain of tuberculosis that can kill off entire aquariums of fish rapidly and unexpectedly. This strain expresses mycolic acid on the surface of its cells, which prevents treatment by antibiotics. We used the mycolic acid promoter MMAA2, which we received from Dr. Glickman of Kettering University, and combined it with GFP to create a warning system for aquarium owners.

Heidelberg LSL

Unveiling the Invisible - Synthetic Measurement Toolkit for the precise Quantification of UV and radioactive Radiation

Track: New Application
Presentation: Blue and Gold Room, 10:00AM, Session 1

UV radiation and radioactivity are two natural radiation types we get in contact with every day. In low doses, UV and radioactive radiation are mostly harmless to cells and can even be beneficial for the survival of an organism. Though, when exceeding the healthy range, they can cause severe cellular damage, which may lead to diseases such as cancer in humans. The iGEM team Life-Science Lab Heidelberg has developed a synthetic measurement toolkit consisting of standardized parts for the precise quantification of both UV and radioactive radiation. Our toolkit is applicable in a variety of everyday life settings- from checking the exposure of your body to UV-light during sun-bathing to detecting sources of radioactivity in high-risk-areas. Finally, by exploring our toolkit in context of a real consumer product called "iGEMs", we want to raise the public awareness for the invisible danger and exemplify the great perspectives offered by synthetic biology.

Lethbridge Canada

Treating type I diabetes: A synthetic biology approach

Track: Health or Medicine
Presentation: CMR, 9:30AM, Session 1

Hyperglycemic diabetes mellitus (type I diabetes) is a disorder in which pancreatic beta (insulin-producing) cells within the body are compromised, and results in the inability of the body to control glucose levels. Conventional methods of treatment can have unfavorable implications. Therefore, our team worked on using synthetic biology to derive another, potentially more viable treatment.

Our project involves engineering a glucose detection and insulin production/secretion system. As a method of glucose detection, we are utilizing the natural mechanism of glucose-induced gene expression present in Escherichia coli — mlc inhibition coupled with the phosphotransferase system. The induced gene will be red fluorescent protein (RFP) as a proof of principle in place of insulin. In order to secrete insulin (or RFP respectively), we will use N-terminal signal sequences to direct targeting across the cell membrane. We are testing two—twin arginine tag and heat-stable toxin I— to determine their efficiency in secreting proteins.

NC School of Sci Math

Engineering a silver nanoparticle biosensor using the Escherichia coli bacterium

Track: Environment
Presentation: Media Center, 9:30AM, Session 1

Silver nanoparticles (AgNP's) have a variety of beneficial health effects but can be detrimental to both human and environmental health in excessive quantities. As a result, NCSSM iGEM has attempted to develop an inexpensive biosensor for detecting AgNP's in vivo. This novel AgNP biosensor utilizes ACE1, a silver binding transcription factors from S. cerevisiae (yeast), in an E. coli chassis. In the biosensor's synthetic gene network, a constitutive promoter upstream of ACE1 ensures continuous expression of the ACE1 protein. In the presence of AgNP's, ACE1 activates the CUP1 promoter which has been placed upstream of a Green Fluorescent Protein gene. Subsequently, exposure of the E. coli biosensor to AgNP's will result in high levels of GFP expression. Network success was confirmed in vivo by spreading the biosensor on plates containing varying concentrations of AgNP's. However, due to the antimicrobial effects of AgNP's, network success under high AgNP concentrations remains unconfirmed.

PrepaTec GarzaSadaMx

Synthesis of Tyrian Purple through the transformation of bacteria E. coli

Track: Environment
Presentation: CMR, 2:00PM, Session 3

The purpose of this experiment is to obtain Tyrian purple in a more environmentally friendly and efficient way than the one commonly used. The mollusk Bolinus Brandaris is killed in order to obtain this dye, thus we used the recombinant DNA techniques in order for the E. coli to produce Tyrian purple. We inserted two genes in E. coli for it to generate two enzymes which induce the reactions that produce indigo. After a chemical process, known as halogenation of benzene, indigo is turned into Tyrian purple. This process needs the usage of a catalyst called BFe3 in order for it to occur. Because we believe it´s essential that these species are kept from being endangered. The importance of this is related to the fact that it´s significant to maintain the biodiversity, as a way of preventing the disruption of the balance of the ecosystems.

Saloniki Greece 12
Introducing iGEM and Synthetic Biology to Thessaloniki

Track: Food or Energy
Presentation: CMR, 11:30AM, Session 2

The field of synthetic biology continues to grow and develop. Over the course of twelve weeks, a team in Thessaloniki, Greece has worked to gain an understanding of synthetic biology and developed a project idea with nitrogen-fixing bacteria. The concept was to improve the nitrogen-fixing bacterial pathways, so that they would provide more NH3 for use in plant growth. Along the way, we have had to focus on how to make iGEM fit into the Greek system both educationally and socially. Bioethics and acceptance of biotechnology have been extremely important to our project, as genetic engineering still faces some resistance in Greece. We have established a structure and schedule to ensure next year our team will be better equip to meet the demands of the competition. This project has fostered bonds across three different school structures and forced collaboration that is much needed in Greece.

Sharon BasicallyAcid
Proton Blaster

Track: Food or Energy
Presentation: CMR, 11:00AM, Session 2

A major factor that inhibits plant growth is the soil pH level. Plants like tomatoes and blueberries need to be cultured in acidic environments to efficiently absorb nutrients. The problem is that soil pH levels are constantly fluctuating due to factors like rainfall and fertilizer. Many methods are available to combat this issue, but they require constant human maintenance. We proposed a project designed to perfect the acidity level in soil, promoting maximum growth. It utilizes modified bacteria that monitor the planting soil environment. The goal is to combine a pH sensor and a hydrogen pump to create a device that effectively modifies the basic areas. Although we did not test our hypothesis, this bacteria could potentially replace the currently solution of directly applying acids. Our bacteria would create a self-sustaining system that constantly monitors and adjusts the pH for an ideal environment.

SouthBendMishawakaIN
The "Arsenator:" Design and development of a biosensor for arsenic in ground water

Track: Environment
Presentation: Blue and Gold Room, 11:30AM, Session 2

Millions of people worldwide are exposed to toxic levels of arsenic through contaminated drinking water. In last year's project, we began the development of an E. coli-based arsenic biosensor using an arsenic-induced promoter from the Registry (K190015). Like the Groningen Team, we found that this promoter is "leaky," having a constant low level of activity. We explored ways of reducing background activity to improve the sensitivity of our device. We have built and characterized biosensors using K190015 and a number of chemiluminescence generators from Vibrio fisheri and two species of fireflies. In order to standardize our biosensor we have designed and built a simple luminometer. Paired with our device, this can be used to inexpensively and rapidly detect arsenic in water, even by people in underdeveloped parts of the world.

Tyngsboro MA Tigers
E. (CO) Factory: An olfactory test for the detection of carbon monoxide

Track: Environment
Presentation: CMR, 1:30PM, Session 3

In the United States alone, carbon monoxide is responsible for over 2,100 deaths every year, with our only current defense being the warning sounds of carbon monoxide alarms. Carbon monoxide (CO) cannot be seen or smelled, so our project idea was to develop a biological alternative to the typical carbon monoxide detector to produce a warning smell, rather than a sound. Our circuit consists of the CO transcriptional activator CooA. In the presence of a CO inducer and an isoamyl alcohol precursor, the characteristic smell of bananas will be produced. Our team has developed a proof of concept circuit using the banana odor generating device as a reporter and the Tetracycline repressor as a constitutive generator to activate the transcription of ATF1 in an indole-free chassis. This circuit will replace CO gas with doxycycline as an inducer and isoamyl alcohol as a precursor to generate the banana smell.

WarrenCentral WCC IN

Detection of Mercury in Water Sources

Track: Environment
Presentation: Media Center, 10:00AM, Session 1

Exposure to mercury is a widespread problem. Mercury in water can arise from runoff from farms, chemical and industrial plants, household products in the trash, and sewage.We are using Saccharomyces cerevisiae yeast as a tool to detect mercury. In yeast, there are a number of transcription factors and genes that respond to oxidative stress and toxic metals. The yes associated protein (YAP) family is a family of transcription factors that is involved with oxidative stress regulation and redox homeostasis. They affect a number of genes, but we are focusing on GSH1 and GSH2. These genes are involved in the glutathione pathway. Glutathione is an antioxidant that protects the cell from oxidative stress. The Kozak + mCherry translational unit is being used to give off a red fluorescent glow when the mercury is detected. In the plasmid, we will include the GSH2 promoter and the ADH1 terminator.