



2022 GRAND JAMBOREE

Competition Abstracts

Aachen

Project Title: MEtaPhos - Modified Enzymes targeting Phosphate-recycling

-  Booth: Environment Village, I-1
-  Village Presentation: October 27, 10:00-10:15 CEST, Plaza 5
-  Judging Session: October 26, 13:00-13:30 CEST, Room J7

Phosphorous is an essential element of life. Regarding the decreasing rate of phosphate mining and the waste of phosphate in wastewater, there will soon not be enough to sustain a civilization of ten billion people. Up until now, there is no efficient solution to regain phosphate from wastewater. If humanity fails to recycle phosphate, we will have a wide range of challenges. One problem is the pollution of soils and water with high amounts of phosphate from agricultural and industrial waste. Furthermore, the need for phosphate fertilizers will only grow as the earth's population grows. MEtaPhos aims to revolutionize the phosphate cycle by fusing a phosphate-binding protein with a molecular optogenetic switch. By blue light irradiation, we can control the binding and release of phosphate in a highly specific manner. Our goal is to recycle phosphate from wastewater and generate polyphosphate to be reused in the industry.

<https://2022.igem.wiki/aachen>

Aalto-Helsinki

Project Title: Qblock - preventing biofilm formation by quorum quenching

-  Booth: Therapeutics Village, D-1
-  Village Presentation: October 26, 9:45-10:00 CEST, Plaza 2
-  Judging Session: October 27, 13:00-13:30 CEST, Room J4

Chronic wounds are a 'hidden epidemic' that place an undue strain on patients and the healthcare system. They often arise as a secondary complication of more persistent health problems. Biofilms are present around 80% of chronic wounds and contribute to their slowed healing. Our project, QBlock, is intended to limit biofilm formation by targeting bacterial communication molecules (i.e. AIPs) that contribute to biofilm formation in *Staphylococcus epidermidis* by impeding the bacterial communication via DARPins (designed Ankyrin Repeat Proteins), which are synthetic proteins mimicking antibodies. A DNA library of 42 DARPins was generated by altering and randomizing amino acid positions. AlphaFold2 predicted the structure of these DARPins, and the affinity of DARPins towards AIP was experimentally measured via ribosomal display. Control experiments employed a GFP-binding DARPIn with a known sequence. Structural predictions and modeling not only confirmed a significant binding with AIP, but also highlighted the diversity and heterogeneity of DARPins.

<https://2022.igem.wiki/aalto-helsinki>

Aboa

Project Title: CropFold - A Bioassay for Easy On-site Plant Pathogen Detection

-  Booth: Food & Nutrition Village, E-1
-  Village Presentation: October 26, 9:15-9:30 CEST, Plaza 3
-  Judging Session: October 27, 10:00-10:30 CEST, Room J13

Plant diseases are an increasing threat to global food security. As plant infections can rarely be visualized at early phases of plant-pathogen encounter, we sought to devise a bioassay kit that could identify an infection before phenotypic symptoms arise. For this purpose we developed a low-cost cell-free system to be used on-site, based on exchangeable toehold switches that respond to pathogen-specific gene sequences. As a demonstration, we built a novel toehold switch for detecting barley yellow dwarf virus (BYDV), and compiled a library of alternative switches towards other pathogens to showcase system modularity. Reporter plasmids harboring the BYDV toehold switch were successfully constructed, and the reporter protein expression without the toehold was shown to work in a cell-free system. Although the function of the toehold-reporter combinations could not be verified, several iterations of system testing allowed us to pinpoint critical issues for the next steps of the assay development.

<https://2022.igem.wiki/aboa>

AFCM-Egypt

Project Title: A Phenylketonuria Diagnostic Platform using Aptamers and E.coli-Based Biosensors along with a Novel Therapeutic Approach.

-  Booth: Diagnostics Village, F-1
-  Village Presentation: October 26, 13:15-13:30 CEST, Plaza 4
-  Judging Session: October 27, 10:30-11:00 CEST, Room J10

Phenylketonuria is a metabolic disorder that induces brain damage due to phenylalanine hydroxylase (PAH) deficiency. Herein, we are establishing a diagnostic and therapeutic platform for Phenylketonuria as a prototype for Inborn Errors of Metabolism. The diagnostic approach is achieved via Lateral Flow Assay which provides a cost-effective, accurate, and user-friendly test. We are introducing a novel consumption line in which aptamers-nanoparticles conjugates with pre-specified concentrations consume the normal level of phenylalanine in the sample. The designed aptamers are generated using our directed evolution software tool. Subsequently, the sample passes through the test line that contains a whole cell-based biosensor that releases beta-galactosidase enzyme, providing a semi-quantitative colorimetric signal. This approach uses a CRISPR-regulated therapeutic circuit to control the release of PAH. We introduce a novel Selective Endogenous eNcapsidation for cellular Delivery (SEND) of PAH. Furthermore, safety measures included incorporating anti-CRISPR proteins to control off-targeting actions of Cas proteins.

<https://2022.igem.wiki/afcm-egypt>

Aix-Marseille

Project Title: SeaCare: specific bacterial degradation of microplastics



Booth: Environment Village, I-2



Village Presentation: October 26, 13:30-13:45 CEST, Plaza 5



Judging Session: October 27, 10:00-10:30 CEST, Room J8

The pollution of our oceans and seas has intensified upon the excessive use of plastic in our daily lives and industrial and commercial activities. The Mediterranean is one of the world's most polluted seas, mainly because it's almost entirely enclosed by land. Its surface waters contain 84,800 microplastics per km², which increases yearly, endangering the marine ecosystem. Our project, of global and local scope, aims to degrade the most abundant microplastics in this sea, namely polyethylene, polystyrene, and polypropylene. It is about engineering a 'plasticosome', a large bacterial extracellular multienzyme complex which degrades plastic. The particularity of this complex will be its specificity to recognise plastic through plastic adherent peptides that we have tested and specific VHH antibodies that we have found. We are also committed to raise public awareness on the issues surrounding the widespread use of plastics and plastic waste management while considering health, social and environmental challenges.

<https://2022.igem.wiki/aix-marseille>

Alma

Project Title: Unraveling a Toxic River



Booth: Environment Village, I-3



Village Presentation: October 27, 15:00-15:15 CEST, Plaza 5



Judging Session: October 26, 15:30-16:00 CEST, Room J6

Alma College iGEM has invested their efforts into researching and engineering a testing solution for our Red Fluorescent Protein detection device. As a student-led research team, we have spent this year adding to our project and finding solutions that can better equip our students in the lab. We have investigated a cell-free protein synthesis protocol and have better engineered our plasmid with a kill switch to guarantee environmental safety should our product spill into the ecosystem. With our efforts focused on the Pine River and those in Alma, we have projected our causes and promoted our project to local schools, libraries, and the outside community with the help of our published book and STEM kit. As we continue our research, we will have a cost-friendly product to sell to the market, which will aid the community of Alma and those involved with the toxic effects of DDT pollution.

<https://2022.igem.wiki/alma>

Anatolia_College_HS

Project Title: Biofilter for the Catabolism of Nitrates found in Fertilizers from Eutrophicated Bodies of Water

-  Booth: High School Village, C-1
-  Village Presentation: October 26, 15:15-15:30 CEST, Plaza 3
-  Judging Session: October 27, 9:30-10:00 CEST, Room J4

Eutrophication is caused by microorganisms in water bodies thriving on excess nitrate levels. Nitrates can make their way into water bodies due to fertilizer use in agriculture or industrial activity. This creates an unpleasant smell and look and blocks sunlight from reaching marine life inside the water, killing plants and leading to the destruction of marine life. The foul smell can avert tourists, which can devastate small businesses that rely on seasonal income. This is why we are designing a filter to convert the nitrates into an indigestible form of nitrogen that can't be utilized by these microbes, stopping eutrophication. We will achieve this by expressing the gene responsible for the production of nitrate reductase in *E. coli*, and harvesting the enzymes. They will then be immobilized on a 3 layer water filter which can be installed in water drainage systems. We offer a solution to the problem of eutrophication.

<https://2022.igem.wiki/anatolia-college-hs>

AshesiGhana

Project Title: Design of a Bio-Sensor for Gold Prospecting in Mining

-  Booth: Biomanufacturing Village, B-1
-  Village Presentation: October 26, 14:00-14:15 CEST, Plaza 1
-  Judging Session: October 27, 15:00-15:30 CEST, Room J8

Underlying mineral deposits, weathered debris, pathfinding elements such as iron or arsenic can serve as geochemical signals for the detection of gold deposits. The process of gold prospecting is time-consuming, costly and environmentally destructive. For instance, in low-income countries such as Ghana, open trenches are left by disappointed small-scale miners. Our project seeks to reduce environmental degradation and time by engineering a number of *E-Coli* that separately detects the presence of Au and some selected pathfinder elements (As and Fe) that signal gold prospects in a location. These bacteria will be co-cultured to create a multifunctional biosensor. The engineered organisms are encapsulated in hydrogel spheres which will be placed in a stake which can be driven into the soil up to 1-2m in depth to assess the presence of gold deposits. UV induced promoters which control lysozymes are incorporated in the biosensor to ensure bio-safety.

<https://2022.igem.wiki/ashesighana>

ASIJ_Tokyo

Project Title: No title

 Remote Team Village

 Judging Session: October 26, 10:00-10:30 CEST, Room J1

No abstract

<https://2022.igem.wiki/asij-tokyo>

ASU

Project Title: Chlamydomon[As]

 Booth: Environment Village, I-4

 Village Presentation: October 26, 16:15-16:30 CEST, Plaza 5

 Judging Session: October 27, 16:00-16:30 CEST, Room J6

People in Arizona still struggle to access clean water due to a history of scarcity and mining contamination. 19% of the drinking wells sampled in Arizona exceed the maximum arsenic level established by the US EPA, threatening the health of those who rely on these water sources. In response, ASU iGEM created Chlamydomon[As], an engineered microalgae capable of bioremediating arsenic from contaminated water. We're enhancing an existing arsenic uptake pathway in *C.reinhardtii* by introducing arsenate reductase (ACR2p) and phytochelatin synthase (PCS) genes into the *C.reinhardtii* nucleus. ACR2p reduces incoming arsenic into arsenite, and PCS enhances the cell's ability to bind and sequester arsenite in the vacuole. Multicistronic transgene expression was achieved by developing a tricistronic vector separated by viral 2A peptides that allow independent gene expression under the control of a single promoter. Chlamydomon[As] has the potential to revolutionize bioremediation technologies to solve the issue of arsenic contamination in water.

<https://2022.igem.wiki/asu>

Athens

Project Title: PERspectives: In-vitro development of PERceptrons

-  Booth: Foundational Advance Village, A-1
-  Village Presentation: October 27, 9:15-9:30 CEST, Plaza 1
-  Judging Session: October 26, 14:00-14:30 CEST, Room J12

Inspired by computer science, our project's goal is to implement the perceptron, a computational algorithm that is the basis of Artificial Neural Networks, in a biological system. By imitating a single-layered perceptron, an input pattern is converted into an intermediate signal in a weighted manner. Then, using an activation function, it is classified to a specific class. Our system is built on a population scale to avoid the metabolic burden of a single-cell system by taking advantage of the natural ways bacteria communicate, i.e., exploiting bacterial quorum sensing signals, Acyl-Homoserine-Lactones, in E.Coli consortia. Ribosome Binding Site variants are used as plug-and-play devices to tune the weights, and a steep genetic activation function is built to engineer a living binary classifier. Along with other research, the proposed workflow aims to pave the way for taking biological information processing a step further, giving rise to the emergence of biological artificial intelligence.

<https://2022.igem.wiki/athens>

Austin_UTexas

Project Title: ARROWE: Acinetobacter baylyi Recognition and Recombination of White Nose Syndrome and eDNA

-  Remote Team Village
-  Judging Session: October 26, 17:30-18:00 CEST, Room J11

Acinetobacter baylyi ADP1 is a bacterium capable of taking up DNA directly from the environment (eDNA). Despite its natural transformation capabilities, it is not widely-used as a chassis in synthetic biology. For our project, we developed a detection system capable of recognizing any eDNA featuring ADP1 as a chassis. ARROWE specifically focuses on detecting eDNA from Pseudogymnoascus destructans, a fungus that causes White Nose Syndrome in bats. This system works via homologous recombination, which occurs when P. destructans eDNA is detected, producing a fluorescent signal and yielding resistance to azidothymidine. We also constructed and tested ADP1 strains engineered to detect the nptII and blaTEM-1 antibiotic resistance genes to demonstrate other applications of our approach and characterize parameters affecting DNA detection. We hope ARROWE will draw attention to ADP1's potential and serve as a model for future ADP1-centric projects.

<https://2022.igem.wiki/austin-utexas>

Barcelona_UB

Project Title: Vesiprod. Engineered Cell-based Designer Exosome Production

 Booth: Biomanufacturing Village, B-2

 Village Presentation: October 26, 16:00-16:15 CEST, Plaza 1

 Judging Session: October 27, 14:00-14:30 CEST, Room J9

Extracellular vesicles (EVs) are a heterogeneous group of small, lipid-based nanoparticles that play a key role as mediators of many physiological and pathophysiological processes. Unfortunately, substantial obstacles block their implementation as therapeutic agents. The ability to produce high amounts of designer EVs and a standard and specific purification methodology are still lacking. Here, we present a biological system to produce designer exosomes based on HEK293T cell line. Firstly, we have included a tag system to improve and simplify the collection and purification techniques. Furthermore, we have implemented a molecular device based on L7Ae:C/D-box interaction that permits the direct loading of shRNA-labelled molecules into exosomes inside the cell, avoiding the cumbersome process of artificial loading. Lastly, we pretend to validate our system by producing exosomes loaded with shRNA against myc to use them as an innovative therapy against Burkitt's lymphoma.

<https://2022.igem.wiki/barcelona-ub>

Beijing_United

Project Title: Modification of SbPETase in Escherichia coli and the establishment of its efficient secretion system

 Remote Team Village

 Judging Session: October 27, 10:30-11:00 CEST, Room J1

Polyethylene terephthalate (PET), one of the most widely used plastics in the world, is currently causing serious environmental pollution. In recent years, more and more researchers have focused on the enzymatic degradation of PET, which is a more environmentally friendly degradation and recycling method than the traditional chemical and physical recycling methods. In this study, the team established an efficient secretion system of PET degradation enzyme in E. coli BL21(DE3) using the signal peptide PelB and the colistin-releasing protein Kil, which not only improved the enzyme yield but also greatly simplified the purification process of PET degradation enzyme. This provided a more convenient tool for further study of the enzyme. In addition, the team rationalized the PET hydrolase SbPETase from Schlegelella brevitalea sp. nov. and used the established secretion system to rapidly screen for triple mutants with significantly increased activity.

Key Words: PET, PelB, Kil

<https://2022.igem.wiki/beijing-united>

BFSU-ICUnited

Project Title: An electrochemical enzyme biosensor for bisphenol A detection

 Remote Team Village

 Judging Session: October 27, 14:30-15:00 CEST, Room J1

Environmental pollution has always been a critical issue, our project focuses on one of the most widely used chemicals, bisphenol A. Since its advantages in industrial production, bisphenol A has been used in plenty of aspects of the industry. However, the majority of people have nearly no awareness of how BPA is harmful to our health. It is verified to be associated with a variety of diseases. Therefore, investigating a method to detect bisphenol A is crucial. Our detection method is based on displaying tyrosinase on the surface of *E. coli*, followed by adsorption onto a glassy-carbon electrode. In detail, BPA can be oxidized by tyrosinase and eventually produce an electric signal. By detecting this electric signal, the concentration of BPA can be obtained. Finally, in applications, the results show our detection method can provide a better solution for BPA detection in cost, accuracy, and simplification.

<https://2022.igem.wiki/bfsu-icunited>

BGU_Israel

Project Title: Asensa – amino acid biosensors

 Booth: Diagnostics Village, F-2

 Village Presentation: October 26, 16:30-16:45 CEST, Plaza 4

 Judging Session: October 27, 13:30-14:00 CEST, Room J11

MSUD is a rare metabolic disease caused by defects in the branched-chain α -ketoacid dehydrogenase complex, which results in elevation of the branched-chain amino acids (BCAAs) in the plasma. Current therapy for MSUD include a diet low in BCAAs and regular monitoring of BCAA blood levels. Our project is to create an electrochemical signal-based biosensor for the detection of BCAAs. To achieve this, we designed several systems. The first system uses L-amino acid oxidase fused to a high affinity peptide to gold. A byproduct of the oxidation is H_2O_2 which can be measured using a gold electrode. The second system is based on the conjugation of an amino acid to the appropriate tRNA synthetase that releases AMP. This reaction is coupled to an AMP aptamer-based sensor that releases ferrocene and can be measured by an electrode. The last system utilizes a fused tRNA synthetase to pyruvate oxidase to generate H_2O_2 as a byproduct.

<https://2022.igem.wiki/bgu-israel>

Bio-Brussels

Project Title: Biologically inspired functionalisation of endospore appendages for water softening

 Booth: Biomanufacturing Village, B-3

 Village Presentation: October 27, 17:00-17:15 CEST, Plaza 1

 Judging Session: October 26, 16:00-16:30 CEST, Room J10

In this project the Bio-Brussels team looked through many databases in order to find peptides related to biocalcification, examples were found in animals such as corals, sponges, and mollusks. 19 selected constructs were recombinantly introduced in a protein scaffold based on endospore appendages found in different *Bacillus* species. The functionalization of this scaffold caused a significant decrease in the concentration of free calcium ions, as shown by titration. This decrease could be attributed to 2 different constructs, independent of temperature and protein concentration. This, in combination with TEM images of the protein, introduces the belief that the working mechanism is nucleation based. The team additionally proved that the endospore appendages could be produced by *Lactococcus lactis* in order to increase safety in further applications.

<https://2022.igem.wiki/bio-brussels>

Bioplus-China

Project Title: Recombinant spider silk gels as bio-ink for 3D printing of artificial skin

 Remote Team Village

 Judging Session: October 26, 13:00-13:30 CEST, Room J1

Skin lesions caused by burns and trauma are very common in clinical practice. However, due to the limitations of such factors as large area of skin graft, long treatment period and high price, it is not enough to meet the needs of patients. In recent years, the development of 3D biological printing has provided a new idea for skin transplantation and brought dawn to patients with skin diseases and skin related industries. In the process of preparing biological ink for 3D printing, materials with good printing adaptability and cell compatibility is the biggest bottleneck at present. As recombinant spider silk protein has low immunogenicity, good cell compatibility and physical crosslinking ability, we set to construct a composite gel based on spider silk bio-ink, and evaluate its potential as a new biomaterials for 3D artificial skin or other scaffold printing or as new wound dressings.

<https://2022.igem.wiki/bioplus-china>

BIT

Project Title: Etiological classification system of chronic musculoskeletal pain based on miRNA biomarkers

 Remote Team Village

 Judging Session: October 26, 10:30-11:00 CEST, Room J11

Chronic musculoskeletal pain (CMP) is the most common chronic pain in clinical practice. The prevalence of CMP is increasing due to aging of the population and lifestyle changes. Low treatment and remission rate of CMP have reduced quality of life and caused a waste of medical resources. Accurate distinction between two origins of CMP, namely neuropathic and nociceptive, can help diagnosis and treatment. The expression of miRNAs is distinct in different types of CMP. Using HCR+CRISPR system and paper-based chips, we developed a programmable quantitative detection device for a variety of miRNAs. HCR is an enzyme-free isothermal nucleic acid amplification system. The downstream CRISPR/Cas12a system recognizes and cleaves the amplification products of HCR, generating fluorescence signals. Meanwhile, we designed a portable paper chip and incubator suitable for various application scenarios, and used smartphones to analyze the reaction results, and combined with the classification model, achieved pain classification and evaluation.

<https://2022.igem.wiki/bit>

BIT-China

Project Title: Oxygen Hunter

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J10

The production of chemical products by synthetic biology has become more and more advantageous than traditional chemical synthesis. Many enzymes used in biosynthesis need to be isolated from oxygen, while microbial respiration cannot produce energy without oxygen. At present, physical means are mainly used to infuse nitrogen to create a hypoxic environment, which cannot meet all application scenarios. Therefore, this year, BIT-China team was committed to creating an intracellular hypoxic environment at normal metabolic levels of microorganisms, using *Escherichia coli* to express functional elements for introducing synthesis modules to promote product efficiency. In addition, we also built an easy-to-use toolbox for BP neural network prediction to facilitate future practitioners to model.

<https://2022.igem.wiki/bit-china>

BJEA_China

Project Title: A popular deteriorated cheese —— BslA

 Remote Team Village

 Judging Session: October 26, 15:00-15:30 CEST, Room J1

Hydrophobins are small surface-active amphiphilic proteins that contain both hydrophobic and hydrophilic areas on their surface. They can self-assemble to form a stable film at the interface of both polar and non-polar solution phases. Thanks to high surface activity and amphiphilicity, Hydrophobins have broad application prospects as surfactants in interface engineering, emulsifiers in food processing, bioimmobilization agents in nanotechnology, and powerful protein purification tags in biotechnology. Our project features BslA, a bacterial-origin hydrophobin with great potential and wide application in synthetic biology. BslA is much easier to produce compared to their fungal-origin cousins, which overcomes the limitations of their industrial use. We hope to unleash the potential of BslA and solve some of the major concerns of the synbio community and humanity as a whole. To this end, Our team designed three BslA fusion proteins that target three problems: protein purification, antibiotic abuse, and plastic pollution.

<https://2022.igem.wiki/bjea-china>

BJWZ-China

Project Title: Put Ears On Yeast Make Them Hear The Voice Of The World

 Remote Team Village

 Judging Session: October 27, 9:30-10:00 CEST, Room J2

Hearing, as we know, is an animal's ability to perceive sound, It's the process of converting mechanical energy into electromagnetic signals. But the mechanism is not fully understood B JWZ-China is trying to be the first to explore a similar sensory system in microbes. We set out to exploit the 'NAN-IAV pattern' of ion channels that make up auditory mechanotransduction in *Drosophila*. In the experiment, it was introduced into *Saccharomyces cerevisiae* and the auditory module was constructed. We transformed the designed plasmid into *Escherichia coli* for amplification and culture, and then transferred into yeast for yeast transformation by plasmid extraction. Yeast DNA was extracted for PCR verification, followed by electrophoresis verification. Finally, the transformers were prepared and frozen in glycerol tubes. By studying this life phenomenon, we conducted the first round of research for the project of sensing cancer, and preliminary exploration for the subsequent research of sound transduction in microorganisms.

<https://2022.igem.wiki/bjwz-china>

BNDS_China

Project Title: LySLEUTH: A LysPBC5 based *Bacillus cereus* detection kit

 Remote Team Village

 Judging Session: October 27, 12:30-13:00 CEST, Room J1

The aim of our project is to develop a kit that can detect the presence of a common bacterial pathogen *B. cereus*, which is present in improperly stored leftover food and could cause digestive disease. Current detection methods including PCR-based tests are expensive and require specialized laboratory equipment. Here, we aim to develop an alternative detection method based on a *B. cereus*-specific endolysin (LysPBC5), ATP sensor, and the one-Hour Low-cost Multipurpose highly Efficient System (HOLMES). These two systems will be assembled by mixing purified LysPBC5 and Cas12b to form an efficient *B. cereus* test kit. To lower the cost of protein purification, we employed Pro-QC and crystal violet inducible protein expression system by reducing incomplete transcripts and the cost of inducer. Our design of the test kit could also guide the development of methods to detect other pathogens in the future.

<https://2022.igem.wiki/bnds-china>

BNSC_China

Project Title: ONCE: Advanced Synthetic Biology Platform for Industrialization

 Remote Team Village

 Judging Session: October 26, 13:30-14:00 CEST, Room J12

BNSC_China is a team composed of iGEM alumni in China. We were ONCE iGEMers, and now we are more than an iGEM team. Our goal is to bring out an iGEM project from idea to industrialization, and finally change the world. After a thorough market and industry analysis, we noticed that the tide of biomanufacturing is just forming. Traditional development of a new synthetic biology product is time-consuming. However, to fit the fast-changing need of consumers, a fast R&D pipeline is required. To address this problem, we developed a CRISPR-based genetic manipulating toolkit for a fast-growing non-model organism, *Vibrio natriegens*. With these enabling technologies, we presented our first product, (-)-alpha-bisabolol, and achieved a yield significantly higher than *E. coli*. Beside (-)-alpha-bisabolol, a further business plan for food and cosmetics products is made and is coming true. ONCE iGEMers, more than an iGEM team. Together, we believe iGEMers ARE changing the world.

<https://2022.igem.wiki/bnsc-china>

BNU-China

Project Title: Cannabis 'Vaccine'

 Remote Team Village

 Judging Session: October 27, 12:30-13:00 CEST, Room J6

In 2020, the United nations officially recognized the medical use of cannabis. However, the booming usage of cannabis led by legalization has created an extraordinary high risk of drug leakage. And the main psychoactive compound found in the cannabis plant is Δ^9 -tetrahydrocannabinol, THC for short. Our project is aimed at preventing cannabis addiction by colonizing intestinal flora to degrade THC and is expected to be used by narcotics agent, people reluctant to consume cannabis, medical user and so on. Therefore, we engineered the E.coli Nissle1917 to secrete our enzymes which can transfer THC into cannabinoid glucuronic acid, and reporter protein only when it senses THC in the intestinal tract. Overall, we sincerely wish to provide a secure system for future cannabis exploration.

<https://2022.igem.wiki/bnu-china>

BNUZH-China

Project Title: BCAID - An in-vivo Biodegradable Skin Regeneration Scaffold System Based On Bacterial Cellulose

 Remote Team Village

 Judging Session: October 27, 13:30-14:00 CEST, Room J9

Skin tissue defects caused by various wound factors are very common clinically. Relying on the epithelium and basal tissue of their own wound margins, severe wounds and chronic wounds such as extensive burns and venous ulcers are difficult to heal. Tissue engineering scaffolds have great advantages in repairing skin wounds. The excellent properties of bacterial cellulose (BC) make it to be qualified as a high-quality tissue engineering scaffold. However, cellulose is non-degradable in vivo, which is a knotty problem that restricts its application at present. BCAID provides a solution in synthetic biology for the real application of BC tissue engineering scaffolds in human body, which is of great significance for repairing skin tissue wounds. BCAID is divided into basic BC production module, healing promoting module, blue-light activated BC degradation module and red-light activated engineered fibroblast(BJ) suicide module. The four modules constitute the whole BCAID with complete functions and excellent characteristics.

<https://2022.igem.wiki/bnuzh-china>

BOKU-Vienna

Project Title: Pichitecture: Creating an environmentally friendly building material with the help of synthetic biology.

-  Booth: Climate Crisis Village, G-1
-  Village Presentation: October 26, 9:30-9:45 CEST, Plaza 4
-  Judging Session: October 27, 10:30-11:00 CEST, Room J14

According to the 2019 IEA Global Status Report, the production of building materials causes 11% of global CO₂ emissions. Using synthetic biology to create alternative building materials may be the solution. Our goal is the creation of an alternative brick material with help of two microorganisms. The cyanobacterium *Synechocystis* PCC 6803 has the ability to take CO₂ from the air, converting it to CaCO₃. Meanwhile the yeast, *Komagataella Phaffii* (a.k.a. *Pichia Pastoris*), expresses polymers such as gelatin, spider silk and PHB. These polymers cross-link with the carbonate, giving our bricks structure. The brick also includes considerations of a circular economy, as our material includes sand, lignin, and construction waste to explore their effect on the material. We created our plasmids via Golden Gate Assembly, focusing on expression cassettes in both yeast and cyanobacteria. In silico and in stakeholder meetings, we consider up-scaling approaches for future implementation.

<https://2022.igem.wiki/boku-vienna>

Bonn-Rheinbach

Project Title: Cyan Energy: Biofuel from Cyanobacteria

-  Booth: Climate Crisis Village, G-2
-  Village Presentation: October 26, 9:45-10:00 CEST, Plaza 4
-  Judging Session: October 27, 9:30-10:00 CEST, Room J14

Cyanobacteria has the capability to produce hydrocarbons such as alkane, which could be utilized in jet fuel. One existing problem is that long chain alkanes tend to precipitate due to hydrophobic interactions. A possible solution to this is HEFA-SPK (Hydroprocessed Esters and Fatty Acids-Synthetic Paraffin Kerosene), a commonly used drop in. The HEFA-SPK pathway requires free fatty acids to be converted into alkane and eventually branched alkanes through hydrotreatment. By this hydrotreatment, alkane isoforms with more branches would be generated reducing the hydrophobic interactions. The enzymes aldehyde deformylating oxygenase (ADO) and acyl-ACP reductase (AAR) in cyanobacteria have been confirmed to be responsible for catalyzing the production of hydrocarbon. In order to optimize the expression of the two enzymes, expressions of other less important enzymes are inhibited, while overexpressing the forementioned two enzymes with the help of plasmid transformation. This could bypass the first step of HEFA pathway, thereby optimizing production.

<https://2022.igem.wiki/bonn-rheinbach>

BostonU_HW

Project Title: The AM1: A novel, modular hardware system utilizing microfluidic device integration for automated toxin detection

 Booth: Environment Village, I-5

 Village Presentation: October 26, 16:30-16:45 CEST, Plaza 5

 Judging Session: October 27, 15:00-15:30 CEST, Room J7

The AM1 is a novel, modular piece of hardware technology with integrated electronic and microfluidic components. It will allow users to fully customize an aquatic environment of their choice via a user-friendly touch screen interface. The device combines a liquid input with any user-provided biosensor to create nano-sized reaction droplets in a microfluidic chip that outputs live data reflecting levels of toxicity. With the automated AM1 system, the process of toxin detection within liquid inputs has increased flexibility in testing options, lowered costs, and additional customizability, all in a portable, easy to use system. This device has the potential to change current industry standard water treatment and testing processes, and create new approaches for biosensor production, through the automated customization of aquatic environments.

<https://2022.igem.wiki/bostonu-hw>

BS_United_China

Project Title: S. aureus Bacterial Inhibition with TurboID

 Remote Team Village

 Judging Session: October 27, 15:30-16:00 CEST, Room J1

Staphylococcus aureus (S. aureus) threatens the food safety especially for home storage. The enterotoxins can be generated by S. aureus quorum sensing (QS) system related to several genes named accessory gene regulator (Agr). Only AgrC and AgrB encode channel proteins which can react with autoinducing peptide (AIP). To block the QS channels, we utilized protein proximity labeling technology by fusing TurboID with N-AgrD and AIP. The fused proteins will bring TurboID to the quorum sensing channels AGRC and AGRB which will further be blocked by protein biotinylation on multiple lysine residues. The automatic biotinylation happens when the engineered Escherichia coli itself can produce more biotin through its own metabolic pathways. We therefore increased the expression of dethiobiotin synthetase and biotin synthase and, at the same time, knock-out of biotin consumption gene named bifunctional ligase/repressor BirA by CRISPR-Cas9. Thus, purified TurboID-AIP can be used for protecting food and our health.

<https://2022.igem.wiki/bs-united-china>

BUCT

Project Title: ACE.hair: 2-phenylethyl Alcohol, Caffeine and E. coli used to create healthy hair-growth environment

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J6

The scalp microenvironment suffers from a variety of irritations, for which hair loss become a common and distressing symptom. Most functional hair products don't stay on the scalp for more than 30 seconds. We might as well call them cleansing products. In addition, a growing number of people believe that scalp health is closely related to hair growth. Our new idea is to use probiotics to achieve continuous scalp care. E. coli Nissle 1917, engineered by BUCT, consumes aliphatic acids or fatty acids which are one of the main causes of microbial growth and low hair density; to improve scalp microenvironment. Not only can E. coli stay on the scalp well, but probiotics which synthesize hair growth factors can also promote hair growth. Perfume molecule 2-phenylethyl alcohol is also produced to improve the smell of sebaceous glands and make hair full of fragrance.

<https://2022.igem.wiki/buct>

BUCT-China

Project Title: Cultured Meat

 Remote Team Village

 Judging Session: October 26, 10:00-10:30 CEST, Room J13

Based on the environmental pollution of traditional animal husbandry, over-exploitation, and excessive transmission of viruses in the process of unregulated breeding leads to avian influenza and such public health events. Our project intends to research cultured meat, to provide a new technology for the development of food safety, food hygiene, and standardized food production. Therefore, our design includes producing scaffold materials and cultivating muscle cells. Firstly, to reduce the influence of metabolic disturbance, E.coli with the autonomous dynamic regulation function was constructed to produce PHFA and provide raw materials for the scaffold system. Besides, to meet up with the challenge of the high-cost 3D-print scaffold can't be industrialized, the method of cell culture by microspheres is proposed, which greatly promotes the process of industrial large-scale production. As a result, our project will improve the human nutritional diet, reduces global carbon emissions, and also be a firm source of intergalactic colonialization.

<https://2022.igem.wiki/buct-china>

Bulgaria

Project Title: CADABRA - Cleaning Agent Development for Antibiotic Resistance Annihilation

 Booth: Environment Village, I-6

 Village Presentation: October 27, 16:15-16:30 CEST, Plaza 5

 Judging Session: October 26, 13:00-13:30 CEST, Room J8

Latest research shows increased levels of 14 commonly used antibiotics in rivers across 72 countries on six continents. This finding is supported by reports from Patancheru (India) that indicate levels of the antibiotic ciprofloxacin a million times higher than usually found in treated urban sewage. In Europe, sediments from the Sava river reveal antibiotic levels 1,000 times higher than normally expected. The first step of our project is to potentially find an enzyme that degrades multiple kinds of antibiotics found in water sources. To do this we talked with field professionals as well as did our own research, in order to find applicable antibiotics which could become water pollutants, leading to high levels of antibiotic resistance. After selecting the best enzymes for our purpose, our second step will be expressing them in laboratory *Escherichia coli* cells, in order to modify them via directed evolution for optimal activity in wastewater environments.

<https://2022.igem.wiki/bulgaria>

CAFA_China

Project Title: A kill switch for synthetic life

 Remote Team Village

 Judging Session: October 26, 13:30-14:00 CEST, Room J14

A 'kill switch' is defined as an artificial system that causes cell death under certain conditions. In other IGEN team projects, the kill switch is often used to ensure the biosafety of the project. Our team designed a series of cell death programs, programmed control of life and presented a series of 'engineered bacterial death simulators' in the form of installation art, in which bacteria will perform their life performance.

<https://2022.igem.wiki/cafa-china>

Calgary

Project Title: Cellucoat: Keeping foods fresh from the field to your fridge.



Booth: Food & Nutrition Village, E-2



Village Presentation: October 26, 13:00-13:15 CEST, Plaza 3



Judging Session: October 27, 16:30-17:00 CEST, Room J13

Globally, about half of all food produced is not eaten. In Canada, this comes to 50 billion dollars worth of food being wasted. Of all food products, fruits and vegetables have the highest wastage rates, making up 45% of total waste. To tackle this, Cellucoat designed a preservative bacterial cellulose (BC) packaging which can extend the shelf life of fruit and replace current plastic packaging. Our BC is functionalized with antimicrobial properties through recombinant expression of a food safe and antimicrobial peptide called nisin. Since Canada is banning the use of single-use plastics, we are expressing recombinant polyhydroxybutyrate (PHB), a bioplastic, to strengthen our packaging. For cost-effective production and homogeneous distribution of antimicrobial and strengthening properties, our BC packaging is developed through a coculture between *Escherichia coli* and *Komagataeibacter xylinus*. Cellucoat aims to deliver a sustainable antimicrobial packaging to help prolong the shelf life of produce.

<https://2022.igem.wiki/calgary>

Cambridge

Project Title: AdaptR: A biological integral feedback controller to enable consistent protein production



Booth: Foundational Advance Village, A-2



Village Presentation: October 26, 10:45-11:00 CEST, Plaza 1



Judging Session: October 27, 15:00-15:30 CEST, Room J11

Variability in biology is a significant challenge when designing systems reliant on consistent protein expression levels. It presents a particular problem in fields such as metabolic engineering, where fluxes through pathways must be tightly controlled; or microbial drug delivery, where consistent levels of drug release would be required. To counter this inherent variability, we are using control theory to create a set of standardised integral controllers, tailored for different protein expression levels, to reduce steady state error. Using a combinatorial approach, we are designing, testing and modelling a variety of circuits, to build a user-friendly robust adaptation platform. Our system will allow simple one step cloning of the gene of interest into the circuit, and choice of circuit with a desired output level and feedback properties. This allows for wide application, as any protein of interest can be easily inserted into the circuit and held at a reference production level.

<https://2022.igem.wiki/cambridge>

Canton_HS

Project Title: Autism Detector

 Remote Team Village

 Judging Session: October 27, 14:00-14:30 CEST, Room J3

Autism is a developmental disorder with increasing incidence. Studies have found that the levels of tryptophan, Glutamate, and copper in autism patients are significantly increased. Our research uses biosensors to detect the levels of these substances in the blood for early screening of autism. We constructed an engineered strain of recombinant plasmid pTrc99K-trp to detect tryptophan, and constructed a CopA plasmid containing a specific promoter for detecting copper ions; and by constructing a SLC7A5 gene plasmid, we increased the level of Shanks3 to achieve the effect of treating autism. Key Words: Autism, tryptophan, Glutamate, copper, SLC7A5

<https://2022.igem.wiki/canton-hs>

CAU_China

Project Title: COM ON!: Protect stone relics by calcium oxalate monohydrate film

 Remote Team Village

 Judging Session: October 26, 16:30-17:00 CEST, Room J10

Cultural relics are the heritage of human civilization. Open-air stone cultural relics, exposed outdoors for a long time, are susceptible to weathering damage. Nevertheless, parts of Lingyin Temple, a temple built from stone more than 1,000 years ago, are still intact due to the presence of natural calcium oxalate protective film. Inspired by this instance, CAU_China plan to use Bacteria-Induced Mineral Precipitation (BIMP) to replicate this protective film, by engineering *Pseudomonas fluorescens* to make it produce oxalic acid and consequently form a dense calcium oxalate monohydrate (COM) protective film with the assistance of EPS. The realization of this technique will be a historical advance in the protection of stone relics, and will be the well-being of all cultural heritage stakeholders, present and future.

<https://2022.igem.wiki/cau-china>

CCA_San_Diego

Project Title: SchistoGONE: Novel Prevention of Parasitic Diseases

-  Booth: High School Village, C-2
-  Village Presentation: October 27, 16:45-17:00 CEST, Plaza 3
-  Judging Session: October 26, 17:30-18:00 CEST, Room J1

Schistosomiasis cases number over 200 million annually, with another 700 million living in endemic areas. The disease persists despite 40 years of available treatments because current methods are reactionary, inaccessible to affected communities, and slowly becoming ineffective. SchistoGONE introduces a novel, environmental approach to permanently ending schistosomiasis by exploiting the sporocyst stage of schistosoma residing in biomphalaria glabrata. SchistoGONE starts with the biosynthesis of plant-based, anti-schistosomal compound sanguinarine using a 7 plasmid e.coli and W303 s.cerevisiae combination—an optimized biosynthesis pathway and insurance that environmental containment breach releases only benign substrates. Modified microorganisms are contained in specially designed plates situated by bodies of water that allow easy access for biomphalaria glabrata snails, naturally attracted to yeast. The resultant consumption of sanguinarine by the sole intermediary host of schistosoma eradicates residing sporocysts. SchistoGONE can save the lives of nearly a billion and improve countless more by eradicating schistosomiasis at its source.

<https://2022.igem.wiki/cca-san-diego>

CCU_Taiwan

Project Title: Guardian of cardiac health — PACOMega

-  Booth: Food & Nutrition Village, E-3
-  Village Presentation: October 26, 14:00-14:15 CEST, Plaza 3
-  Judging Session: October 27, 9:30-10:00 CEST, Room J13

Cardiovascular disease (CVD) is the leading cause of death both globally and locally. To tackle CVDs, CCU_Taiwan proposes a PACOMega project combining strategies from two aspects. In the aspect of healthy life, we encouraged people to exercise by holding campus walking and pop-up activities. In the aspect of healthy eat, we collaborated with other iGEM teams to establish the cookbook to decrease the intake of bad oil. To increase the intake of good oil, we generated a new source of Eicosapentaenoic acid (EPA) supplement by synthetic biology. The EPA production was mediated by pfa genes from Moritella marina and Shewanella pneumatophori. We further applied Acc genes to increase the raw materials of EPA, and chemical cerulenin to inhibit the lipid products competing with EPA. Together, we believed that PACOMega project not only passively protect people from CVDs, but also actively help people to gain a healthy life.

<https://2022.igem.wiki/ccu-taiwan>

Chalmers-Gothenburg

Project Title: MOD³ - Modular DNA Detection Device

 Booth: Diagnostics Village, F-3

 Village Presentation: October 27, 16:15-16:30 CEST, Plaza 4

 Judging Session: October 26, 12:30-13:00 CEST, Room J10

The parasitic worm disease Schistosomiasis currently affects 240 million people worldwide and causes tens of thousands deaths every year. The current methods of treatment and diagnostics are insufficient. Therefore we wanted to develop a point of care test for DNA detection, enabling fast diagnosis and more accurate treatment of infected individuals. We have designed two separate systems. The first one is a cell free system that uses a fusion of dCas9 and split TEV protease. When bound to the target sequence it activates and induces alpha-complementation that forms the tetramer beta-galactosidase, which produces a blue pigment for a visual readout. The second method uses DNA-binding zinc fingers bound to the membrane of a yeast cell. Upon binding to the target sequence, production of the purple pigment violacein is induced as well as production of mating factor alpha. This induces the same genes in nearby cells, thereby amplifying the visible readout.

<https://2022.igem.wiki/chalmers-gothenburg>

CHINA-FAFU

Project Title: Microalgae Growing,Water Clearing

 Remote Team Village

 Judging Session: October 26, 13:30-14:00 CEST, Room J8

Taking the climate and water ecology environment into consideration, our project chooses *Phaeodactylum tricornutum* as the research subject. By constructing engineered algae strains through synthetic biology methods, we improve its carbon sequestration capacity as well as nitrogen and phosphorus absorption capacity to alleviate the current environmental problems. Meanwhile, increase the content of high economic value components, such as oil and fucoxanthin. Our team always adhere to the concept of sustainable development. While working on water ecology restoration and climate improvement, we also try to popularize environmental protection knowledge and concepts to the public in multiple ways. And expect more people to participate in environmental protection and environmental restoration.

<https://2022.igem.wiki/china-fafu>

CityU_HongKong

Project Title: Development of novel anticancer drug candidates: applying synthetic biology in improved fungal natural product biosynthesis

 Booth: Therapeutics Village, D-2

 Village Presentation: October 27, 14:30-14:45 CEST, Plaza 2

 Judging Session: October 26, 9:30-10:00 CEST, Room J6

Natural products (NPs) have always been a vital source of anticancer medicines. However, NPs exist in complex mixtures, and their modification is typically hindered by complicated chemical structures. The team “SeCure” aims to apply synthetic biology to the fungal biosynthesis of secalonic acids (SADs), leading to the controllable production of novel bioactive substances. We constructed an artificial biosynthetic pathway by modifying the natural biosynthesis of SAD via the replacement of a short-chain dehydrogenase gene with the gene from the biosynthetic pathway of neosartorin. The engineered pathway was expressed in the fungus *Aspergillus oryzae*. The isolated metabolites revealed high efficacy against colon cancer in vitro and in vivo. In silico modelling showed that their anticancer potency was linked to their ability to bind human topoisomerase I. As a result of this iGEM project, several team members received an entrepreneurial grant of HK\$100,000 to develop this idea into a startup.

<https://2022.igem.wiki/cityu-hongkong>

City_of_London_UK

Project Title: aLFA REMASK

 Booth: High School Village, C-3

 Village Presentation: October 26, 16:45-17:00 CEST, Plaza 3

 Judging Session: October 27, 14:00-14:30 CEST, Room J1

Project aLFA REMASK combines established processes of RPA and Sherlock CAS 12A, alongside novel thermal lysis, to create an in-situ diagnostic mask for Tuberculosis that is entirely uncompromising. By utilising a miniaturised heat chamber that lyses exhaled breath samples, the mask collects, amplifies, and detects the presence of DNA sequences specific to Tuberculosis through a lateral flow architecture. In this, specific heat shock protein coding sequences can be qualitatively displayed on a ‘test line’, visible to only the wearer, allowing patients to get rapid, cheap, and reliable triaging for Tuberculosis.

<https://2022.igem.wiki/city-of-london-uk>

Concordia-Montreal

Project Title: The genetic engineering of cyanobacteria for the degradation of organophosphate pesticides in wastewater

 Booth: Environment Village, I-7

 Village Presentation: October 27, 16:30-16:45 CEST, Plaza 5

 Judging Session: October 26, 15:00-15:30 CEST, Room J8

With uses ranging from agricultural to industrial, organophosphates are some of the most commonly-used pesticides in the world. However, when these pesticides are improperly managed, they accumulate in wastewater, which may cause harm to human health, wildlife, and the surrounding environment. Moreover, current pesticide degradation methods—Fenton and Photo-Fenton treatments—are costly and unsustainable. Our bioremediation project seeks to use biological processes as an efficient and economic solution for the degradation of organophosphates. Using organophosphate hydrolases (opH and opdB), we aim to genetically engineer two strains of cyanobacteria (PCC 6803 and PCC 7942) to degrade Fenitrothion and Malathion. In order to prevent biocontainment breaches, a controlled cell death system was incorporated into our project. The kill switch is activated in the presence of residual pesticides and their by-products, ensuring that the GMO remains confined to a controlled environment.

<https://2022.igem.wiki/concordia-montreal>

Cornell

Project Title: MicroMurals: Developing an educational tool that intersects synthetic biology and art

 Booth: Biomanufacturing Village, B-4

 Village Presentation: October 26, 17:15-17:30 CEST, Plaza 1

 Judging Session: October 27, 15:30-16:00 CEST, Room J8

MicroMurals utilizes synthetic biology to create BioArt, both as an educational and environmental tool. This was inspired by the need for synthetic biology to reach the public in an accessible and aesthetic way. MicroMurals provides an avenue to initiate discussions about synthetic biology with those at all levels of expertise, interest, and familiarity. Our team implemented an inducible hydrogel bio-ink system with biofilm-forming curli fibers fused to the chromoproteins aeBlue, asPink, and amajLime to create “microbial paints.” Hydrogels were harvested from *E. coli* and can be functionalized using VOC-uptaking cyclodextrin nanofibers or carbon-fixing microbes. We built a 3D bioprinter to print these hydrogels, as well as a handheld bioprinter for greater accessibility. Computer modeling was conducted for protein expression, protein folding, bioprinter extrusion, and bioreactor cell growth. Educational outreach events were held for multiple age groups, and BioArt exhibits were hosted on our campus to engage undergraduate students.

<https://2022.igem.wiki/cornell>

Costa_Rica

Project Title: Chassei: a toolbox for bioengineering *Lactobacillus casei*

-  Booth: Foundational Advance Village, A-3
-  Village Presentation: October 27, 12:45-13:00 CEST, Plaza 1
-  Judging Session: October 26, 17:30-18:00 CEST, Room J12

A previous Costa Rican iGEM team from 2019 proposed the use of *Lactobacillus casei* as a chassis for the delivery of their treatment; however, they faced a lot of difficulties during their journey because genetic parts, plasmids, and protocols used in *L. casei* were not previously characterized. Following this, we looked at the iGEM parts repository, and realized that over 130 iGEM teams have proposed probiotics as a chassis, but many teams came across problems when executing their assays with this probiotic. Given the lack of parts, plasmids and protocols, and the potential of this GRAS microorganism to be engineered and applied in many different industries, we decided to take a step back, and develop a toolbox for *L. casei*, composed of different genetic parts including inducible and constitutive promoters, RBS's, terminators, reporter proteins, a shuttle vector designed de novo and a killswitch system for biosafety.

<https://2022.igem.wiki/costa-rica>

CPU_CHINA

Project Title: Convenient and readable platform for cancer screening

-  Remote Team Village
-  Judging Session: October 27, 15:00-15:30 CEST, Room J10

2022 CPU_-CHINA team focuses on screening and early detection of cancers, and preliminary detection of various cancers, aiming to provide more health security to people in underdeveloped areas. We used bioinformatics to screen out a lncRNA molecule that is highly correlated with the occurrence and development of more than 20 kinds of cancers and then designed a point-of-care matching detection platform system for it. The platform system is easy to operate and does not require expensive instruments to quantitatively detect the expression of lncRNA in human blood. It provides a very meaningful indicator for predicting the risk of cancer.

<https://2022.igem.wiki/cpu-china>

CPU_Nanjing

Project Title: Accelerating the Evolution of Phosphorus on Terrestrial Planets by Coupling Phosphite Oxidation and Polyphosphate Synthesis.

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J9

Low oxidation state phosphite, the dominant form of phosphorus on terrestrial planets, posed a formidable challenge on future interstellar migration. Involved in every aspect of life, phosphate rather phosphite is indispensable in the progress of human civilization. Thus, manufacture phosphate from phosphite is key to future success. Herein, by coupling phosphite dehydrogenase (PD) and polyphosphate kinase (PPK), we proposed a strategy that can spur *E. coli* to continuously produce phosphate from phosphite. In our engineered metabolic pathway, polyphosphate that derived from intracellular ATP is the crucial intermediate. Given that one phosphoric acid radical of ATP is deprived by PPK for polyphosphate synthesis, regeneration of ATP necessitated the oxidation of more phosphite by PD, thus achieving a high phosphate yield. In addition, to achieve the production trial in the context of terrestrial planets, we developed solar-energy driven algae processing hardware aiming at providing oxygen and nutrients for the engineered chassis.

<https://2022.igem.wiki/cpu-nanjing>

Crete

Project Title: A.T.R.O.P.A. - Agricultural Techniques and Research On Preventive Agrodiagnostics

 Booth: Conservation Village, H-1

 Village Presentation: October 26, 17:15-17:30 CEST, Plaza 5

 Judging Session: October 27, 14:00-14:30 CEST, Room J14

As the scourge of the global food crisis intensifies, an increasing number of countries of the European Union have edible crops infected by highly contagious pathogens such as tospoviruses. Tomato Spotted Wilt Virus (TSWV) belongs in the family of Tospoviridae and is one of the most economically important plant pathogens. Our project concerns the utilization of Leukine Rich Repeat (LRR) domain containing proteins for plant pathogen diagnosis and specifically tospoviruses. We will acquire the LRR domain of Sw-5b resistance gene of *Solanum Peruvianum* and surface display it on *e. coli* (DH10b) cells. The ability of these LRRs to recognize a specific epitope will be tested by using as a bait the movement protein of TSWV fused with YFP (Nsm:YFP).

<https://2022.igem.wiki/crete>

CSMU_Taiwan

Project Title: AID can aid

 Booth: Biomanufacturing Village, B-5

 Village Presentation: October 27, 17:15-17:30 CEST, Plaza 1

 Judging Session: October 26, 15:30-16:00 CEST, Room J9

With higher awareness of animal rights, more and more people in recent years are advocating for animal welfare, such as gradually eliminating experimental animals. For example, non-animal-derived antibodies have thus been developed to replace animal-derived antibodies. However, this replacement may lead to the enormous waste of hybridomas, the main manufacturers of animal-derived antibodies. Besides, there are still many problems relating to non-animal-derived antibodies. Therefore, CSMU_Taiwan devise a win-win solution based on optimizing the hybridoma technology. We hope to reduce animal use while simultaneously retaining the advantages of animal-derived antibodies.

<https://2022.igem.wiki/csmu-taiwan>

CSU_CHINA

Project Title: Diagnosing Circulating Cell-free DNA of echinococcosis through multi-sgRNA bulletin using CRISPR-Cas12a

 Remote Team Village

 Judging Session: October 26, 14:00-14:30 CEST, Room J11

Our diagnostic system for parasitic diseases will test a person's Circulating cell-free DNA (cfDNA) in their blood to see if they are infected with the parasite. We used the multi-primers Recombinase Polymerase Amplification (RPA) to amplify cfDNA. Then the amplification product and multi-sgRNA were used to activate the trans-cleavage activities of CRISPR-Cas12a system, cut the nucleic acid probe we designed and synthesized. Finally, the colloidal gold test strips were used to detect the cut product.

<https://2022.igem.wiki/csu-china>

CU-Boulder

Project Title: Magic Beans: Finding Environmental Solutions for Chemotherapeutic Cultivation in Soybeans

 Booth: Biomanufacturing Village, B-6

 Village Presentation: October 26, 17:30-17:45 CEST, Plaza 1

 Judging Session: October 27, 16:30-17:00 CEST, Room J8

The chemotherapeutic Paclitaxel is listed as an essential medicine by the World Health Organization and is one of the most intensively used anti-tumor drugs. Unfortunately, Paclitaxel is difficult to obtain and produce, with one dose requiring the harvest of six old-growth Pacific Yew trees. The development of complete and semi-complete chemical syntheses have improved extraction efforts, but production is still inefficient and expensive. The CU-Boulder iGEM Team is engineering a system in soybeans to produce Paclitaxel to increase the accessibility of this essential chemotherapeutic while decreasing the environmental impact of producing Paclitaxel. The paclitaxel precursor taxadiene can be synthesized in soybeans by genetically integrating enzymes that are naturally found in the Yew Tree. Soybeans can be easily farmed and are the most common genetically modified crop in the world.

<https://2022.igem.wiki/cu-boulder>

CUG-China

Project Title: A Broadly Applicable Transcription-Based C-di-GMP Biosensor

 Remote Team Village

 Judging Session: October 27, 13:30-14:00 CEST, Room J4

In nature, microbes can exist as either planktonic or biofilm. Once pathogens biofilm is formed in human body, it will be rather hard to eradicate. The second messenger c-di-GMP is a positive regulator of biofilm formation, and c-di-GMP signaling is regarded as a potential target for the development of antipathogenic compounds. However, it has not been possible to monitor c-di-GMP levels in real time in many bacteria, which limits to effectively screen c-di-GMP-targeted antipathogenic compounds. To overcome this limitation, we will construct a c-di-GMP biosensor that is readily adaptable for gauging c-di-GMP levels in different bacteria. To demonstrate the application of the c-di-GMP biosensor, we will use it as a tool to screen agents that can induce *Escherichia coli* and *Shewanella oneidensis* biofilm dispersal by decreasing its c-di-GMP levels.

<https://2022.igem.wiki/cug-china>

CUHK-HongKong-SBS

Project Title: Antigen-based Tumour REcognising Universal System (ATREUS)

 Remote Team Village

 Judging Session: October 27, 9:30-10:00 CEST, Room J5

Antigen-based Tumor REcognizing Universal System (ATREUS) is a combination of chimeric antigen receptor T cell (CAR T) therapy and gene therapy, with to vision to overcome the existing limitations of CAR T therapy in solid tumors, whilst enhancing the safety and efficiency of cancer therapies. It utilizes recombinant AAV vector to deliver a novel antigen to tumor cells as a tag, then CAR-T cells targeting the novel antigen would be engineered, which enhances the specificity of CAR target to solid tumour cells. The expression of transgene is expected to be confined to tumor cells by incorporation of tumor-specific promoters, while the addition of two miRNAs would improve CAR-T infiltration and antigen expression. It is hoped that the system would develop into a precision medicine for patients of different tumor types, as the components of the system are customizable depending on the tumour microenvironment of every patient.

<https://2022.igem.wiki/cuhk-hongkong-sbs>

CUHKSZ

Project Title: Point-of-Care detection of Nitrite based on nrfA triggered by NarP-dependent regulation in Escherichia coli

 Remote Team Village

 Judging Session: October 26, 12:30-13:00 CEST, Room J13

Recently, intensive use of nitrite is adversely affecting the environment and human health. However, current detection methods require sophisticated pre-treatment and instrumentation, significantly limiting usage scenarios and increasing detection costs. Our team is therefore motivated to develop a fast, easy-operative solution for portable nitrite determination. Discovering the dissimilatory nitrite reduction pathway within E.coli, we genetically engineered BL21 to overexpress nitrite reductase NrfA to detect nitrite concentration more efficiently in the water, food, and plasma samples. With the E. coli being coated on a paper-based biosensor, electrons produced from nitrite reduction are transferred into an electrical signal and transformed to nitrite concentration after data preprocessing. The result will be shown to every customer, accompanying an evaluation of the sample's safety. Harnessing the power of nature, we lead a step toward a more intelligent, proactive, and environmentally friendly lifestyle.

<https://2022.igem.wiki/cuhksz>

CU_Egypt

Project Title: Novel synthetic switchable systems targeting degradation of protein aggregations to treat Alzheimer's

 Booth: Therapeutics Village, D-3

 Village Presentation: This team has switched to remote attendance

 Judging Session: October 27, 14:00-14:30 CEST, Room J5

The number of people suffering from memory loss has been increasing drastically. Alzheimer's Disease (AD) brings about 65% of the dementia cases, it is predicted by DW to be a main cause of death by 2050, especially in the Middle East. Whereas the latter is expected to witness a dementia pandemic during the next decades. Unfortunately, most of the current medications only hinder the progression of the disease. In our project Zekra, we focus on eliminating the causes of the disease by degrading the silent-killer aggregations of tau and amyloid beta (A β) proteins, these aggregates block the neurons communication and trigger neuroinflammation eventually leading to cell apoptosis. We decided to target both tau and amyloid plaques degradation with the help of two systems: one activates the proteasomal degradation cascade intracellularly while the other is a switchable protease system that degrades tau and A β ; on site, extracellularly.

<https://2022.igem.wiki/cu-egypt>

DeNovoCastrians

Project Title: Investigating Microbial BTEX Degradation

 Remote Team Village

 Judging Session: October 26, 10:00-10:30 CEST, Room J7

Environmental contamination from aromatic hydrocarbons such as Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) is of particular concern in the Newcastle region. Our team aims to investigate microbial BTEX degradation pathways to work towards bioremediation of BTEX contamination. We will do this by cloning characterised gene clusters from environmental isolates of Rhodococcus and Acinetobacter baylii into Escherichia coli and exploring new combinations of the genes in these clusters to better understand them and the function of their enzymes. Work will be undertaken to characterise a transporter often found with these BTEX degradation clusters. From this we aim to create a synthetic optimised BTEX degradation cluster. Additionally, novel and characterised BTEX degradation pathways in Rhodococcus will be studied alongside broad cellular responses to the presence of monoaromatic hydrocarbons. Lastly, we will design and test a fluorescent biosensor that can confirm the presence of BTEX or their metabolite, catechol, in real time.

<https://2022.igem.wiki/denovocastrians>

DKU

Project Title: GutGuard - Shigella eradication with cell surface displayed nanobodies

 Remote Team Village

 Judging Session: October 27, 10:00-10:30 CEST, Room J5

Shigella, named as one of the most antibiotic-resistant, problematic pathogens by the CDC in 2019, has mostly been treated with antibiotics to this day. Antibiotics impose strong selective pressure on the bacteria and degrade host gut microbiome diversity upon treatment. Nanobody displayed on cell surfaces can inhibit the type III secretion system on shigella, thus inhibiting bacterial invasion without imposing strong selective pressure on the bacteria. Probiotics are chosen as hosts for the surface display because of their potential inhibition effects on the pathogenic bacteria and host-friendly characteristics.

<https://2022.igem.wiki/dku>

DKU_China

Project Title: Synthetic Biological Whole-Cell Biosensors: A Rising New Method for Pollution Detection

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J8

Heavy metal pollution poses a major threat to human health nowadays. Their wide distribution and high concentrations in the environment amount to a “time bomb” for public health. However, conventional heavy metal testing methods have their current problems such as low cost-efficacy, low efficiency, non-environmental-friendliness, etc. We, Team DKU_China, aim to tackle this challenge by propelling the development of a rising new method for pollution detection: synthetic biological whole-cell biosensors. Our project is focused on the detection of copper in water to set an example and facilitate future research on the detection of other heavy metals. To achieve our goal, we created a biosensor with improved accuracy and sensitivity using high-throughput technologies, compared to traditional methods. We hope our efforts can help whole-cell biosensors become more widely accepted and applied in heavy metal detection. We envision a future with a world cleaner and greener than ever...

<https://2022.igem.wiki/dku-china>

DNHS_SanDiego_CA

Project Title: OxyBANzone

-  Booth: High School Village, C-4
-  Village Presentation: October 27, 17:00-17:15 CEST, Plaza 3
-  Judging Session: October 26, 17:00-17:30 CEST, Room J1

Oxybenzone is a naturally-occurring organic compound and a component of many sunscreens providing broad spectrum ultraviolet light absorption. However, recent research has linked oxybenzone to coral bleaching, a growing problem in marine ecosystems, as well as DNA damage in corals and endocrine disruption in humans. Additionally, current research has focused mostly on the adverse effects of oxybenzone and not detection, which is important for future research to fully assess its impact. The goal of our project is to design a microbial in situ oxybenzone sensor that can rapidly indicate levels of oxybenzone. As oxybenzone is a xenoestrogen, our project uses an intracellular estrogen receptor, which binds to oxybenzone and uses it as a transcription factor to express GFP. The end product is a portable and efficient oxybenzone sensor that will play a vital role in future of oxybenzone research and protection of the ocean environment.

<https://2022.igem.wiki/dnhs-sandiego-ca>

DTU-Denmark

Project Title: Engineering *Aspergillus niger* to detect and convert furfural from lignocellulosic waste

-  Booth: Biomanufacturing Village, B-7
-  Village Presentation: October 27, 17:30-17:45 CEST, Plaza 1
-  Judging Session: October 26, 13:30-14:00 CEST, Room J9

Large amounts of lignocellulosic wastes are generated from forestry and agriculture with substantial proportions being burned or dumped instead of being recycled. Nonetheless, lignocellulosic wastes have the potential to be used as a microbial carbon source in biorefineries of various chemicals, where especially the fungus *Aspergillus niger* has shown a lot of potential. However, the toxic compound furfural, commonly found in lignocellulosic waste, is greatly hampering the growth of *A. niger*, thereby limiting the applications of lignocellulosic waste in biorefineries. DTU Biobuilders is set to solve this problem. Using computational tools, we tuned synthetic transcription factors to detect furfural and subsequently activate the expression of heterologous furfural-degrading enzymes in *A. niger*. This could potentially improve *A. niger* growth in lignocellulosic waste, thereby unlocking the full potential of lignocellulosic waste as a sustainable carbon source in biorefineries.

<https://2022.igem.wiki/dtu-denmark>

Duesseldorf

Project Title: CosMIC: 3D-bioprinting for independent and sustainable manufacturing in space

 Booth: Biomanufacturing Village, B-8

 Village Presentation: October 26, 17:45-18:00 CEST, Plaza 1

 Judging Session: October 27, 15:00-15:30 CEST, Room J9

The short lifetime of equipment and dependance on insecure and costly supply routes not only cause safety issues for researchers on remote expeditions, but are also accountable for high amounts of CO₂-emissions. By combining the opportunities of 3D-printing with a newly designed bioink, consisting of nitrogen-fixing *Azotobacter vinelandii*, we aim to provide an independent and sustainable solution for manufacturing in remote places such as space. Through overexpression of the hydrogel-forming polymer alginate and introduction of a cellulose synthesizing system, our setup provides workers and researchers with a modifiable system to manufacture small tools and consumables of various qualities on demand. By connecting the cellulose synthetase to an optogenetically inducible system, any products can be independently hardened upon exposure to blue light, enabling the opportunity to react to diverse circumstances. This way, CosMIC provides a solution for science to expand further into the yet unknown areas of our universe.

<https://2022.igem.wiki/duesseldorf>

Duke

Project Title: NODES: Novel Organoid-dependent Drug Efficacy Screening implementing high-throughput, droplet-based brain organoids

 Booth: Foundational Advance Village, A-4

 Village Presentation: October 27, 13:00-13:15 CEST, Plaza 1

 Judging Session: October 26, 17:00-17:30 CEST, Room J11

Treatment of glioma, which affects ~20,000 Americans annually, is limited by the lack of a scalable, physiologically relevant model for testing therapeutics. Duke iGEM is developing NODES, a high-throughput organoid-based drug screening platform to characterize treatment efficacy in the common IDH1/2-mutant glioma variant. Our platform measures cellular levels of D-2-hydroxyglutarate (D-2HG), an oncometabolite associated with pathway dysregulation, therapeutic resistance, and cancer progression. After identifying a D-2HG biosensor in Phase 1, we constructed a fluorescence-based reporter system in Phase 2. We validated the system's operational characteristics, including input-output dose response and D-2HG measurement accuracy. To explore the socioethical implications of our work, we extended our Phase 1 stakeholder analyses to review how sexual and racial representation in sample cell lines impact research. Through its physiologically relevant and dynamically measurable design, NODES has the potential to accurately characterize drug responses, offering new hope to glioma patients.

<https://2022.igem.wiki/duke>

DUT_China

Project Title: Strainer - A purification system enable high efficient CRISPR-based genome engineering during cell factory construction

 Remote Team Village

 Judging Session: October 27, 15:00-15:30 CEST, Room J12

CRISPR/Cas system has been successfully harnessed for programmable RNA-guided genome editing in many fields. But CRISPR-based genome engineering strategies have off-target cleaves, variable gRNA efficiency, protospacer-adjacent motif (PAM) specificity and other problems. These hinder us obtaining strains that are accurately edited, prolonging the time of strain construction and screening, costing more manpower and materials. Here, we developed a CRISPR-based purification system “strainer”, which utilizes double stranded DNA breaks (DSBs) as a signal to start the transcription of gRNA targeting on the plasmid harboring inducible toxic gene SacB. Then, only the strain with DSBs and recombineering can survive in the media with sucrose, because SacB converts sucrose to levan that is toxic to E. coli, thereby improving the overall editing efficiency during the genome engineering process. We then applied “strainer” for an isopropanol high-producing strain construction efficiently. “Strainer” can be potentially used as an universal method for cell factory construction.

<https://2022.igem.wiki/dut-china>

East_China

Project Title: N-Butanol Cell Factory

 Remote Team Village

 Judging Session: October 27, 10:00-10:30 CEST, Room J2

N-butanol, an organic compound ($C_4H_{10}O$). There is a larger demand for N-butanol than before. N-butanol can take advantage of its organic compounds to help transport hydrogen and reduce the waste of electricity, while also being a less polluting fuel. However, there are many disadvantages to the traditional N-butanol manufacturing process. Thus, our purpose is to produce N-butanol more efficiently by biosynthesis as well as be more friendly to the environment. Below is the method, Streptomyces acetobutyrate genes thl, hbd, crt, and streptomyces dentatus ter need to be cloned into plasmid expressing butanol synthetic pathway proteins. The plasmid carrying these genes with optimized codon will be introduced into the target strain through electrical transformation to test whether the transformants can successfully synthesize N-butanol. The expression of the strain will be further optimized to successfully construct lactobacillus that could produce N-butanol using glucose as raw material. Key Words: N-butanol, plasmid, gene

<https://2022.igem.wiki/east-china>

East_Coast_BioCrew

Project Title: PCBusters: Here to save the water



Booth: High School Village, C-5



Village Presentation: October 26, 17:00-17:15 CEST, Plaza 3



Judging Session: October 27, 16:30-17:00 CEST, Room J2

Polychlorinated biphenyls (PCBs) are a carcinogen that contaminates waterways due to large-scale industrial dumping. Current methods of detecting and degrading PCBs are either environmentally harmful or expensive. We are developing safe-to-use and accessible methods of detection and degradation of PCBs based on projects from the Stockholm-2020 and Chalmers-Gottenberg-2019 teams. We are genetically engineering both *Rhodococcus* to enhance its natural ability to degrade PCBs and using yeast to produce bioluminescence when in the presence of PCBs. We contacted the PCB division of the EPA for advice on how we could implement our project. Additionally, we reached out to professors in Maryland who worked on developing a technique to deliver PCB-degrading microbes to contaminated bodies of water. To inform the public about our work, we collaborated with other teams to educate people through classes and social media. Our system, conscious of previous work and health concerns, can mitigate the threat of PCBs.

<https://2022.igem.wiki/east-coast-biocrew>

ECNUAS

Project Title: Increase the level of rapamycin fermentation by knocking out the M271_14685/M271_14690 gene in *Streptomyces rapamycinicus*



Remote Team Village



Judging Session: October 27, 13:30-14:00 CEST, Room J2

Organ transplantation faces the problem of immune rejection while giving patients a second life. Rapamycin is a new type of macrolide antibiotic, and it is also a widely used clinical drug for the treatment of immune rejection, which can greatly improve the survival rate of transplanted organs after surgery. But this medicine is low productivity and it is also expensive. Our project intends to construct an engineered strain using genetic engineering, mainly by knocking out the two-component system encoding gene M271_14685/M271_14690 in *Streptomyces rapamycinicus*, optimizing the metabolic regulatory network of rapamycin biosynthesis, and improving the fermentation yield of the rapamycin, which will bring greater value to clinical treatment and help patients which take organ transplantations. Key Words: Organ transplantation, Rapamycin, genetic engineering

<https://2022.igem.wiki/ecnuas>

Edinburgh-UHAS_Ghana

Project Title: 'Petalution' a Holistic Solution to PET Plastic and Heavy Metal Water Pollution



Booth: Environment Village, I-8



Village Presentation: October 26, 16:45-17:00 CEST, Plaza 5



Judging Session: October 27, 15:30-16:00 CEST, Room J7

Water quality is of growing concern in Ghana with about 60% of the water bodies being polluted and most are in critical condition. The main cause of this pollution is unregulated industrial activities such as poor plastic waste management and illegal mining. From this issue, we identified PET plastic and heavy metals as tangible aspects of water pollution that could be mitigated. We wanted to develop a way to safely process PET pollution and heavy metals away from local communities. Through a literature search, we identified target proteins to mitigate Ghana's water pollution issues – PET degrading PETases from *Ideonella sakaiensis*, and metal-binding metallothioneins from *Mytilus edulis*. From this, we created a cell-free biodegradation tool for PET pollution and a bioremediation device for sequestering heavy metals along with a cell-free biosensor to detect heavy metals (mercury, lead, cadmium and arsenic) to locate the acutely affected areas of heavy metal pollution.

<https://2022.igem.wiki/edinburgh-uhas-ghana>

ELTE

Project Title: NanoBlade - a novel bacteria based tool for targeted tumour therapy and diagnostics



Booth: Therapeutics Village, D-4



Village Presentation: October 27, 17:30-17:45 CEST, Plaza 2



Judging Session: October 26, 16:00-16:30 CEST, Room J5

Cancer is one of the leading causes of death, and the pandemic of COVID19 has put a tremendous burden on health care systems, resulting in delayed treatments and diagnosis. We propose a safe and efficient bacterial-based tumour therapy combined with diagnostic elements to enhance its precision. To achieve this, we have designed two sets of devices capable of detecting cancer cells and tissues; NanoBody Display System and MiniNano. Both use a Nanobody displayed on the bacteria's outer membrane to attach cancer cells selectively. These interactions, also the tumour's localisation, can be visualised by fluorescence. However, the centrepiece of our project is a blue-light inducible expression system, with which we aim to release precisely, under great spatiotemporal control, a cytotoxin into the tumour's environment, killing cancer cells locally. To test our light-controlled system, we developed an easy-to-build, no-code LED panel, which can serve as a valuable tool for other iGEM teams.

<https://2022.igem.wiki/elte>

EPFL

Project Title: HESTIA: Hydrophobic E.coli-based Sustainable Thermally Insulative Aerogel - Reimagining Sustainable Insulation through Synthetic Biology

 Booth: Biomanufacturing Village, B-9

 Village Presentation: October 27, 17:45-18:00 CEST, Plaza 1

 Judging Session: October 26, 14:00-14:30 CEST, Room J9

'Energy is scarce, let's not waste it!' - With this slogan Switzerland launched an energy saving campaign in response to the threat of blackouts in the coming winter months. The current energy crisis is acute, but in a world with a rapidly changing climate, this plea to preserve energy must endure. Enter HESTIA, a synthetic biology-based, modular, high performance insulation material. The HESTIA solution is founded upon the excellent insulative properties of cellulose aerogel, improving upon the material through two recombinant protein biofilm layers integrated via cellulose binding domains. The first layer, based upon recombinant Green Lacewing Silk, protects the aerogel from humidity. The second layer is fully customizable enabling additional properties, such as fire resistance, to be introduced. Our solution reimagines sustainable insulation materials using synthetic biology to save energy now and, being fully biodegradable, reduce the environmental impact of insulation waste in the future.

<https://2022.igem.wiki/epfl>

Estonia_TUIT

Project Title: SpaceYeast

 Booth: Biomanufacturing Village, B-10

 Village Presentation: October 26, 14:15-14:30 CEST, Plaza 1

 Judging Session: October 27, 14:00-14:30 CEST, Room J8

Open space is a hostile environment, where one of the threats for living organisms is harmful radiation. If we dream to terraform other planets, we need to find efficient ways to mitigate these hazards. Our well-being depends on other living organisms, therefore, we must find ways to adapt these organisms to the space environment. Our team is focusing on making budding yeast resistant to space radiation. We are engineering yeast to produce melanin, a known chemical that protects cells from both UV and ionizing radiation. To achieve this, we are expressing exogenous tyrosinase from *Bacillus megaterium*. To mitigate potential cytotoxic effects of melanin precursors, we are also aiming to isolate tyrosinase in viral-like nano compartments and alternatively to attach tyrosinase to the outer cell wall. The latter strategy would coat yeast with melanin. These yeasts could be used in spaceships and even other planets to produce valuable compounds for humans.

<https://2022.igem.wiki/estonia-tuit>

Evry_Paris-Saclay

Project Title: Electricia coli



Booth: Diagnostics Village, F-4



Village Presentation: October 27, 17:00-17:15 CEST, Plaza 4



Judging Session: October 26, 13:00-13:30 CEST, Room J11

Cancer remains one of the most life-threatening diseases all over the world. Therefore, its early-stage detection is critical for timely intervention needed to save the patient's life. Here we propose a system for more accurate and cost-effective detection of cancer by taking advantage of biomarker sensing together with external electron transfer through a microbial fuel cell. As the final output, we will detect an electrical signal in the presence of a cancer biomarker. Our project relies on the use of a toehold switch biosensor to detect the cancer biomarker PANTR1, a long non-coding RNA, and subsequently express a gene that leads to an electron flow outside the cell resulting in an electric signal. To detect this electric current, we built a microbial fuel cell device connected to an Arduino chip that allows real-time electron transfer measurements with an accuracy higher than fluorescent molecules or chromophores commonly used in such devices.

<https://2022.igem.wiki/evry-paris-saclay>

Exeter

Project Title: BionExe: Manufacturing a silk-reduced graphene oxide biocomposite for tissue regeneration



Booth: Biomanufacturing Village, B-11



Village Presentation: October 27, 14:00-14:15 CEST, Plaza 1



Judging Session: October 26, 10:30-11:00 CEST, Room J9

Peripheral nerve injury has affected over 550,000 people worldwide in the last decade. Currently, the most common treatment option for severe nerve damage is a nerve graft, sacrificing healthy tissue from another part of the body. Our project aims to combine highly conductive reduced graphene oxide (rGO), with strong, biocompatible silk to produce a biocomposite, for use in insertable grafts, to increase the speed and extent of nerve regeneration. We will use *E. coli* to produce recombinant silk proteins, using domains derived from the major ampullate silk of multiple spider species. We use modelling to evaluate the ability of co-expression of amino acid-relevant tRNAs and import proteins to optimise silk protein synthesis. We also aim to investigate and address barriers faced by disabled people in STEM, by interviewing students and professionals regarding their past experiences in science and designing a pipette brace to increase its ease of use.

<https://2022.igem.wiki/exeter>

FAFU

Project Title: “Pipeline Tracker”:New device for regionalized detection of pathogens

 Remote Team Village

 Judging Session: October 27, 12:30-13:00 CEST, Room J12

How to detect an outbreak of an epidemic has been a challenge for mankind since ancient times. After an outbreak of infectious disease in a certain area, rapid response and control will save many lives and restore health. Water is the necessary resource for everyone's survival, at the same time everyone also produces a lot of domestic wastewater every day. Many known pathogens can remain active in domestic wastewater for long periods of time. FAFU used COVID-19 as an example and developed a device to detect the virus by placing it near the sewer pipe in the living area.

<https://2022.igem.wiki/fafu>

FAFU-China

Project Title: Longan GABA cell factory

 Remote Team Village

 Judging Session: October 27, 10:00-10:30 CEST, Room J6

With the increase in the pace of life and competitive pressure, people in current society are often plagued by insomnia and anxiety. FAFU-China iGEM team found that GABA is a substance that improves the quality of human sleep, lowers blood pressure and relieves anxiety. They determined to use synthetic biology and molecular biology as the core tools to screen the key genes in the GABA synthesis pathway and improve the content of GABA in the embryonic healing tissue of longan by constructing overexpression vectors and CRISPR-Cas9 technology. Subsequently, they will further improve the GABA content by some exogenous treatments such as blue light and hormone treatment, in order to create a high yield GABA cell factory, and cooperate with related companies to extract the GABA and use it in the pharmaceutical industry.

<https://2022.igem.wiki/fafu-china>

FDR-HB_Peru

Project Title: ChocoCadmium: Detecting Cadmium in Peruvian cacao soil



Booth: High School Village, C-6



Village Presentation: October 26, 17:30-17:45 CEST, Plaza 3



Judging Session: October 27, 16:00-16:30 CEST, Room J1

Due to the toxic and carcinogenic effects of cadmium, the EU decreed new cadmium concentration limits on cacao products. Surprisingly, only 5% of Peruvian cacao exporters actually meet these requirements, for which almost 50,000 cacao farmers are reporting income loss. In collaboration with Alianza Cacao, our team is developing a cadmium detection system to provide on-site detection of areas with high amounts of cadmium in the soil. We are also working on developing a plasmid construct with a MerR protein that blocks the promoter region of the RFP gene. This MerR protein can be inhibited in the presence of cadmium, allowing the amount of cadmium in the soil to be relatively determined by the amount of RFP protein produced. Once high levels of cadmium are detected in the soil, the next step will be using hyperaccumulating plants along with modified rhizobacteria to bioremediate cadmium in the soil.

<https://2022.igem.wiki/fdr-hb-peru>

Freiburg

Project Title: chAMBER – Tidying up bacterial cells with natural and engineered nanocompartments



Booth: Foundational Advance Village, A-5



Village Presentation: October 26, 12:45-13:00 CEST, Plaza 1



Judging Session: October 27, 14:00-14:30 CEST, Room J11

Despite their small size, bacteria have sophisticated and dynamic internal organization, featuring distinct microenvironments optimized for a given task, such as carboxysomes that perform CO₂ fixation. We aimed to engineer and compare different compartmentalization systems (rigid shells and liquid droplets) for their ability to localize enzymes and promote metabolic processes due to reduced formation of toxic side-products and more efficient interplay between pathway components thanks to physical proximity. Using computational structural biology, we predicted sites at which the incorporation of a non-canonical amino acid (ncAA) could influence pore size. To facilitate the use of ncAAs for future iGEM teams, we developed INCLUSIVE, a database collecting the important information from the literature. Furthermore, we investigated the impact of genome reduction on compartment formation and metabolic pathway output. In conclusion, our project lays the foundations for using compartmentalization as a tool to exploit the full power of bacterial cells.

<https://2022.igem.wiki/freiburg>

FSU

Project Title: No title

 Booth: Climate Crisis Village, G-3

 Village Presentation: October 26, 10:15-10:30 CEST, Plaza 4

 Judging Session: October 27, 16:30-17:00 CEST, Room J14

No abstract

<https://2022.igem.wiki/fsu>

Fudan

Project Title: Rester: A Vitamin A Biomanufacturing Cell Factory for Skincare Products

 Booth: Biomanufacturing Village, B-12

 Village Presentation: October 26, 14:30-14:45 CEST, Plaza 1

 Judging Session: October 27, 14:30-15:00 CEST, Room J9

Our society has been under massive academic and work pressure recently. However, as the most exterior health indicator, skin loses the care that it should have according to research indicating that over 40% of people have worsened skin health due to a work-life imbalance and a lack of skincare awareness during the pandemic. Our project Rester centers on Vitamin A, an effective skincare reagent but with possible side effects. Our modified cell factories featuring phase separation and enzyme anchoring contain the reaction route of beta-carotene, retinal, and retinol through consecutive enzymatic reactions with appropriate efficiency. It would underlie the production of Vitamin A derivatives that overcome the instability and hazard issues of typical Vitamin A forms in skincare products. This biomanufacturing plan helps people with heavy stress and skincare queries raise their proper skincare awareness, ease their financial burden of skincare, and ultimately regain confidence in their careers and life.

<https://2022.igem.wiki/fudan>

Fujian_United

Project Title: Heavy metal detection

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J3

With the development of industry and human activities, a large number of metal ions are released. Many of these metal ions, such as cadmium, chromium, and mercury, are enriched in the food chain and often cause many hazards to local ecosystems and human health. This project will establish a broader and cheaper rapid detection technology to reduce the intake of undesirable metal ions in the human body. In this project, by constructing recombinant plasmids ArsD, ArsR, and ArsA using Escherichia coli and Bacillus metal-responsive promoters, the sensitivity of biosensors is detected by the intensity of fluorescent signal, and the concentration of metal ions in the sample is displayed. This project can be used to detect heavy metals, provide warnings to people, and reduce the health damage to the human body. Key Words: heavy metal, biosensor

<https://2022.igem.wiki/fujian-united>

GastonDay-Shangde

Project Title: Cinnamon to Sodium Benzoate: Treating Nonketotic Hyperglycinemia

 Remote Team Village

 Judging Session: October 27, 15:00-15:30 CEST, Room J4

Nonketotic Hyperglycinemia (NKH) causes seizures, low muscle tone, lethargy, coma, and apnea caused by the accumulation of glycine. Sodium benzoate (SB) helps regulate glycine levels by increasing elimination through the kidneys. However, SB irritates the digestive system. Compounds found in cinnamon are metabolized to SB by the liver leading some families to use cinnamon as an adjunct treatment for NKH. However, the composition of cinnamon bark is variable from area to area and between different barks, so there is no accurate dose for the medicine. We are in the process of expressing enzymes to produce cinnamic acids, cinnamoyl-CoA, and cinnamaldehyde in E. coli. We will look into producing the intermediates in the phenylalanine-to-cinnamaldehyde pathway in cell-free conditions using the cloned enzymes. Ultimately, these products can be assessed for their ability to remove glycine from body fluids and reduce the symptoms of NKH.

<https://2022.igem.wiki/gastonday-shangde>

GA_State_SW_Jiaotong

Project Title: A Co-Culture Between Genetically Modified *C. minutissima* and *E. coli* for Efficient Biofuel Production

 Booth: Climate Crisis Village, G-4

 Village Presentation: October 27, 10:15-10:30 CEST, Plaza 4

 Judging Session: October 26, 17:00-17:30 CEST, Room J6

Climate change is largely driven by the combustion of fossil fuels but recent studies show that biofuels offer a carbon-neutral solution. Microalgae can be used to produce biofuels while consuming harmful environmental agents, such as carbon dioxide and wastewater. Our goal is to create a synthetic biology system that will increase lipid production from microalgae to serve as an intermediate in chemical reactions needed to create biofuels. Specifically, we will create a co-culture between *C. minutissima* microalgae and *E. coli* to increase the cell density of *C. minutissima*. To increase *C. minutissima*'s growth rate, *E. coli* will be genetically modified to produce indole-3-acetic acid (IAA). *C. minutissima* will be genetically modified to express glycerol-3-phosphate acyltransferase (GPAT), lysophosphatidic acid acyltransferase (LPAAT), and diglyceride acyltransferase (DGAT) to increase lipid production. We hypothesize that these factors will create a dense algae population with high lipid content, providing ideal parameters for biofuel production.

<https://2022.igem.wiki/ga-state-sw-jiaotong>

GDSYZX

Project Title: Application of photoinducible promoter in the biosynthesis of patchoulol in yeast

 Remote Team Village

 Judging Session: October 26, 13:00-13:30 CEST, Room J4

Patchoulol is one of the main active components of *Pogostemon cablin*, which is often used to defend against phytopathogenic microbes and combat human diseases. Patchoulol can be obtained by natural extraction, chemical synthesis, and synthetic biology engineering. However, the natural extraction is often low-efficiency, and the chemical synthesis is often costly and inefficient, and may not yield enantiomerically pure patchoulol. We engineered high level patchoulol production in yeast by overexpression of farnesyl diphosphate synthase (FPS, ERG20) and patchoulol synthase (PTS) either driven by strong promoter or light-induced promoter HIGH CHLOROPHYLL FLUORESCENCE173 (HCF173). The strategy increased the synthesis of patchoulol, which may also provide the foundations to generate higher levels of other terpenes for research, industrial production or therapeutic applications.

<https://2022.igem.wiki/gdsyzx>

GEMS_Taiwan

Project Title: Fusarium Won't: A Biofungicidal Rhizobacteria to Persistently Protect Against Fusarium Wilt of Bananas

 Booth: High School Village, C-7

 Village Presentation: October 27, 17:30-17:45 CEST, Plaza 3

 Judging Session: October 26, 9:30-10:00 CEST, Room J2

Bananas have teetered on the brink of destruction due to disease - amongst the deadliest pathogen to the Cavendish cultivar is *Fusarium oxysporum cubense* Tropical Race 4 (Foc TR4), which causes Fusarium Wilt. Current solutions to Foc TR4 are insufficient to stop its global spread or to treat disease symptoms. To prevent devastation to the Cavendish banana, our project aims to engineer a *B. subtilis* biofungicidal rhizobacteria to provide persistent protection against Foc. By engineering SEC-mediated chitinase secretion, the bacteria would induce growth inhibition in Foc. We designed a malate-induced toxin-antitoxin biocontainment system that restricts the bacteria to the banana rhizosphere such that a protective barrier of bacteria is formed to ward off Foc. Beyond solving the specific crisis of bananas, our project serves to spearhead the application of genetic engineering to rhizobacteria as a means of buying time for the development of sustainable agricultural methods to save threatened crops.

<https://2022.igem.wiki/gems-taiwan>

Goethe_Frankfurt

Project Title: CADch me if you can! - Detection and Remediation of Cadmium from Waters and Soils

 Booth: Environment Village, I-9

 Village Presentation: October 27, 16:45-17:00 CEST, Plaza 5

 Judging Session: October 26, 15:00-15:30 CEST, Room J7

We engineer *E. coli* strains to detect cadmium via the inherent bacterial chemotaxis, which we modify based on recent publications. Furthermore we design a recycling strain that stores cadmium from contaminated sources and turns it into reusable cadmium quantum dots, that will be used in the production of new solar panels.

<https://2022.igem.wiki/goethe-frankfurt>

Goettingen

Project Title: From Wastegas to Biofuel



Booth: Climate Crisis Village, G-6



Village Presentation: October 27, 10:30-10:45 CEST, Plaza 4



Judging Session: October 26, 10:30-11:00 CEST, Room J14

The extensive emission of carbon oxides by fossil fuel combustion leads to a rapidly increasing greenhouse effect. Biofuels are providing great potential for sustainable fuels as they are produced from cell material instead of fossil resources. However, these agricultural products compete with food production. Biofuel production utilising CO₂ as substrate can contribute to a drastic reduction of greenhouse gases. The acetogenic Wood-Ljungdahl pathway of Clostridia utilises CO or Syngas (CO₂, CO, H₂) as metabolic substrate to produce the central intermediate Acetyl-CoA. Biofuel production by these bacteria failed in the past due to low yields of valuable products. To overcome this obstacle, we introduced metabolic pathway genes of the Wood-Ljungdahl pathway into a high yield butanol producing organism to generate high biofuel yields from industrial waste gas. Our work presents a sustainable approach for the production of biofuel which is usable for various combustion engines by expressing central metabolic pathway genes.

<https://2022.igem.wiki/goettingen>

GO_Paris-Saclay

Project Title: CO₂CURE



Booth: Climate Crisis Village, G-5



Village Presentation: October 26, 10:30-10:45 CEST, Plaza 4



Judging Session: October 27, 10:00-10:30 CEST, Room J14

The carbon dioxide (CO₂) is the most common greenhouse gas that overheats our planet. Here we present the proof of concept for making prolific producers of antibiotics autotrophic chassis by implementing the Calvin cycle in *Streptomyces*. To turn these bacteria into autotrophs, we cloned GC-rich sequences encoding RubisCO (Ribulose-1,5-bisphosphate Carboxylase Oxygenase) and PRK (Phosphoribulokinase), key genes for the Calvin cycle. We have developed new genetic tools for the integration of these genes into the *Streptomyces* genome. Furthermore, to obtain antibiotic production in the minimal medium and implement the Calvin cycle, we engineered genetic tools via the CRISPR-dCas9 system to switch off the expression of genes of interest. Finally, we compared various *Streptomyces* strains, their phenotypic characteristics, and genomes to determine the best chassis for this project and generate a STREPTObook. The CO₂CURE project will enable faster, more affordable, and sustainable bioproduction of antibiotics and many other useful derivatives.

<https://2022.igem.wiki/go-paris-saclay>

GreatBay_SCIE

Project Title: Environmentally friendly approach to cloths recycling by constructing cellulosome-like protein complexes

 Remote Team Village

 Judging Session: October 26, 12:30-13:00 CEST, Room J2

Fast fashion is an indispensable part of people's lives, while it causes non-negligible detrimental effects on the environment due to waste consumption. Inspired by cellulosome from *C.thermocellum*, we designed two cellulosome-like protein complexes to degrade the cellulose and PET respectively. Accordingly, we engineered *Kluyveromyces. marxianus* to express dockerin-fused cellulase, "cellulase boosters", PETase and MHETase, which can be assembled on to mini scaffoldins expressed by *E.coli*. Moreover, we enable *E.coli* to express a surface display system and thereby as the host of our "cellulosome-like nanomachines". Eventually, the products can be converted back into high-value textiles, including bacterial cellulose and polyester. GreatBay_SCIE further explored enzyme-microbe synergy to improve the efficiency of enzymes and metabolically inactivate microorganisms to boost the yield of products. Therefore, our nanomachines can serve as an innovative means of cloth recycling in the future.

<https://2022.igem.wiki/greatbay-scie>

Groningen

Project Title: Nanobuddy: A Novel Nanotherapeutic Prevention Strategy Against Highly Pathogenic Avian Influenza

 Booth: Therapeutics Village, D-5

 Village Presentation: October 26, 16:30-16:45 CEST, Plaza 2

 Judging Session: October 27, 10:30-11:00 CEST, Room J6

The highly pathogenic avian influenza virus sweeps through the world. Current biosecurity and prevention strategies (e.g. intravenous vaccination) are insufficient and logistical nightmares, resulting in deaths of millions of poultry worldwide. With Nanobuddy we propose a novel solution by engineering *Lactobacillus reuteri*, a native species in the lung and intestinal microbiome of chickens, to secrete broadly neutralizing nanobodies against bird flu. These nanobodies bind to a conserved region of the virus's hemagglutinin receptor, blocking it from entering cells. We researched several facets of our project: We investigated *L. reuteri*'s ability to secrete nanobodies and explored via lung-microbiomics *L. reuteri*'s presence in Dutch chickens. We explored the efficacy of the anti-avian influenza nanobodies and proposed an in-silico nanobody design workflow. Additionally, we developed a temperature sensitive biosafety module and performed extensive human practice to inform our final product. Nanobuddy, administered as a convenient spray, might revolutionize the fight against avian influenza.

<https://2022.igem.wiki/groningen>

Guangxi-U-China

Project Title: Engineered Bacteria for Immunotherapy of Triple Negative Breast Cancer

 Remote Team Village

 Judging Session: October 26, 10:00-10:30 CEST, Room J6

Treatment of triple negative breast cancer is difficult because of the absence of specific targets, low chemotherapy responses and immune escapes. We are aimed to reverse the noninflammatory polarization of tumor associated macrophages with engineered bacteria that can clear away lactic acid from glycolytic metabolism. Engineered *E. coli* Nissle 1917 bacteria with acid/base inducible promoters are designed to live on lactate, carry monocarboxylate transporters, target cancerous cells and promote phagocytic activities of macrophages. Experimental protocols for determining activities of RNases in tumor and normal tissues and co-culture of cancer cells with bacteria are established. Mathematic models are developed for epidemiological questionnaire and the dynamics of glucose metabolism with chromatographic measurement. Metabolomic and proteomic changes are identified and imaged with mass spectrometry. A prototype portable photoacoustic device and software are developed for the detection of solid tumors. We have been dedicated to raising public awareness, providing educational and social services.

<https://2022.igem.wiki/guangxi-u-china>

Guelph

Project Title: Project Ceres: An inducible bioinsecticide for preventing the spread of insect pathogens in greenhouse crops

 Remote Team Village

 Judging Session: October 26, 15:30-16:00 CEST, Room J14

In 2020, Canada produced over 679,000 tonnes of greenhouse produce, with a farmgate value of 1.8 billion CAD. In Ontario, Leamington alone is home to more greenhouse acreage than the entire United States. However, many factors influence yield of these crops, and growers can experience massive yield losses due to insect damage. To meet the demand for innovative strategies to control insect pests, we engineered *Bacillus subtilis* to inducibly express insect Cytotoxic (Cyt) proteins through an IPTG responsive promoter, Pgrac. When “off”, the modified *B. subtilis* behaves normally and may have a positive effect on plant growth. When “on,” the bacterial biofilm produces Cyt proteins, creating a pesticide barrier to any Dipteran insect larvae that may be present in the soil. This powerful bioinsecticide designed by iGEM Guelph will place a new tool in the hands of growers to combat harmful greenhouse insect pathogens.

<https://2022.igem.wiki/guelph>

GXU-China

Project Title: Blue-green light-regulated sewage treatment bacterium preparation based on *Bacillus subtilis*

 Remote Team Village

 Judging Session: October 26, 9:30-10:00 CEST, Room J8

Our project aims to modify *Bacillus subtilis* by building a molecular switch in *Bacillus subtilis* which expresses a large number of nitrogen-related enzymes under blue light irradiation to control the total nitrogen content in water with synthetic biological way. We hope it can decompose nitrogen-containing organic matter and avoid eutrophication of water bodies. On the other hand, we design the suicide mechanism under green light irradiation causing the death of the strain which could significantly reduce the cost of biosafety disposal. By monitoring and analysis of temperature, dissolved oxygen, nitrogen salt concentration and other indicators in the water body with biosensors and mathematical modeling, we hope to make a photo-regulated bacterium preparation that is green and environmentally friendly with less repeated addition, a strong sewage treatment effect and adjustment of its concentration in real time.

<https://2022.igem.wiki/gxu-china>

GYHS

Project Title: Separation and Multiplex Colorimetric Detection of Foodborne Pathogens Based on Phage Receptor Binding Protein

 Remote Team Village

 Judging Session: October 26, 12:30-13:00 CEST, Room J3

Global food safety problems emerge one after another, and people's requirements for quality of life are constantly improving. At this time, it is very important to put forward a method that can quickly and directly detect pathogenic bacteria. We hope that this project can strengthen people's attention to food safety and reduce the tragedies caused by food safety. We used phage binding protein-nanomagnetic bead complexes combined with a paper-based sensor to isolate and colorimetrically detect a variety of foodborne pathogenic bacteria in food. We hope our device could help to detect foodborne pathogens at home for people so that we eat healthier and safer.

<https://2022.igem.wiki/gyhs>

HainanU_China

Project Title: NATer—— Nucleic acids tracker

 Remote Team Village

 Judging Session: October 26, 13:00-13:30 CEST, Room J10

Since the discovery of penicillin by Fleming in 1929, antibiotic research has developed rapidly and the large-scale use of antibiotics has brought about serious problems of microbial resistance. Combined with human activities, the cross-species and cross-habitat spread of drug-resistant microorganisms and antibiotic-resistant genes occurred at the 'Human-marine animal-environment' interface. Antibiotics and their metabolites were enriched in the environment, spread to human by marine animals and animal products, produced drug-resistant microorganisms and caused the spread of drug-resistant genes, which has been a serious impact on human health. At present, there is no rapid detection instrument in the field of marine environmental monitoring to characterize microbial resistance in seawater. Based on the combination of CRISPR/CAS system and CSM6 protein, we identify mutagenic genes with single-base precision, detect specific drug-resistant genes in marine microorganisms and develop a platform for rapid detection of drug resistance in marine microorganisms.

<https://2022.igem.wiki/hainanu-china>

Harvard

Project Title: CARPE: Computationally-Aided Rapid Protein Engineering

 Remote Team Village

 Judging Session: October 27, 16:00-16:30 CEST, Room J12

Directed evolution has become the forefront method of generating novel protein-peptide activity in protein engineering. However, current directed evolution protocols rely on random mutagenesis, consuming disproportionate amounts of time and resources. CARPE, computationally-aided rapid protein engineering, is a faster and more resource-efficient alternative to directed evolution. Using computationally proposed mutations to the active site of the Ste2 GPCR in *Saccharomyces cerevisiae*, we engineered Ste2 to recognize the kidney disease biomarker Cystatin-C instead of its native ligand. Evolutionary relationships were explored through pairwise alignments to identify binding residues with high Shannon entropy in Ste2. These target residues were computationally mutated to evolutionarily related amino acids to determine sets of mutations that optimized binding energy to Cystatin-C. To validate results, computationally-favorable mutations were induced in *Saccharomyces cerevisiae* upstream of mVenus to assess binding affinity between CARPE-mutated Ste2 and Cystatin-C.

<https://2022.igem.wiki/harvard>

HBUT-China

Project Title: Antioxidant Alchemy: Cutting-edge synthesis of the potent antioxidant Ergothioneine

 Remote Team Village

 Judging Session: October 27, 14:30-15:00 CEST, Room J12

Aging and diseases are associated with the production of excess free radicals. Finding an effective way to scavenge free radicals is thought to be one of food and cosmetic industries. Ergothioneine (EGT), a natural antioxidant, which is commonly found in mushrooms, has fairly powerful properties. However, human body cannot synthesize it, as a result, there is a huge market demand for the production of Ergothioneine. Our main goal is to achieve higher production of EGT. We engineered a yeast *Saccharomyces cerevisiae* as a chassis for the production of EGT. We applied CRISPR-Cas9 technology to integrate two genes into the yeast genome, and succeeded in constructing EGT biosynthesis pathway in *S.cerevisiae*. Additionally, the production can be further improved after optimizing the media with proper concentration of amino acids, which is the precursor of EGT. This work offers a more sustainable, low cost and efficient approach for the industrial production of EGT.

<https://2022.igem.wiki/hbut-china>

Heidelberg

Project Title: siRNA Tech for Neuroinfections

 Booth: Therapeutics Village, D-6

 Village Presentation: October 27, 17:45-18:00 CEST, Plaza 2

 Judging Session: October 27, 15:30-16:00 CEST, Room J12

Encephalitis is a lethal stage of viral infections in the brain and very difficult to treat, as the therapeutic must first pass through the blood brain barrier. We tackled this problem by delivering siRNAs packed in liposomes via the nose-to-brain route. Our team has designed a therapeutic platform where siRNA against a specific viral encephalitis can be produced easily in *E.coli* and packed into the corresponding optimal formulation of liposomes. This optimal formulation is obtained with our microfluidics liposome generator in the future. Therefore, not only can we circumvent the blood brain barrier and transport therapeutics more effectively to the brain, but we also have created a platform technology to develop therapeutics against many different types of viral encephalitis. As it is one of the deadliest types of brain inflammation, and moreover no vaccine exists against it, we designed our siRNAs to work against the herpes simplex encephalitis.

<https://2022.igem.wiki/heidelberg>

HiZJU-China

Project Title: No title

 Remote Team Village

 Judging Session: October 26, 12:30-13:00 CEST, Room J7

No abstract

<https://2022.igem.wiki/hizju-china>

HKUST

Project Title: Fisherly: Safe Fish on Your Dish

 Booth: Food & Nutrition Village, E-5

 Village Presentation: October 26, 14:15-14:30 CEST, Plaza 3

 Judging Session: October 27, 14:00-14:30 CEST, Room J13

Fresh seafood products are highly susceptible to spoilage, so it is important to monitor their quality throughout storage and delivery. We aim to create a colorimetric biosensor that detects bioamine levels in raw fish, as high levels of bioamines signify the degradation of meat quality and cause bioamine poisoning. Our circuit detects the bioamine levels by converting them into H₂O₂ with rat diamine oxidase. H₂O₂ subsequently oxidizes the transcription factor OxyR, activating the katG promoter, which drives the expression of a red output. Essentially, the system turns green if the fish is safe to consume and red when it is spoiled. We use an E. coli-based cell-free system as the detection mechanism in our biosensor and a swab test will be done for extracting the final sample by users. Compared to current products, our biosensor will be a more ready-to-use, intuitive, and robust indicator of fresh fish quality.

<https://2022.igem.wiki/hkust>

HKU_HongKong

Project Title: Transgenic Cecropin B-expressing *Chlorella autotrophica* for passive immunization of fish



Booth: Foundational Advance Village, A-6



Village Presentation: October 27, 13:15-13:30 CEST, Plaza 1



Judging Session: October 26, 10:30-11:00 CEST, Room J12

Antimicrobial resistance is a global phenomenon arising from the indiscriminate use of antibiotics. To combat this problem, the Antimicrobial Peptide Cecropin B (CecB), a highly-effective, broad-spectrum antibiotic alternative is expressed in transgenic *Chlorella autotrophica*, a well-studied and highly-productive protein expressing microalgal chassis. It is expressed with a secretion signal peptide for extraction; and SUMO-tag for in-vitro cleavage using SUMO-protease. To validate efficacy, the isolated CecB is tested against common aquatic pathogens. The in-vitro cleavage system, barring the signal peptide, is also expressed using a bacterial chassis. This is to test the design and quantify the differences between microalgal and bacterial synthetic capabilities. To modify the system for industrial use, the signal peptide is removed and the SUMO-protease is additionally inserted, under a nitrogen-starvation inducible promoter, to cleave SUMO in-vivo and generate active AMPs. The microalgae are then freeze-dried, preserving active AMPs internally, which can then be used as supplemental feed.

<https://2022.igem.wiki/hku-hongkong>

HK_CPU-WYY

Project Title: Project SSS



Remote Team Village



Judging Session: October 27, 13:00-13:30 CEST, Room J2

Inspired by the production of insulin, we came up with the idea of producing abundant spider silk in order to utilize such wonderful materials to replace the current materials to enhance the quality of products and promote environmental protection by synthetic biology. In this project, we aim to engineer *E.coli* BL21 to produce a protein named spidroin, the basic unit of spider silk. Masp1, Masp2 and NT2RepCT are planned to be manufactured. Based on our modeling result, we have predicted the concentration of IPTG needed to make an ideal spider silk. In the future, the mechanical properties of silk products, like strength, will be adjusted by controlling the proportion of spidroin with different properties. Thus, we hope to obtain spidroin with different properties to cater to different needs, like as string of musical instruments or as bio-concrete to stabilize the collapsing buildings, hence providing alternative materials for other goods.

<https://2022.igem.wiki/hk-cpu-wyy>

HK_SSC

Project Title: A biosynthetic production pathway of valerolactam using the cyanobacteria strain *Synechococcus elongatus* UTEX 2973.

 Remote Team Village

 Judging Session: October 27, 15:00-15:30 CEST, Room J1

The chemical commodity valerolactam is among a family of amides called lactams that are traditionally produced through petrochemical methods, which require intense energy and toxic environments. One of the end-products of valerolactam is nylon, which is heavily demanded every year. Taking note of the impact the petrochemical production methods of valerolactam has on the environment, we explore the biosynthesis of valerolactam as a green alternative. Switching to a biosynthetic production method of valerolactam allows an overall more sustainable manufacturing of its end-products. Molecular dynamic simulations are also carried out to improve the efficiency of existing enzymes. The precursor molecule to valerolactam, 5AVA, is synthesized by the cyanobacteria strain *Synechococcus elongatus* UTEX 2973 using carbon dioxide as the carbon source. The cyclization enzyme 5YSS then cyclizes 5AVA to valerolactam, and the protein NitR embedded on magnetic beads captures valerolactam molecules. The NitR-valerolactam complex is then isolated by applying a magnetic field.

<https://2022.igem.wiki/hk-ssc>

HNU_China

Project Title: P Pack

 Remote Team Village

 Judging Session: October 26, 10:30-11:00 CEST, Room J8

P Pack is generally a genetic-modified *E.coli* strain which can recycle inorganic phosphate from eutrophic water. Our project focuses on three native genetic parts related to phosphorus metabolism in *E.coli* genome. Pst complex, which generally express during phosphorus starvation, is used to absorb phosphate efficiently. Phosphate in cytoplasm of *E.coli* can polymerize to create poly-phosphate(polyP) as the storage form. This process is conducted by mutated PPK protein. YjbB complex, which generally conducts phosphate release, is regulated for phosphate recycling. The framework of these parts is conducted by a thermal-sensitive repressor called cl857. The genetic-modified *E.coli* strain can switch its mode between phosphate absorbing and release in different thermal condition.

<https://2022.igem.wiki/hnu-china>

Hopkins

Project Title: G-Roots: Engineered Magnetotropism for Zero-G Root Growth

-  Booth: Food & Nutrition Village, E-6
-  Village Presentation: October 27, 13:00-13:15 CEST, Plaza 3
-  Judging Session: October 26, 15:30-16:00 CEST, Room J13

With rising interest in resuming spaceflight, plant growth in space is crucial for manned missions as they provide food, oxygen, and atmospheric regulation. Resource scarcity and sustainability is crucial in space, and the cost of sending food to the International Space Station is high. Plants grown in space are unfortunately smaller than their Earth counterparts since gravitropic cues responsible for guiding root growth are absent. Stunted root growth in turn, translates to reduced plant size and diminished caloric value for astronauts. We aim to engineer roots to grow directionally in gradient magnetic fields - magnetotropism. Filling statoliths with iron-loading proteins like ferritin will allow statoliths to move in response to a gradient magnetic field, and this field will be generated using a pair of Helmholtz coils. This method of engineering hardware and root cells to generate and respond to magnetic cues can advance astrobiology and enhance nutritional outcomes for astronauts.

<https://2022.igem.wiki/hopkins>

HS_China

Project Title: Good news for lactose intolerant patients

-  Remote Team Village
-  Judging Session: October 27, 15:00-15:30 CEST, Room J2

Lactose intolerance is a prevalent issue that cannot be overlooked. As much as 75% of the world's human population is intolerant to ingested dietary lactose. We decided to use *E. coli* Nissle 1917 (EcN) as our chassis and make it synthesize β -galactosidase (lacZ) with a secretory signal peptide, which can effectively prevent lactose uptake by EcN. Second, we plan to use enteric-coated pills to contain the freeze-dried bacteria for ingestion which helps the bacteria bypass the chemical barrier the gastric acid imposes and ensures safe transport to the intestines. Third, we aim to create a protective film using CAP (capsular polysaccharides surrounding) to ensure that the bacteria safely implant themselves in the intestinal environment without damage. The CAP helps the bacteria adapt to a wider range of temperature and pH, shuts out harmful chemicals and toxins, as well as assisting them to stick to the intestinal walls.

<https://2022.igem.wiki/hs-china>

HUST-China

Project Title: REE Miner

 Remote Team Village

 Judging Session: October 26, 12:30-13:00 CEST, Room J8

REE Miner is an optimized absorption kit of rare earth elements. As a type of nonrenewable resource, rare earth elements are of great significance to human society, resulting in a substantial global demand. It is estimated that 1 ton of rare earth elements requires an average of 263 tons of water to extract. In addition, the wastewater generated by rare earth mining can have negative effects on our health and the environment. To solve this issue, we designed a brand-new kit based on the project accomplished in 2017. We chose two validated systems, the pmr system and the gols system, to express the functional protein, with both systems modified to detect particular ions in wastewater. The four proteins oprf, Sitag, LanM, and dLBT combine to form a rare earth element concentrator, enabling REE Miner to purify the environment while recollecting these valuable resources.

<https://2022.igem.wiki/hust-china>

HUS_United

Project Title: A new type of biological parts: degradation-tuning RNAs

 Remote Team Village

 Judging Session: October 27, 16:30-17:00 CEST, Room J3

Enhancing gene expression is vital for downstream applications such as biosynthesis of valuable chemicals or manipulating behaviors of designed gene circuits against intrinsic noise. The traditional means is to adopt promoters with higher activity to increase the inflow of mRNA and protein translation, which inevitably increases metabolic pressure for the chassis, thus limiting the scale and complexity of artificial biological circuits. Instead of increasing gene expression, we seek to modulate the degradation rate of mRNA by degradation-tuning RNAs (dsRNAs) on the 5'UTR region of the mRNAs, which function by promoting or inhibiting the attack from endogenous RNases. It allows us to enhance protein expressions without posting an extra metabolic burden to the host, and we introduce these functional structures on mRNA to synthetic biology as a new type of standard biological parts.

<https://2022.igem.wiki/hus-united>

HZAU-China

Project Title: C.V.D: Curer of Vessel Disease

 Remote Team Village

 Judging Session: October 26, 10:30-11:00 CEST, Room J6

As living standards have improved, many people are suffering from overeating. An unhealthy diet will affect the level of low-density lipoprotein (LDL) and triglyceride in the body, which will lead to the occurrence of a series of cardiovascular diseases (CVD) such as thrombosis. This year, the HZAU-China team hopes that the intestinal content of TMA (trimethylamine), the precursor of TMAO (trimethylamine oxide) and an important factor inducing thrombosis, can be efficiently reduced by using *Escherichia coli* Nissle 1917 from two aspects: inhibiting the production of TMA and degrading the TMA already existed, so as to reduce the possibility of thrombosis. At the same time, our engineered bacteria will also release some relief substances that are beneficial to vascular protection. The project aims to develop an edible probiotic powder and provide a new idea for cardiovascular disease treatment by intestinal drug therapy.

<https://2022.igem.wiki/hzau-china>

iBowu-China

Project Title: Extragalin: Manufacturing Astragalin for a Potential Alzheimer's Disease Cure Using Synthetic Biology

 Remote Team Village

 Judging Session: October 26, 16:00-16:30 CEST, Room J3

About 10 million Alzheimer's Disease patients are diagnosed in China, the world's largest. Currently no sufficient treatment exists, especially in China, due to lack of effective and affordable drugs. This year, team iBowu-China learned about a plant-based substance, Astragalin, with the potential to be an effective cure. Astragalin is a natural flavonoid compound existing in medicinal plants. The traditional extraction doesn't lead to high enough product quantity and limited its large scale usage with economical availability. We study the bio-synthesis pathway of manufacturing Astragalin using engineered *E. coli*, expressing a series of plant-originated enzymes in the strains to generate Astragalin from a widely available substrate Naringenin. Experimentally we characterized the production of the enzymes, verified the production of Astragalin and attempted to optimize the production conditions for higher yields. We also conducted creative Education and Science Communication activities to raise social awareness of the Alzheimer's Disease and synthetic biology.

<https://2022.igem.wiki/ibowu-china>

ICJFLS

Project Title: Dawnlight Saga: A Portable Detector for MDD Based on Toehold Switch and Cell Free System

 Remote Team Village

 Judging Session: October 27, 10:30-11:00 CEST, Room J4

Major depressive disorder (MDD) is a common chronic psychological disease, resulting in heavy family and social burdens. However, current diagnosis of MDD is mainly based on the patients' description of symptoms, assessment of mental status and evaluation of clinical behaviors, which increase the rate of misdiagnosis. Developing the biomarkers and effective diagnosis method of MDD remains a challenge. Here we report the development of a novel, inexpensive, and portable filter-paper-based biosensor, which can be used to diagnose MDD patients by detecting the abundance of specific microRNA in blood. This biosensor comprises nucleic-acid toehold switches designed to bind to the identified differentially expressed biomarker miRNAs in MDD, namely miR-34a-5p, miR-221-3p and let-7d-3p. Each toehold switch requires a biomarker miRNA-antimiRNA complex to trigger the expression of a marker protein, which could be easily measured. The developed switches may be embedded in a composite biosensor to yield a paper-based device for detecting MDD.

<https://2022.igem.wiki/icjfls>

ICT-Mumbai

Project Title: Construction of a Standard BioBrick Assembly for the 5' UTR

 Booth: Foundational Advance Village, A-7

 Village Presentation: October 26, 13:00-13:15 CEST, Plaza 1

 Judging Session: October 27, 9:30-10:00 CEST, Room J12

The 5' untranslated regions of the mRNA upstream of the coding sequence are retained post-mRNA splicing and can form secondary structures that can further form stem-loops, pseudoknots, and other motifs, which can influence translation, transcription, frequency of translation initiation, elongation speed, mRNA half-life and folding of nascent proteins. In the iGEM Part Registry, we have the BioBrick constructs of promoters, ribosome binding sites, protein-coding sequences, terminators, but not the 5'UTR. We are attempting to optimize the 5'UTR sequences and make them available as a BioBrick sequence to enhance the translation initiation further. We are using E. coli as a chassis with marker proteins and correlating their expression with OSTIR predictions, structural predictions of NUPACK and a neural network to construct a set of UTR sequences which would be tested in the wet lab. Finally, these sequences could be used further understand gene expression and potentially fine tune biotechnology processes.

<https://2022.igem.wiki/ict-mumbai>

IISc-Bengaluru

Project Title: Halocleen- Bioengineering *Pseudomonas putida* to degrade halocarbon-based refrigerants

 Booth: Climate Crisis Village, G-7

 Village Presentation: October 27, 13:30-13:45 CEST, Plaza 4

 Judging Session: October 26, 10:00-10:30 CEST, Room J14

Refrigerants are key drivers of a lot of essential technologies, domestic as well as industrial. Halocarbons which include CFCs, HCFCs, and HFCs, serve more than 80% of our current refrigerant needs. Contrary to their role in cooling, halocarbons are one of the leading causes of global warming, in addition to ozone depletion. As we are shifting slowly towards greener cooling technologies, we are rendering tons and tons of halocarbons obsolete every year. If left untreated, their emissions can destroy the ecosystem in no time. IISc-Bengaluru aims to develop a sustainable system that can process halocarbons on a large scale. We are incorporating enzyme systems that can degrade most of these gases through a sequential anaerobic-aerobic pathway into the industrial workhorse, *Pseudomonas putida*. To deliver our remedy to the world, we are designing a cost-efficient bioreactor. With Halocleen, we want to contribute towards preserving the environment for generations to come!

<https://2022.igem.wiki/iisc-bengaluru>

IISER-Pune-India

Project Title: Hydrazome—reducing waterlogging-based stress responses in plants through hypoxia-induced breakdown of ACC

 Booth: Food & Nutrition Village, E-7

 Village Presentation: October 27, 13:15-13:30 CEST, Plaza 3

 Judging Session: October 26, 13:30-14:00 CEST, Room J13

12% of the world's arable land is waterlogged frequently, leading to approximately 20% crop yield reduction. Global warming causes waterlogging to be even more unpredictable in its nature, making it troublesome to solve. Waterlogging is excessive accumulation of water in the plant rhizosphere, negatively affecting plant and soil health. In plants, waterlogged soil causes exaggerated stress responses, releasing harmful amounts of ethylene. Hydrazome is a biofertiliser containing an engineered nitrogen-fixing, plant growth-promoting soil bacterium. We will be introducing the *acdS* gene to break down ACC in the soil before it is taken up by the plant and converted to harmful ethylene. The *acdS* gene will be in effect only during waterlogging, when the hypoxic conditions of the soil activate our hypoxia-induced promoter. We will also be upregulating the production of exopolysaccharides to absorb water, nutrients, and promote soil aggregation. Hydrazome will aid crops throughout their life, with or without waterlogging.

<https://2022.igem.wiki/iiser-pune-india>

IISER-Pune2_India

Project Title: AbDEN: Engineered antibody fragments against Dengue



Booth: Therapeutics Village, D-8



Village Presentation: October 26, 17:30-17:45 CEST, Plaza 2



Judging Session: October 27, 14:00-14:30 CEST, Room J4

Dengue fever is the most widely spread mosquito-borne viral disease that affects millions every year. Despite its devastating effects, no true therapeutic exists against it yet. We used synthetic biology and antibody engineering to address the issue, taking care of the problem of antibody-dependent enhancement (ADE), a pitfall that often causes dengue antibody therapeutics to fail. We designed an engineered antibody fragment that checks all boxes of an ideal therapeutic against Dengue: pan-neutralizing, potent, does not cause ADE, has adequate half-life and is cheap. Our in-silico molecular dynamics simulations helped us probe the ideal geometry, stability and functionality of the drug. In the lab, we further characterized its properties and established an optimal production system using the SHuffle strain of E. coli. Since Dengue is a major issue in India, we made sure to reach out to all possible stakeholders in this endeavor. Their inputs shaped our approach immensely.

<https://2022.igem.wiki/iiser-pune2-india>

IISER-Tirupati_India

Project Title: AptaSteles: A novel aptamer-based diagnostic kit for Polycystic ovarian syndrome (PCOS) or Stein Leventhal Syndrome



Booth: Diagnostics Village, F-6



Village Presentation: October 27, 17:15-17:30 CEST, Plaza 4



Judging Session: October 26, 13:30-14:00 CEST, Room J11

The prevalence of Polycystic Ovarian Syndrome has risen drastically in the past few years due to lifestyle shifts. The syndrome's lack of accurate diagnosis makes people susceptible to chronic metabolic and cardiovascular ailments. Our project AptaSteles aims to make a better diagnosis method for PCOS. The microfluidic chip in our kit would detect miRNAs (using the FASTmiR approach), proteins and hormones (using the dual-aptamer approach) in a patient's blood to cover a broad range of PCOS symptoms. Keeping in mind the low concentration of miRNAs in the blood samples, an amplification technique has also been incorporated into the kit. Once detected, the various combinations of biomarkers would give us a fluorescent readout, which can be used for further treatment. We have been in constant touch with our stakeholders, whose valuable inputs helped us modulate our project. We aim to make the process of PCOS diagnosis accurate, efficient, private and secure.

<https://2022.igem.wiki/iiser-tirupati-india>

IISER_Berhampur

Project Title: Development of an Aptamer-based Solution to detect Uropathogenic Bacteria at the Point-of-Care

 Booth: Diagnostics Village, F-5

 Village Presentation: October 26, 17:30-17:45 CEST, Plaza 4

 Judging Session: October 27, 13:30-14:00 CEST, Room J10

Urinary Tract Infections (UTIs) are the third most prevalent bacterial infection in India and the second most diagnosed infectious disease worldwide. Urinary Tract Infections often, asymptomatic, complicate into sepsis, benign prostatic hyperplasia and chronic infections affecting organs of the Urinary Tract, like the kidneys. Chronic UTI leads to frequent recurrences, antibiotic resistance, and kidney infections. Current diagnosis methods include antibody-based testing which requires technical expertise, laboratory conditions and cold chains. This is a time consuming procedure and has limited availability at the point of care. We aim to develop a diagnostic kit with a multiplex aptamer-based solution to detect uropathogenic bacteria at the point-of-care. This will provide a multifactorial advantage that provides rapid, novel, cost-effective and precise results without the application of refrigerated infrastructures, which is beneficial for economically weaker sections of the demography.

<https://2022.igem.wiki/iiser-berhampur>

IISER_Bhopal

Project Title: Decomposition of crop residue using genetically engineered bacteria and its conversion into bioplastic

 Booth: Environment Village, I-10

 Village Presentation: October 26, 10:00-10:15 CEST, Plaza 5

 Judging Session: October 27, 13:30-14:00 CEST, Room J7

Crop residue left in agricultural fields after harvest is known as stubble. Farmers need to get rid of the stubble left in the field before they can sow again. One of the most common methods used by farmers in India to get rid of stubble is by burning them. Stubble-burning causes a lot of problems, including air pollution, respiratory health issues, loss of biodiversity, and depletion of soil fertility. Burning the lignocellulosic biomass also results in the loss of a potential renewable resource that can be converted into various beneficial products. Here we have genetically engineered bacteria that can synthesize and exude enzymes which decompose lignocellulosic biomass. Additionally, we have designed a method for extraction of vanillin from decomposed stubble, followed by its conversion into bioplastic. Our project fosters sustainable stubble management that can provide alternatives for two major environmental hazards: stubble burning and non-degradable plastic waste.

<https://2022.igem.wiki/iiser-bhopal>

IISER_Mohali

Project Title: NeuraSyn - Neural Chip-based Simultaneous Microbial detection using Aptamers

-  Booth: Foundational Advance Village, A-8
-  Village Presentation: October 27, 13:30-13:45 CEST, Plaza 1
-  Judging Session: October 26, 15:00-15:30 CEST, Room J12

Research in biocomputation has gained tremendous relevance due to its versatility, sustainability, and superior performance. In this regard, neurons, entities that power thinking and learning, have a lot to offer. Neural networks have been shown to “learn,” adapt and perform complex computations similar to and even better than conventional systems. We have created neural chips using N2a and SH-SY5Y cell lines that can be trained, following Hebbian learning principle, to compute and make decisions. The working of the chip was demonstrated in the detection of three microbes - bacteria *E. coli*, *S. typhimurium*, and fungus *Penicillium*. We have designed a platform that contains three specific aptamers against the three microorganisms. There is an electrical impedance change when aptamers bind to their respective targets. This impedance change (in the form of electrical current) is relayed to the neural chip that identifies the microbes (out of the three) present in the sample.

<https://2022.igem.wiki/iiser-mohali>

IISER_TVM

Project Title: Duonco: A dual nanovesicle drug delivery system targeting breast cancer

-  Booth: Therapeutics Village, D-7
-  Village Presentation: October 26, 17:15-17:30 CEST, Plaza 2
-  Judging Session: October 27, 12:30-13:00 CEST, Room J4

Poor specificity is a fundamental issue with contemporary cancer drug therapy, necessitating improved alternatives. We have conceptualized and developed Duonco, a dual nanovesicle drug delivery system to address breast cancer, a growing concern in our community. Duonco targets HER2 and CX3CR1, two cell surface markers over-expressed in HER2+ breast cancer. We bioengineered *E. coli* to produce two distinct outer membrane vesicles (OMVs) populations, to selectively deliver chemotherapeutic prodrugs and their cognate enzymes, respectively, into tumour cells. This system is developed such that it functions analogous to an AND gate, where the drug is only activated in cells that overexpress both markers, and remains inactivated or undelivered in normal cells. Using hypervesiculating strains of *E. coli*, we have generated OMVs expressing anti-HER2 or anti-CX3CR1 affinity proteins on their surface and characterized them. We propose that such an adaptable system has immense potential for cell-specific targeting as well as in personalized medicine.

<https://2022.igem.wiki/iiser-tvm>

IIT-Delhi

Project Title: LEADer: Bacterial Biosorbant for Lead Recovery and Whole-Cell Oscillatory Biosensor



Booth: Environment Village, I-11



Village Presentation: October 26, 10:15-10:30 CEST, Plaza 5



Judging Session: October 27, 10:00-10:30 CEST, Room J7

According to UNICEF, a third of the world's children are affected by lead poisoning, a challenge that may even prove to be fatal. Exposure to lead can be via contaminated air, water, food, and consumer products, which makes assessment and monitoring of lead contamination extremely crucial. We comprehensively solve this problem by addressing two needs - detection and recovery. At the low lead concentrations found in groundwater or even wastewater, current recovery methods are inefficient and uneconomical. We perform a comparative study on multiple lead-binding proteins - PbrR, its metal-binding domain and PbrR691 - by expressing them on the surface of Escherichia coli to develop a bacterial biosorbant for lead recovery with the highest degree of cell-surface display, affinity to lead and specificity. Lead, highly recyclable, can be desorbed from the surface for further use, generating value. We are also developing an oscillatory frequency-based whole-cell biosensor for efficient lead detection.

<https://2022.igem.wiki/iit-delhi>

IIT_Roorkee

Project Title: CRISPRLY



Booth: Diagnostics Village, F-7



Village Presentation: October 26, 17:45-18:00 CEST, Plaza 4



Judging Session: October 27, 14:30-15:00 CEST, Room J10

Cervical Cancer, despite being one of the most preventable cancers if detected in early stages, is still the fourth-most common cause of death from cancer in women. Prevention of Cervical Cancer is very dependent on early detection of the Human Papillomavirus, which virtually causes 100% of the cases. This can be attributed to the lack of a national HPV screening programme and public awareness in rural areas. Available tests are also reliant on expensive equipment that requires trained personnel to results. Detection of the HPV using a simple-and-rapid method is extremely important to take appropriate action against cervical cancer, particularly in areas where healthcare is inaccessible. Our project is a kit for detecting the most oncogenic strain of Human Papillomavirus using the CRISPR Cas12a system producing a visual readout on a lateral flow assay. Our focus is restructuring our healthcare systems to attend to the needs of rural women.

<https://2022.igem.wiki/iit-roorkee>

Imperial_College_London

Project Title: Sporadicate: a broad-spectrum biofungicide based on *Bacillus subtilis* spores

-  Booth: Food & Nutrition Village, E-8
-  Village Presentation: October 27, 14:00-14:15 CEST, Plaza 3
-  Judging Session: October 26, 9:30-10:00 CEST, Room J13

Over the next 35 years, the world's growing population will demand more food than has ever been produced in human history. A major source of yield loss are fungal pathogens, constituting 75% of all plant diseases. Current solutions are falling short, with farmers relying on unselective spraying of fungicides due to delayed emergence of visible symptoms, often missing the early stages of infection when treatment is most effective. We propose Sporadicate, a broad-spectrum biofungicide based on *Bacillus subtilis* spores that eliminates the time-lag between diagnosis and treatment. Our bacterial spores are engineered to display chitinase enzymes on the surface, which degrade the cell wall of pathogenic fungi. This generates a biomarker that can be detected via a modified receptor – enabling spores to selectively germinate into vegetative cells exhibiting biocontrol properties. Given the innate durable properties of spores, our system would be robust, easily storable, widely applicable, and cost-effective.

<https://2022.igem.wiki/imperial-college-london>

INSA_Lyon1

Project Title: Lighting up the future of agriculture: FIAT LUX, a biosynthetic tool to track bacteria

-  Booth: Food & Nutrition Village, E-9
-  Village Presentation: October 27, 14:15-14:30 CEST, Plaza 3
-  Judging Session: October 26, 15:00-15:30 CEST, Room J13

Food security is an immense challenge nowadays, particularly as crops are further endangered each year by new bacterial phytopathogens. The current tools to study pathogens are not efficient. Our project, FIAT LUX, based on an improved version of the luxCDABE operon ilux, aims at simplifying the use of luminescence as a reporter gene, notably for in vivo infection studies. It enables the tracking of luminescent bacterial spread in tissues, without having to sample or kill the host. Our team has focused the proof of concept on the soft rot disease in potatoes, caused by *Dickeya*. FIAT LUX is a promising tool to better understand this infection, helping to combat it and would contribute towards building more sustainable agricultural practices. After iGEM, we will extend the use of FIAT LUX to as many host-pathogen relationships as possible, and it may also be useful in the future to study beneficial symbiotic interactions.

<https://2022.igem.wiki/insa-lyon1>

Ionis_Paris

Project Title: StarchLight: generating and storing energy in a bacterial fuel cell powered by brewers' spent grain

 Booth: Climate Crisis Village, G-8

 Village Presentation: October 26, 10:45-11:00 CEST, Plaza 4

 Judging Session: October 27, 16:00-16:30 CEST, Room J14

StarchLight aims at upgrading brewers' spent grain, a largely available waste produced by the beer brewing industry, into a power source. The innovative microbial fuel cell goal is to both store energy and to produce electricity by using spent grain as its sole power source. Eventually, StarchLight wants to provide brewers a solution to reduce their carbon footprint while getting rid of the unwanted waste they generate. The StarchLight device relies on two bacterial strains: *Escherichia coli* (*E. coli*) and *Shewanella oneidensis* (*S. oneidensis*). To use spent grain as a power source, we designed a system based around the genetic engineering of *E. coli*: it degrades the starch in spent grain into lactate, stores it intracellularly as polylactate, and delivers lactate on-demand to *S. oneidensis*. *S. oneidensis* can then use the lactate to produce electricity by means of chain electron transfers in its inner membrane.

<https://2022.igem.wiki/ionis-paris>

ITESO_Guadalajara

Project Title: BerryVax: Taking biocontrol in berry crops to the next level

 Booth: Food & Nutrition Village, E-10

 Village Presentation: October 27, 9:15-9:30 CEST, Plaza 3

 Judging Session: October 26, 16:30-17:00 CEST, Room J13

Berries are fruits rich in bioactive phytochemicals that provide us health benefits. Mexico is one of the most important berry exporters in the world. Our state, Jalisco, is accountable for half of these exports, employing more than 500,000 people. However, fungal pests have been causing up to 40% of losses in harvests because of the difficulties to identify them at an early stage. We designed BerryVax, a preventive and corrective biocontrol solution with a self-manageable system. In it, we propose to genetically modify *Bacillus subtilis* to overexpress surfactin, activating the plant's defense system while improving water absorption and fruit quality. Furthermore, the bacteria will be able to produce chitinase to degrade the fungal wall as a corrective measure when fusaric acid (produced by pathogenic *Fusarium oxysporum*) is present, ensuring that the corrective mode will be activated only when needed. BerryVax, innovating in Mexican agriculture one berry at a time.

<https://2022.igem.wiki/iteso-guadalajara>

IvyMaker-China

Project Title: The Fully-armed PET Buster

 Remote Team Village

 Judging Session: October 27, 15:30-16:00 CEST, Room J2

Based on previous studies, we developed a surface display system for *Candida tropicalis*. We used the system to display PETase and MHETase separately, and found that both enzymes were active and had obvious degradation effects on PET film and powder. To increase the effectiveness and convenience of the degradation of PET plastic, we plan to display MHETase and PETase at the same time. Hence, our goal is to develop a self-assembled multi-enzyme display system of *Candida tropicalis*. To attain co-display, we combined our display system with two selective protein binding systems, SpyTag-SpyCatcher and SnoopTag-SnoopCatcher. To improve PET plastic degradation efficiency, we imitated cellulosome and controlled the ratio and display sequence of PETase and MHETase enzymes. Additionally, the surface display multi-enzyme self-assembly system that we developed can be applied to fields other than plastic degradation.

<https://2022.igem.wiki/ivymaker-china>

Jiangnan-China

Project Title: Construction of acid-tolerant *Escherichia coli* chassis cells based on membrane key factor CFAs from extremophiles *Acidithiobacillus caldus*

 Remote Team Village

 Judging Session: October 26, 9:30-10:00 CEST, Room J12

Acid stress conditions are frequently encountered during industrial fermentation as a consequence of the accumulation of acidic metabolites, which calls for more efficient and cost-effective acid-tolerant strains. However, bioleaching microbes have such superb acid resistance that they can thrive in the extremely acidic environment of bioleaching solution. *Acidithiobacillus caldus* shows the most outstanding ability to resist acid stress. Through a series of literature review and previous experiment, we studied cyclopropane fatty acid synthase (CFAs) gene, the core acid-resistant element of *A. caldus*, and designed a promoter modification strategy, which was successfully applied in *E. coli* to improve the acid resistance of chassis cells. In addition, our Hidden Markov Model (HMM) can help to identify 38 dependent promoters in different strains.

<https://2022.igem.wiki/jiangnan-china>

Jiangsu_United

Project Title: Targeting FoxO1 for anti-T2DM drug development

 Remote Team Village

 Judging Session: October 26, 13:30-14:00 CEST, Room J4

Approximately 537 million people around the world suffer from diabetes, while 90% of which are type 2, such disease affects the body's response or production of insulin, thus limiting one's capability of controlling blood sugar levels. Current solutions to this potentially fatal condition are accepted as commonplace in their treatment. However, this inaccessibility to life-saving medicine prompted us to find an alternative to treating symptoms of type 2 diabetes. We constructed a drug screening platform targeting FoxO1, a primary controller for glucose production. And it was successfully screened that compound 355 has the activity of inhibiting the FoxO1 gene. This compound provides a root solution for diabetes, lowering glucose levels in the blood without the need for insulin. We aim for this treatment to be a tablet-pill-based medicine, and more affordable to the general masses. Key Words: FoxO1, diabetes

<https://2022.igem.wiki/jiangsu-united>

Jilin_China

Project Title: Coleader.zip——Heavy metal treatment of copper, lead and zinc

 Remote Team Village

 Judging Session: October 27, 15:30-16:00 CEST, Room J6

Heavy metal pollution is a serious environmental problem in both developed and developing countries. The existing chemical degradation methods have problems such as high cost, complicated process, low recovery efficiency, and severe secondary pollution. In 2022, Jilin China team is trying to build a new type of engineered bacteria for the treatment of copper, lead and zinc ions, which integrates heavy metal ion sensing and adsorption. The specific promoter can effectively sense the presence of heavy metal ion, and then activate the downstream fused expression of the metal binding protein and outer membrane protein on the cell surface. And the expression is to achieve the purpose of adsorbing heavy metal ions. Combined with our practical design, our whole system is expected to solve the increasingly serious heavy metal ion pollution.

<https://2022.igem.wiki/jilin-china>

JLU_China

Project Title: OlfacMood

 Remote Team Village

 Judging Session: October 26, 15:30-16:00 CEST, Room J10

Facing the negative emotions of sadness and anxiety, our project aims to combine Artificial Intelligence with synthetic biotechnology to construct an emotion recognition and regulation device. In the recognition part, we use Convolutional Neural Network for facial emotion recognition, smart bracelet to record heart rate, and finally multimodal emotion judgment through software. In the regulation part, we focus on the sadness emotion, identify the judgment and start the blue light signal, thus stimulating *E. coli* EL222 photosensitive protein, initiating KdcA and Adh1 to catalyze the synthesis of PPA into phenylethyl alcohol, and releasing it through the aromatherapy system to achieve the emotional calming. Based on the overall closed loop, we further explored more extensions of light sources and emotion regulation, such as anxiety recognition into red light initiation and release of linalool regulation. Also extended such as music, light multi-sensory functions, in order to better assist the odor emotion regulation.

<https://2022.igem.wiki/jlu-china>

KAIT_JAPAN

Project Title: Effective Biosynthesis of Cannabidiol via *Saccharomyces cerevisiae*

 Remote Team Village

 Judging Session: October 27, 12:30-13:00 CEST, Room J9

Stress can affect all parts of our life, including our emotions, behaviors, and physical health. These symptoms can be eased by using a substance called CBD. CBD is known to have relaxing and anti-inflammatory effects. CBD is extracted from hemp. The methods of extraction are complicated and costly. Therefore, CBD infused products are expensive. Our main goal is to produce CBD efficiently via *Saccharomyces cerevisiae*. The production of CBD requires two substances. These substances are, geranylgeranyl-PP(GPP) and olivetolic acid (OA). During the production of GPP, two rate-limiting enzymes are present. Therefore, by overexpressing these enzymes, we expect an increase in the production yield. OA should be added to the culture medium to produce CBD. However, OA is expensive. Therefore, we thought of producing OA in *S. cerevisiae*. We believe that this method of CBD production can be cost and yield effective. Therefore, making CBD infused products more affordable for consumers.

<https://2022.igem.wiki/kait-japan>

KCIS_Xiugang_Taipei

Project Title: NObesity: a Test for Local Solutions to Solve Obesity

 Remote Team Village

 Judging Session: October 26, 15:00-15:30 CEST, Room J3

Obesity is a severe threat to the world with the rocketing obese population. Our project aims to reduce obesity rates by identifying supplements that possess environmental-stress-related-phenotype-mitigating properties with a similar model as viability assay for cancer drug testing research using engineered yeast with overexpression SNF1(the homologous yeast gene of AMPK, a metabolism sensor gene in humans). We tested the effectiveness of our product with supplements from local products in Taiwan proven to have anti-obesity and metabolism-boosting properties such as green tea and brown algae, containing Catechins and Fucoxanthin respectively. With our design, possible synergistic effects between overexpression SNF1 and nutrient samples could mitigate the environmental-stress-related-phenotypes more significantly, allowing us to effectively test the possible environmental-stress-related-phenotype-mitigating properties of supplements.

<https://2022.igem.wiki/kcis-xiugang-taipei>

KCL_UK

Project Title: Engineering Escherichia coli to improve production of pterostilbene for patients with early stage Alzheimer's disease

 Booth: Therapeutics Village, D-9

 Village Presentation: October 26, 17:45-18:00 CEST, Plaza 2

 Judging Session: October 27, 15:00-15:30 CEST, Room J5

Over 55 million people worldwide are currently living with dementia, of which approximately 60-80% are Alzheimer's disease (AD) patients. By 2050, this number will increase to nearly 155 million. The polyphenol pterostilbene is known to modulate one of the main hallmarks of AD by targeting the NLRP3/caspase-1 neuroinflammatory pathway. Currently, pterostilbene is purified from plants at concentrations too low for wide scale therapeutic use. Therefore, at Symemco Therapeutics we have engineered E. coli to improve the production of pterostilbene to be used in mild to moderate stage AD. By using four key enzymes involved in pterostilbene production: tyrosine ammonia-lyase from Rhodotorula glutinis, 4-coumarate:CoA ligase from Arabidopsis thaliana, stilbene synthase and resveratrol O-methyltransferase both from Vitis vinifera, we have created a system with the potential to produce pterostilbene at concentrations necessary for AD therapies. Thus, our improved pterostilbene production method has the capacity to help AD patients worldwide.

<https://2022.igem.wiki/kcl-uk>

KEYSTONE

Project Title: Aromata

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J2

Body malodor is a social issue that bothers almost every individual, causing social embarrassment. After investigation, we have realized that *Staphylococcus* spp. are major cause of malodor. Therefore, team KEYSTONE 2022 aims to create a bio-deodorant that synthesizes antimicrobial lipopeptide fengycin, which can inhibits the quorum sensing system of *Staphylococcus aureus*, and a sandalwood perfume developed from santalene. We knocked-in the *sfp* and *degQ* gene into *Bacillus subtilis* to produce the fengycin. We also heterologously expressed the MVA pathway, ERG20, and santalene synthase in engineered *E. coli* to produce santalene. Our product, Aromata, has the hardware that guarantees a sustainable development by reducing transportation-emissions, comparing to the current single-used products. Hence, Aromata can provide a pleasing scent, while avoiding risks like chemical allergies and reducing negative environmental impacts.

<https://2022.igem.wiki/keystone>

Korea_HS

Project Title: Novel Digital Data Storage Model: TFAM-DNA Packing Architectural Role for the Stability of DNA

 Booth: High School Village, C-8

 Village Presentation: October 27, 17:45-18:00 CEST, Plaza 3

 Judging Session: October 26, 14:00-14:30 CEST, Room J2

Due to the rapid pace of data production, the demand for data storage is increasing. Considering the limitations of current mediums, an alternative method for data storage has been proposed: storing data in DNA which is more cost and space efficient. Binary data is encoded into nucleotide bases. However, DNA, when exposed to stress factors deforms, leading to lost or altered data in DNA; thus, methods to ensure the stability of DNA are critical to implementing DNA data storage. We hypothesized that forming Transcription Factor A Mitochondria (TFAM)-DNA complex in an aqueous solution supports DNA stability during data storage and retrieval. TFAM preserves DNA inside the mitochondria, acting as an adequate stabilizer. The TFAM-DNA complex was created with replicated human lung cDNA and purified TFAM protein. This complex was able to maintain stability in conditions with various stress factors, suggesting that DNA can be a viable method to store data.

<https://2022.igem.wiki/korea-hs>

KUAS_Korea

Project Title: ABC biofilter: Algal Bloom Cleaning & Anammox Based on Cell free biofilter

 Remote Team Village

 Judging Session: October 26, 13:30-14:00 CEST, Room J7

We observed the damage of river ecosystems caused by algae bloom in Republic of Korea this year, and community members suffered from algae bloom, with the odor of rivers and microcystin detected in tap water and various crops. Therefore, we have devised ABC biofilter, which solves this problem while also considering bio safety. Because anammox bacteria are difficult to cultivate, we produce enzymes necessary for the anammox process through cell free system, produce the biofilter with that enzymes which convert NO_2^- and NH_4^+ into N_2 and prevent eutrophication which is the main cause of algae bloom. Also, we use cell free system to produce Superoxide dismutase (SOD) which produce H_2O_2 that remove green algae. Through this, we will prevent the algae bloom and remove green algae to maintain a healthy ecosystem of rivers and help people around the world from being harmed by algae bloom.

<https://2022.igem.wiki/kuas-korea>

KU_Leuven

Project Title: Dose-dependent colorectal cancer biosensor and therapy delivery system

 Booth: Foundational Advance Village, A-9

 Village Presentation: October 26, 13:15-13:30 CEST, Plaza 1

 Judging Session: October 27, 14:30-15:00 CEST, Room J11

Colorectal cancer is the second deadliest cancer in women and men worldwide. In Belgium, it persists as a serious health problem. However, screening and therapy still require invasive methods and lack specificity. Biosensors have been developed before but the tunability is mostly low, despite being fundamental for a broad application. The safety of biosensors also remains a hurdle to entering the clinics. Therefore, our goal is to develop a dose-dependent biosensor using NarX-NarL two-component nitrate sensing system and a naringenin responsive promoter in *E. coli* as a proof-of-concept. Temperature-sensitive riboswitches and a type II toxin-antitoxin system are used to establish biocontainment. To support and guide biosensor development, modeling is done to predict the threshold needed. The final goal is to combine these two genetic circuits in *Lactobacillus* spp., which is part of the gut microbiome, and to replace fluorescence with drug allowing therapy with fewer side effects.

<https://2022.igem.wiki/ku-leuven>

Lambert_GA

Project Title: CADlock: Early Screening for Coronary Artery Disease by Detecting MicroRNAs Through the Rolling Circle Approach

-  Booth: High School Village, C-9
-  Village Presentation: October 26, 17:45-18:00 CEST, Plaza 3
-  Judging Session: October 27, 16:00-16:30 CEST, Room J2

Coronary artery disease (CAD) accounts for 17.8 million deaths worldwide annually, with especially high rates in the southeastern United States. Current detection methods are costly and invasive, making them inaccessible to many. CADlock utilizes microRNA biomarkers to provide a novel screening tool for CAD. Our project uses padlock probes with rolling circle amplification to quantify microRNAs via fluorescence. Furthermore, we developed ProbeBuilder, a padlock probe generating software based on microRNA input, and Micro-Q, a portable fluorescent quantifier that allows for point-of-care screening for CAD. Current microRNA research in CAD is limited, which led us to offer CADlock as a tool for researchers to add miRNA characterization. We contacted stakeholders, including the American Heart Association, Georgia Office of Cardiac Health, cardiologists, researchers, and patients to gain feedback on the impact of our project. CADlock provides an additional detection method for researchers and physicians, facilitating a point-of-care screening procedure for CAD.

<https://2022.igem.wiki/lambert-ga>

Latvia-Riga

Project Title: RhodoCrocini - First Full Biosynthetic Crocin Pathway in Yeast

-  Booth: Biomanufacturing Village, B-13
-  Village Presentation: October 27, 14:15-14:30 CEST, Plaza 1
-  Judging Session: October 26, 12:30-13:00 CEST, Room J9

Crocini is a carotenoid compound found in *Crocus sativus* - the most expensive spice in the world. It has been shown to exhibit antioxidant, neuroprotective, as well as antiproliferative properties in cancer cells. Saffron requires specific climate conditions to grow and thrive. Additionally, the yield of crocini via extraction from saffron is rather low and the process is costly and labor consuming. To overcome these issues, we have decided to build upon previous iGEM projects and focus on engineering the full crocini biosynthesis pathway in the unconventional yeast *Rhodotorula toruloides*.

<https://2022.igem.wiki/latvia-riga>

Leiden

Project Title: Binanox: A microbial factory for the production of bimetallic nanoparticles, suitable for photothermal cancer therapy

 Booth: Biomanufacturing Village, B-14

 Village Presentation: October 26, 14:45-15:00 CEST, Plaza 1

 Judging Session: October 27, 13:00-13:30 CEST, Room J9

Yearly, over 900,000 cases of head and neck cancer are diagnosed worldwide. A novel and promising treatment for these cancers is called photothermal therapy (PTT). PTT utilizes nanoparticles that convert light at 800 nm from a laser to heat, which kills the tumor cells. Biological production of nanoparticles for PTT is superior to other synthesis methods. Our team developed a microbial factory to produce these nanoparticles by overexpressing the genes *napA*, *copA*, *cueO*, and *melA* in *Escherichia coli* BL21. These strains' supernatants were used to reduce silver and gold ions and form bimetallic nanoparticles. The nanoparticles were analyzed using spectrophotometry and Transmission Electron Microscopy (TEM). We employed a statistical model called Box-Behnken Design to optimize absorbance at 800 nm. The produced nanoparticles had an urchin-like shape and diameter of 50-100 nm, which is ideal for PTT, and were able to convert 800 nm light from a laser into heat.

<https://2022.igem.wiki/leiden>

Lethbridge

Project Title: CyaNoMore

 Booth: Environment Village, I-12

 Village Presentation: October 26, 10:30-10:45 CEST, Plaza 5

 Judging Session: October 27, 15:00-15:30 CEST, Room J6

Cyanobacteria, also called blue-green algae, are a group of photosynthetic prokaryotes that form blooms in bodies of water. In Alberta, many lakes are close to farms whose operations release nutrients such as phosphorus, which contribute to the proliferation of cyanobacteria. Overgrowth of harmful algal blooms (HAB) causes damage to aquatic ecosystems, primarily by oxygen consumption and cyanotoxin release during HAB decay. *Microcystis aeruginosa* (MC) produces the cyanotoxin microcystin-LR (MC-LR), which is toxic to animals if consumed. Chemical treatments, such as copper sulfate, cause off-target effects to lake organisms. Our objective is to utilize a CRISPR-Cas13a target-specific system contained in a phage-like particle to combat HAB. This system will control overgrowth of cyanoblooms without off-target effects. Furthermore, incorporating the microcystin-degrading enzyme *mlrA* in our genetic construct mitigates the dangers of MC-LR by peptide linearization. Overall, this provides a treatment method that tackles the harm due to cyanobacteria in aquatic ecosystems.

<https://2022.igem.wiki/lethbridge>

Lethbridge_HS

Project Title: Dia-Beatable: Self-amplifying RNA as a medium for treatment of diabetes

 Booth: High School Village, C-10

 Village Presentation: October 27, 15:15-15:30 CEST, Plaza 3

 Judging Session: October 26, 16:30-17:00 CEST, Room J1

Diabetes affects millions of people across the globe. Current treatments for Type I diabetes are routine insulin injections or islet cell transplants. Our proposed project, Dia-Beatable, utilizes self-amplifying messenger RNA (sa-mRNA) to produce insulin. The self-replicating nature will allow for fewer injections over longer periods of time. The proposed RNA construct would be self-regulating as we have incorporated an insulin-binding RNA aptamer as a control mechanism. This creates a negative feedback loop where the RNA aptamer acts a switch that terminates the translation process when insulin levels are high. Dia-Beatable also has potential uses in veterinary care and could be used to treat diabetes in pets as well. We hope that with our proposed treatment, patients and caregivers can minimize the strenuous maintenance process required when dealing with Type I diabetes.

<https://2022.igem.wiki/lethbridge-hs>

Linkoping_Sweden

Project Title: AptaTear - A new approach against Neurodegeneration

 Booth: Diagnostics Village, F-8

 Village Presentation: October 27, 17:30-17:45 CEST, Plaza 4

 Judging Session: October 26, 10:00-10:30 CEST, Room J10

Mild traumatic injury, mTBI, is a neurological disorder that causes impaired cognitive function and affects a person's ability to function independently. More than 100'000 people are affected in Sweden and millions of others worldwide. mTBI can occur at any age due to falls, sport injuries etc. The disease is characterised by increased levels of tau proteins. There is currently a gap in early detection of neurodegeneration related to mTBIs. By using our biosensor in the future, a quick, non-invasive first screening can be done to understand the severeness of the diseases. AptaTear could change the way we detect neurodegenerative diseases as we use tears as our samples rather than spinal fluid. We hope that this would one day reduce the risk of developing a neurodegenerative disease with high severeness and allow patients to maintain most of their life quality.

<https://2022.igem.wiki/linkoping-sweden>

LINKS_China

Project Title: UV-PRISMA: UltraViolet radiation Protection and skin Repairing by Innovative Sunscreen with Mycosporine-like Amino acids

 Remote Team Village

 Judging Session: October 26, 10:00-10:30 CEST, Room J3

UV-radiation damages our skin, causing sunburn, inflammation and skin aging. Mycosporine-like amino acids (MAAs) are natural products produced by various marine organisms such as cyanobacteria and algae, able to absorb UV radiation. However, the low rate of MAA production limits the potential of commercializing MAAs as sunscreen ingredient. This year, LINKS_China engineered *Saccharomyces cerevisiae* to produce three MAAs—shinorine, porphyra-334 and palythine—and another UV-absorbing molecule, gadusol. We incorporated enzymes from *Nostoc punctiforme*, *Nostoc linckia* and *Actinosynnema mirum* to structure the optimal pathway, and introduced the xylose metabolism pathway to increase yield. These yeast products has successfully absorbed UV radiation, covering most UVA and UVB rays. For skin repairing, we introduced superoxide dismutase and catalase to remove reactive oxidative species produced in the skin. UV-PRISMA, our MAA-based sunscreen product, will bring a healthier, gentler, and more environmentally friendly way of UV protection.

<https://2022.igem.wiki/links-china>

Lund

Project Title: Beecilli: Glyphosate-degrading probiotic for honey bees

 Booth: Conservation Village, H-2

 Village Presentation: October 27, 17:15-17:30 CEST, Plaza 5

 Judging Session: October 26, 12:30-13:00 CEST, Room J14

More than 70% of crop species are pollinated by bees. However, beekeepers in Europe and other regions worldwide have been reporting severe colony losses over the past decades. Pesticides are suspected to be one of the main contributors. One example is glyphosate which has several sublethal effects on honey bees including weakening the immune system and a decrease in brood survival. For Beecilli, we designed a probiotic that heterogeneously expresses glyphosate-degrading enzymes. These proteins act on the C-P or C-N bonds of glyphosate breaking it down. By incorporating the foreign DNA into the chromosomal DNA, we provide a stable construct that does not require a constant selection pressure and thus simplifies potential real-life applications.

<https://2022.igem.wiki/lund>

LZU-CHINA

Project Title: Targeted Treatment of Colorectal Cancer with Gene-Editing Probiotics

 Remote Team Village

 Judging Session: October 26, 10:30-11:00 CEST, Room J5

Colorectal cancer (CRC) is one of the most common malignancies, according to the WHO GLOBOCAN database. Current treatments for colorectal cancer include chemotherapy, radiation therapy, immunotherapy etc. However, the biggest challenge of these therapies is the indiscriminate killing of normal cells. The environment in which tumor cells live is usually characterized by high lactate concentration, low pH and hypoxia. LZU-CHINA takes advantage of this characteristic by introducing three promoters into the probiotic, equipping the strain with an automated tumor targeting system. In order to make the system stable and enhance the specificity of the engineered microbe to kill tumor cells, we also added other genetic components including amplifying genetic logic gate, adhesion factor, killing factor and lysis factor. 2022 LZU-CHINA is dedicated to provide new approaches and ideas for cancer therapy by synthetic biology through gene circuit optimization and construction.

<https://2022.igem.wiki/lzu-china>

LZU-HS-China-A

Project Title: Cell Surface Display Showing Chitosan System Produce Chitosan Oligosaccharide

 Remote Team Village

 Judging Session: October 26, 16:00-16:30 CEST, Room J2

The reason we chose this topic is that we saw many shrimp and crab shells are wasted in our dining hall and kitchen. We believe that Chitosan oligosaccharide can do something valuable. After reading some articles, we decided to investigate the topic about converting into chitosan oligosaccharide since chitosan is insoluble in water, but chitosan oligosaccharide is soluble in water, and it maintain the value that chitosan brings. Shells will be converted into chitosan oligosaccharide. Our experiment will mainly focus on the last part of the progress. We use cell surface display to make our experiment result better. The work which changes chitosan to chitosan oligosaccharide works more efficient when it takes place on the cells surface. Chitosan oligosaccharide has a lot of values which is good for either human or animals and even plants. It can antioxidant, anti-tumor, anti-bacterial, anti-fungal, make animal bones stronger and help the growth of roots.

<https://2022.igem.wiki/lzu-hs-china-a>

LZU-HS-China-B

Project Title: Recombinant probiotics reduce alcohol-induced damage in humans

 Remote Team Village

 Judging Session: October 26, 14:00-14:30 CEST, Room J3

In our society, there is a group of people who work in the alcohol industry and have to drink alcohol every day because of their work. The excessive consumption of alcohol can cause damage to health, and coupled with the fact that companies do not provide them with certain safety measures, the health of these people is not guaranteed. *Escherichia Nissle 1917* (EcN) has been widely demonstrated to be a safe oral probiotic. In this study, we genetically modified EcN expressing the ethanol dehydrogenase gene, acetaldehyde dehydrogenase gene, NAD synthase gene, and NADH oxidase gene. By expressing the NAD synthase and NADH oxidase genes, the efficiency of ethanol dehydrogenase and acetaldehyde dehydrogenase was increased, and thus the rate of alcohol decomposition was increased. Finally, we constructed an intestinal probiotic with high efficiency in alcohol catabolism to help alcoholic beverage workers to protect their health.

<https://2022.igem.wiki/lzu-hs-china-b>

LZU-HS-China-C

Project Title: The Degradation of Sulfadiazine Using Whole-cell Biocatalysts

 Remote Team Village

 Judging Session: October 26, 9:30-10:00 CEST, Room J3

The excessive use and unregulated environmental discharge of antibiotics in poultry businesses have been a major causality behind superbugs. Our project focused on the degradation of sulfadiazine (SDZ), the most popular antibiotic used in the industry. We designed a whole cell biocatalyst that seeks to degrade SDZ through surface display technique of Lac 6, an enzyme binding to SDZ. By doing so, we wish to provide an alternative method of degrading sulfadiazine that better appeals to farmers.

<https://2022.igem.wiki/lzu-hs-china-c>

LZU-HS-China-E

Project Title: S.A.T.C Saline-alkaline Tolerant E.coli

 Remote Team Village

 Judging Session: October 27, 10:30-11:00 CEST, Room J2

Hypersaline wastewater is crushing the environment. Among various types of wastewater, water that contains Cadmium II is the most destructive one. We build special microbes that are highly saline-tolerated and capable to remove heavy-metal pollutants. We choose the biological method for filtration and use genetic methods to achieve it. Through professional experiments, we test the feasibility of our proposal. We interview specialists and exchange different ideas to improve our program's connection with society.our scheme has been recognized by experts, and we will continue to improve based on experts' suggestions in the follow-up work.

<https://2022.igem.wiki/lzu-hs-china-e>

LZU-HS-Pro-A

Project Title: Psychiatric Disorders Regulating Probiotics

 Remote Team Village

 Judging Session: October 26, 13:30-14:00 CEST, Room J1

Depression is one of the most common mental illnesses, with over 30 million patients worldwide. It causes hopelessness, or even suicidal thoughts. To help relieve depression, our team developed a probiotic to regulate depression, based on the gut-brain axis. Since it has been previously proven that 5-HTP can increase the concentration of serotine in the brain to improve mood, and GABA can block certain nerve cells to inhibit anxiety and stress, we overexpressed the TPH1 gene into E.coli Nissle 1917(EcN) to catalyze the production of tryptophan which consequently catalyzes the biopterin-dependent monooxygenation of tryptophan to 5-HTP. Meanwhile, we overexpressed the GadB gene in EcN to convert the glutamate to GABA using pyridoxal phosphate (the active form of vitamin B6) as a cofactor. To prevent genetically modified contamination, our team developed a suicide system for the strain. This probiotic has the potential to establish a more peaceful society with higher productivity.

<https://2022.igem.wiki/lzu-hs-pro-a>

LZU-HS-Pro-B

Project Title: One test per day, keep the pain away

 Remote Team Village

 Judging Session: October 26, 12:30-13:00 CEST, Room J4

Nowadays, the main method to test urine acid is through taking blood samples, which is invasive, and also inconvenient for patients. Therefore, with the knowledge of synthetic biology, our team is currently designing a non-impairment uric acid sensor that replaces blood tests with urine tests, more precisely, a uric acid test method conducted using urine collected from patients. The test consists of the following three steps. Firstly, the sensor system works as the specific genes transcribe and release signals with the detection of uric acid in the urine. Secondly, the amplification system magnifies the fluorescent signal of the engineered bacteria by compounding DNA sequence hrpRS. Thirdly, the luminosity system displays light signal that could be used to calculate the uric acid concentration. With this invention, we hope to promote a healthier and more convenient 'painless world'.

<https://2022.igem.wiki/lzu-hs-pro-b>

Makerere_Uganda

Project Title: USE OF AZADIRACHTIN FOR MALARIA PREVENTION BY REPELLING MOSQUITOES USING SOLAR-BASED DIFFUSERS

 Booth: Biomanufacturing Village, B-15

 Village Presentation: October 27, 14:30-14:45 CEST, Plaza 1

 Judging Session: October 26, 13:00-13:30 CEST, Room J9

Malaria affects the population in sub-Saharan Africa, especially children and pregnant women, resulting in high mortality rates. There have been strategies to stop malaria using treated mosquito nets. However, the endemic nature of malaria within the region increases the need for better and more effective plant-based synthetic innovations. Thus, the use of azadirachtin obtained from the neem tree has been suggested, a molecule known for its repellent properties. In this study, homologs to AiOSC1 (2,3 oxidosqualene cyclase) and AiCYP71CD2 (cytochrome oxidase) genes, identified in a study as involved in azadirachtin biosynthesis in neem, will be expressed in the yeast, *Saccharomyces cerevisiae*. The cells will be lysed and the contents purified to check for the presence of dihydroniloticin.

<https://2022.igem.wiki/makerere-uganda>

Manchester

Project Title: A bacterial companion to aid growth and lipid accumulation in microalgae

 Booth: Climate Crisis Village, G-9

 Village Presentation: October 27, 13:45-14:00 CEST, Plaza 4

 Judging Session: October 26, 17:30-18:00 CEST, Room J6

The production of renewable energy and efficient wastewater treatment are two pressing challenges globally. Our project addresses these issues. We will create an engineered bacterium that uses wastewater as a growth medium to produce and release auxin, an algal growth factor. When deployed in a co-culture system, the presence of these bacteria will allow microalgae to grow more efficiently on wastewater. Once sufficient algal biomass has been produced, the engineered bacteria can be triggered to move from an auxin-producing state to a phosphate-accumulating state, using a light-dependent genetic switch mechanism. This will lead to phosphate depletion in the medium and a transition of the microalgae from their active growth phase to a state of lipid accumulation (improved by phosphate starvation). Increased lipid accumulation can then be used to produce biodiesel. Our project could be the first step towards economically sustainable microalgal biofuel production to meet global energy demands.

<https://2022.igem.wiki/manchester>

McGill

Project Title: Engineering a Novel Metabolic Pathway in Bacteria for Reduction of Serum Cholesterol

 Booth: Food & Nutrition Village, E-11

 Village Presentation: October 27, 9:30-9:45 CEST, Plaza 3

 Judging Session: October 26, 16:00-16:30 CEST, Room J14

Despite the effectiveness of cholesterol-lowering drugs such as statins, PCSK9 inhibitors, and others, cardiovascular disease (CVD) and hypercholesterolemia remain the world's leading causes of mortality. Currently, there are limited approaches to preventing CVD caused by high cholesterol. To address this, we designed and validated a novel three-step metabolic pathway to metabolize cholesterol into coprostanol, a sterol that cannot be absorbed in the gut. We subsequently integrated this pathway in *B. subtilis*, to engineer a cholesterol-lowering probiotic able to prevent intestinal cholesterol absorption. The pathway consists of *ismA*, a hydroxysteroid dehydrogenase from the bacterium, *E. coprostanoligenes*, and two repurposed sterol-metabolizing enzymes from humans. We tested the functionality of this pathway through in vitro enzymatic assays and confirmed coprostanol formation. Altogether, we engineered and validated the necessary components for a cholesterol to coprostanol-converting *B. subtilis* probiotic bacterium as a novel cholesterol lowering probiotic aimed at preventing CVD.

<https://2022.igem.wiki/mcgill>

McMaster_A

Project Title: onCAP: Designing a novel targeted B-cell lymphoma therapeutic gene delivery platform using AAVP vectors



Booth: Therapeutics Village, D-10



Village Presentation: October 27, 9:45-10:00 CEST, Plaza 2



Judging Session: October 26, 16:00-16:30 CEST, Room J4

onCAP is a novel, phage-based cancer gene therapy using adeno-associated virus phage (AAVP) vectors to treat B-cell lymphoma. We constructed our phage combining two modified fd-tet plasmids, fMCS and f3-55nm, as well as an expression cassette engineered from the pAAV plasmid to include granzyme B and TNF- γ . This plasmid encodes for a phage displaying anti-CD22 short chain variable fragment on its viral coat, which will lead to the release of the plasmid into mammalian cells. Upon plasmid release in human cancer cells, the proteins granzyme B and TNF- γ will be expressed to induce cell death. We hypothesize that an AAVP therapeutic will show high specificity for cancerous B cells with limited off-target effects, because our target marker is primarily expressed on B cells and AAVPs are generally well-tolerated by the immune system. Our goal is to create a proof-of-concept demonstrating the potential of phage therapy in targeting aggressive B-cell cancers.

<https://2022.igem.wiki/mcmaster-a>

McMaster_Canada

Project Title: Developing a tri-input two-cell consortium bacterial biosensor risk assessment tool for major depressive disorder



Booth: Diagnostics Village, F-9



Village Presentation: October 27, 17:45-18:00 CEST, Plaza 4



Judging Session: October 26, 16:30-17:00 CEST, Room J11

Major depressive disorder (MDD) is a mood disorder that includes symptoms like persistent sadness, and lack of motivation. Currently, diagnosis for MDD includes the DSM-5 Diagnostic Criteria, however, there is a need for a risk assessment tool to complement this. Cross-sectional studies show significant differences in the gut microbiota composition between healthy individuals and MDD patients. Of particular interest are the dysregulated bacterial metabolites butyrate, GABA, butyrate, and indole, which have profound effects on the development and progression of MDD, and have a distinct metabolic signature that can be used to profile individuals as having a greater risk for MDD. As such, our team designed a two-cell consortium tri-input biosensor that can assess the levels of each metabolite independently, while also using logic gates to predict overall risk for MDD. Mathematical models of the biosensor were used to validate our system further and identify the system's sensitivity to baseline concentrations.

<https://2022.igem.wiki/mcmaster-canada>

MiamiU

Project Title: Synthesizing a SynPhage Against Antimicrobial Resistance

 Booth: Therapeutics Village, D-11

 Village Presentation: October 26, 10:00-10:15 CEST, Plaza 2

 Judging Session: October 27, 16:30-17:00 CEST, Room J5

Antibiotic resistance (AR) is a growing public health problem resulting in ~35,000 mortalities each year in the United States. However, new antibiotics require decade(s) of research and development. Therefore, our goal is to develop an antimicrobial platform that is highly programmable for targeting emerging threats or new antibiotic resistant mutants. Our therapeutic platform, SynPhage, has two-levels of programmability. The first is genetic programmability to target AR or virulence genes using CRISPR-Cas. The second level is to control which bacteria receive CRISPR-Cas by engineering T7 transducing particles to display a nanobody selective for pathogenic bacterial receptors on the tail fiber complex using a sortase (SrtA) mediated post-translational functionalization strategy. This post translational attachment allows for proper folding of the tail fiber complex prior to nanobody attachment, as AlphaFold modeling predicts complex misfolding for direct protein fusions. Overall our new synthetic biological system serves as a foundation for modular therapeutics against AR.

<https://2022.igem.wiki/miamiu>

Michigan

Project Title: AMPLIFY: Encapsulin-Facilitated Antimicrobial Peptide Biosynthesis

 Booth: Biomanufacturing Village, B-16

 Village Presentation: October 26, 15:15-15:30 CEST, Plaza 1

 Judging Session: October 27, 15:30-16:00 CEST, Room J9

Antimicrobial peptides (AMPs) are a promising alternative to small molecule antibiotics, providing a strategy to address antibiotic resistance. One current limitation to the use of AMPs is that they are difficult to produce by chemical means. Therefore, we have addressed multi-drug resistance by developing a novel, efficient, and scalable method to produce protein-based antibiotics using encapsulins. Our system uses pH sensitive protein nanocompartments to selectively sequester antimicrobial peptides to mitigate toxicity to their host -- E. coli. We generated this system by designing a plasmid construct where an AMP is fused to an encapsulin-specific targeting peptide. Following expression, we extracted and digested the fusion protein to yield a purified antimicrobial peptide. We conclude that this is an inexpensive and scalable method to manufacture antimicrobial peptides that have the potential to supplement or replace current antibiotics, thereby addressing antibiotic resistance.

<https://2022.igem.wiki/michigan>

MichiganState

Project Title: Modifying Phage for Improved Biocontrol against Pathogenic *P. syringae* DC3000

-  Booth: Food & Nutrition Village, E-12
-  Village Presentation: October 26, 9:30-9:45 CEST, Plaza 3
-  Judging Session: October 27, 15:00-15:30 CEST, Room J13

The CDC estimates 2.8 million drug-resistant infections resulting in 35,000 deaths yearly. Pseudomonads are amongst the most resistant to antimicrobials in plant systems like *P. syringae*. Drug-resistant microbes have sparked interest in bacteriophage use in plant infections such as *P. syringae*; a causative agent for multiple diseases. Bacteriophages are predators of bacteria, they have high-host specificity and ability to kill microbes efficiently. Application of phage on crops results in decreased viability as a result of variable environmental conditions including UV and pH levels. Our team isolated two novel *P. syringae* DC3000 phages from our local agricultural community. We propose modifying the phage capsids through novel methods of CRISPR and BRED to increase capsid rigidity through additions of spy tags on the capsid with spy catcher amino acids to increase capsid protein interactions; increasing protection against variable climates on the plant surface to increase phage viability.

<https://2022.igem.wiki/michiganstate>

Mingdao

Project Title: Phaccine – a bacteriophage-based vector for safer vaccine

-  Booth: High School Village, C-11
-  Village Presentation: October 26, 15:30-15:45 CEST, Plaza 3
-  Judging Session: October 27, 10:00-10:30 CEST, Room J1

Emerging pandemics like COVID-19 need instant effective vaccines. Currently, the most successful vaccines are equipped in liposome or adenovirus vectors, which are delivered intravenously into human body. Antigen proteins produced through human-self cells trigger immune responses. For immediate use, the protein target from a less-known pathogen to be determined may be physiologically toxic to human cells. Commensal bacteria are normal flora living in humans. What if the antigen gene being transferred into them? Could the antigen protein be produced and be effective to induce immune responses? In our project, we engineered a T7 bacteriophage with a model antigen (ovalbumin) gene. The isolated intestinal *E. coli* were tested susceptible to the phages and can produce the antigen proteins. We created a model of phage vector - commensal bacteria - antigen production. Based on clinical phage therapy procedure, we are planning to conduct animal studies to examine the effectiveness for phage vaccine.

<https://2022.igem.wiki/mingdao>

Missouri_Miners

Project Title: Disparlure Production in *S. Cerevisiae* for Spongy Moth Population Control using M.O.T.H.Y.

 Remote Team Village

 Judging Session: October 26, 17:30-18:00 CEST, Room J5

Lymantria dispar dispar, commonly known as spongy moths, is a species of moth of Eurasian descent. They are an invasive species in the United States, harming forests and local farms in the midwest and mostly the northeast by defoliating the trees they inhabit. *S. cerevisiae*, or brewer's yeast, were genetically modified to produce the spongy moth pheromone Disparlure, cis-7,8-Epoxy-2-methyloctadecane, through a reductase and desaturase found in the spongy moth genome. A yeast strain that produces this pheromone could be used as a component of an improved spongy moth trap, which we call M.O.T.H.Y (Moth outsmarting through helpful yeast). This could benefit the conservation of local forests and farms, and the general research methodology could be applied to more pheromone-producing invasive species across the globe.

<https://2022.igem.wiki/missouri-miners>

MIT

Project Title: GSHield: Glutathione Patch for Treating Oral Mucositis

 Remote Team Village

 Judging Session: October 27, 16:30-17:00 CEST, Room J12

Oral mucositis (OM) is a common complication of cancer therapies characterized by the breakdown of epithelial cells in the oral cavity, resulting in inflammation-promoting reactive oxygen species (ROS) and DNA damage. This leads to the death of surrounding oral epithelial cells, which leaves the mucosal tissue susceptible to infection and ulceration. Current therapeutics focus on improving oral hygiene and treating pain. However, GSHield aims to reduce surrounding non-cancerous cell death and provide a protective barrier between the oral cavity and irritants. We aim to produce a bacterial cellulose patch functionalized with yeast engineered to increase extracellular production of glutathione, an antioxidant that quenches ROS. ADP1 and GSH1, which are involved in export and synthesis will be overexpressed, while genes encoding for degradation will be knocked out. Our system will be able to sense and respond to environmental signals using the CCP1 promoter, which is responsive to oxidative stress.

<https://2022.igem.wiki/mit>

MIT_MAHE

Project Title: AMPifin

-  Booth: Food & Nutrition Village, E-13
-  Village Presentation: October 26, 9:45-10:00 CEST, Plaza 3
-  Judging Session: October 27, 14:30-15:00 CEST, Room J13

Vibriosis is a bacterial disease primarily observed in marine, estuarine, and occasionally, freshwater fish. It is caused by the bacteria of the genus *Vibrio* and is a significant reason for mortality in pisciculture operations. Among this species, *Vibrio parahaemolyticus* is one of the most prevalent pathogens. The problem remains substantial despite the pre-existing solutions like antibiotics, vaccines, and over-the-counter medicines. For this reason, we intend to design a sustainable alternative to them by synthesising an antimicrobial peptide that will bind to the Multivalent Adhesion Molecule 7 (MAM7)—a surface protein present on the bacteria. MAM7 is responsible for bacterial adhesion to the host's epithelial cells, triggering the infection. Hence, by inhibiting adhesion, the infection will be prevented in its primary stage, consequently rendering the bacteria harmless to the fish. Our peptide would be synthesised by our chassis—BL21, and delivered using chitosan nanoparticles.

<https://2022.igem.wiki/mit-mahe>

Montpellier

Project Title: SHELL'LOCK: saving the pearl of our region

-  Booth: Food & Nutrition Village, E-14
-  Village Presentation: October 26, 10:00-10:15 CEST, Plaza 3
-  Judging Session: October 27, 12:30-13:00 CEST, Room J13

Fast and reliable oyster-pathogen detection is critical to find new strategies to reduce shellfish losses throughout the farming process. In the Thau lagoon, representing 10% of the oyster French production, farmers face up to 80% of adult oyster deaths, mainly due to the bacterium *V. aesturianus*. Current PCR-based pathogen detections are lengthy and not directly accessible to farmers. Instead, we present SHELL'LOCK, a CRISPR-Cas detection system that is user-friendly and paper-based. We showed that SHERLOCK could be used to detect synthetic pathogenic sequences using fluorescence detection. Furthermore, using modeling approaches, we showed that we can have access to key kinetic parameters of the system. Finally, we showed that we can adapt the SHERLOCK system in a paper based test and showed primary results indicating its potential use under physiologically relevant conditions.

<https://2022.igem.wiki/montpellier>

MSP-Maastricht

Project Title: Aestuarium - A Strategy for the Use of Photosynthetic Bacteria in Water Treatment



Booth: Environment Village, I-13



Village Presentation: October 26, 10:45-11:00 CEST, Plaza 5



Judging Session: October 27, 14:30-15:00 CEST, Room J7

Droughts and water shortages are becoming more frequent due to climate change. Accordingly, our team had to design a novel method of water desalination to solve the ongoing challenge of water scarcity, building on earlier efforts. Current desalination systems use fossil fuels, an expensive process that emits greenhouse gases. Our strategy is to create an energy-efficient solution. We accomplish this by genetically altering marine cyanobacteria to take up more salt. The NpHR pump is responsible for Cl⁻ removal, and we went one step further by adding a pH-dependent antiporter in charge of Na⁺ absorption. The pump's activity is controlled by green light, and our strains are enclosed in beads to offer a biocontainment system. Relying on our models, we demonstrate that our modified cyanobacteria can desalinate with minimal energy use. Hence, industries and water management firms have shown great interest in the project, generating new prospects for water security.

<https://2022.igem.wiki/msp-maastricht>

Munich

Project Title: SpecifiCAR – Improving Specificity of CAR T-Cell Therapy Using Tumor Microenvironment Factors



Booth: Therapeutics Village, D-12



Village Presentation: October 27, 10:00-10:15 CEST, Plaza 2



Judging Session: October 26, 13:30-14:00 CEST, Room J6

Despite advances in modern medicine, cancer remains the second leading cause of death globally. Personalized medicine, which allows therapies to be adapted to individual patients, provides promising attempts for fighting cancer diseases. A well known approach is Chimeric Antigen Receptor (CAR) T-cell therapy. However, this emerging treatment is limited by its specificity, with off-tumor responses causing severe side-effects in patients. With our approach – SpecifiCAR – we aim to improve specificity of CAR T-cell therapy utilizing distinctive factors of the tumor microenvironment. Our project involves targeting of acidic pH and CD8⁺ cell clustering around solid tumors. We are using modern tools of the synbio toolbox to introduce an inducible loop facilitating quorum sensing of CAR T-cells. Furthermore, we explored the possibility of a pH control mechanism for CAR activation. To help facilitate future projects involving CARs we have developed a software tool to streamline the design of the receptors.

<https://2022.igem.wiki/munich>

Nanjing-China

Project Title: Silvana - A synthetic biohybrid system of Shewanella and silver nanoparticles

 Remote Team Village

 Judging Session: October 27, 15:30-16:00 CEST, Room J14

An important issue in the climate crisis is global warming caused by massive emissions of greenhouse gases. We noted that microbial fuel cells (MFCs) are a new type of renewable energy that converts the chemical energy of organic matter into electrical energy. It can turn waste organic matter into clean energy, reducing greenhouse gas emissions. But the main problem at present is the unsatisfactory power generation efficiency. Therefore, we designed a silver-binding protein and introduced it into Shewanella. Engineered bacteria can synthesize and enrich silver nanoparticles. Silver nanoparticles can promote electron transfer and bacterial aggregation, effectively improving power generation.

<https://2022.igem.wiki/nanjing-china>

Nanjing_HS

Project Title: Diabetes Drug Screening - GK

 Remote Team Village

 Judging Session: October 26, 16:00-16:30 CEST, Room J1

Nowadays, there are a large number of patients with type 2 diabetes in the world, and the discovery of new anti-type 2 diabetes drugs is imminent. Glucokinase (GK) is distributed in the pancreas, liver, brain, and intestine, and has the effect of regulating blood sugar balance. In this project, we will construct a prokaryotic expression plasmid of human GK, purify the GK protein, establish an in vitro human GK activity detection platform, screen for drugs with GK agonistic activity, and test them at the cellular level to enhance glucose-stimulating insulin secretion and protect pancreatic islets, to contribute to the treatment of type 2 diabetes. Key Words: GK, type 2 diabetes

<https://2022.igem.wiki/nanjing-hs>

Nanjing_NFLS

Project Title: Microcystin Terminator

 Remote Team Village

 Judging Session: October 26, 10:00-10:30 CEST, Room J2

Microcystins are secondary metabolites of cyanobacteria. They contaminate water resources during harmful algal blooms, posing severe threat to both ecological stability health. Upon drinking intake, the group 2B carcinogen causes liver failure and non-alcoholic liver cancer. We utilized microcystin degradation gene mlrA from natural bacteria *Sphingopyxis* sp.m6, and connected it with cross-membrane ice nucleation protein to construct an extracellular enzyme display system. Significant expression of MlrA was found on the surface of recombinant *E. coli*, whose biodegradation capability was verified. Our system demonstrated compatibility with the surrounding environment and an advantage over traditional physical or chemical methods that lead to secondary pollution.

<https://2022.igem.wiki/nanjing-nfls>

NAU-CHINA

Project Title: Liver Monitor: Rapid cell-free detection of liver disease based on bile acids level

 Remote Team Village

 Judging Session: October 27, 13:00-13:30 CEST, Room J11

Liver disease is prevalent in the world nowadays. About 2 million people die of it every year. Many of them suffer from further aggravation or even death due to the untimely detection of liver disease. Bile acid, a very popular index to detect liver disease, is used as the substrate of our system. We choose Bss to remove the 3-sulphate sulfate groups of bile acids from the urina sanguinis. So, they can be identified by FXR and activate it. Then, the activated FXR will combine with RXR, driving the downstream ddRFP-A1 and ddRFP-B1 dimerize and emit fluorescence. Finally, we use cell-free system to quantitatively detect urine bile acid content to achieve efficient and home-based detection of liver-related diseases.

<https://2022.igem.wiki/nau-china>

Navarra_BG

Project Title: BioGalaxy Project: A new method for monitoring air quality, plants as CO2 sensors.

 Booth: High School Village, C-12

 Village Presentation: October 26, 15:45-16:00 CEST, Plaza 3

 Judging Session: October 27, 14:30-15:00 CEST, Room J2

In this post-pandemic world, air quality is a term that has become familiar. Control of the air we breathe is now key to maintaining safe and clean spaces. The pandemic and all the social and environmental changes we are living in; droughts, wildfires, pollution, power shortage, lack of resources, and the need for more eco-friendly spaces have made us think. Our project's objective is to use plants as CO2 sensors. This requires the identification of promoter sequences highly and specifically induced by high CO2 concentrations. To develop our project first we study the different expression levels of several *Arabidopsis thaliana* CO2 inducible promoters under ambient and elevated CO2 conditions. As a proof of concept, we use the GFP reporter gene to measure the transcription level of each promoter using *Nicotiana benthamiana* transitory transformation.

<https://2022.igem.wiki/navarra-bg>

NCHU_Taichung

Project Title: A Novel Therapeutic, Modified Dressing With The Functional PQQ

 Booth: Therapeutics Village, D-13

 Village Presentation: October 26, 10:15-10:30 CEST, Plaza 2

 Judging Session: October 27, 13:00-13:30 CEST, Room J5

An excessive blood sugar concentration in patients suffering from diabetes mellitus (DM) inhibits the healing of skin wounds. When it becomes severe, ordinary wounds can lead to amputations. This year, NCHU_Taichung aims to develop a wound repair-promoting dressing for DM patients with an intrinsic compound, pyrroloquinoline quinone (PQQ). To increase the yield of PQQ, a well-known probiotic was used, *Bacillus subtilis* natto, as our host and redesigned the PQQ plasmid shown in 2021 NCHU_Taichung. A xylose-dependent promoter was implemented to regulate the biosynthesis rate. The fermentation product using glucose-induced keratinocyte to evaluate the effect of PQQ. The results of wound healing assay in HaCaT cells indicated when supplement with PQQ can accelerate the cell migration within 24 hours observation compare with untreated group, which provide a concrete evidence to increase DM patients' injury recovery and has its high-potential to become a commercial product in a low-cost.

<https://2022.igem.wiki/nchu-taichung>

NCKU_Tainan

Project Title: MerSe, invent a future of space living.

 Booth: Biomanufacturing Village, B-17

 Village Presentation: October 27, 14:45-15:00 CEST, Plaza 1

 Judging Session: October 26, 14:00-14:30 CEST, Room J10

Space travel has been recognized as a promising future for sustainable development. To avoid high transportation risk caused by radiation, iGEM NCKU_Tainan provides MerSe as a state-of-art solution by synthesis biology to protect bacteria or cells from radiation exposure. Being able to produce selenomelanin using the 21st amino acid selenocysteine and melanin, Se coli shows superior radiation resistance. To further apply Se coli as a bio-factory, we produce gamma-aminobutyric acid (GABA) alongside selenomelanin. After UV exposure, Se coli shows a higher survival rate compared to both non-melanized and melanin-producing E. coli. We also develop a device called “MerStage” to mimic radiation exposure, cell aggregation, and 3D cell culture to evaluate the biological effects of bacteria. To integrate biomanufacturing, technology, and society approach into the deep future, we focus on real-life circumstances and build a comprehensive solution. MerSe is committed to creating a better life for mankind, to infinity and beyond.

<https://2022.igem.wiki/ncku-tainan>

NDSU

Project Title: A Better Alternative to Azo Dyes

 Booth: Biomanufacturing Village, B-18

 Village Presentation: October 26, 15:30-15:45 CEST, Plaza 1

 Judging Session: October 27, 16:00-16:30 CEST, Room J9

Our student-led iGEM team is working to develop natural dyes for textiles using engineered proteins produced in bacteria. Currently most textile dyeing relies on the use of azo dyes. These dyes can be carcinogenic, photosynthesis reducing agents, and contain heavy metals. They are also highly stable which makes them long lasting in an aquatic ecosystem. We want to replace this with a non-toxic, protein based dye that will denature in an aquatic environment. Many bacteria already produce natural pigments in a wide variety of colors that could be used in the dyeing process. We combined a naturally occurring pigment with a cellulose binding domain to allow for increased pigment retention in cotton fabrics. This process included creating multiple constructs to find optimal protein orientation. Our product will be able to replace the harmful synthetic dyes by offering a sustainable, environmentally safe alternative.

<https://2022.igem.wiki/ndsu>

NEFU_China

Project Title: Standardized DNA assembly strategy for *Saccharomyces cerevisiae*

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J12

Saccharomyces cerevisiae is generally recognized as a safe eukaryotic model microorganism and has shown great potential as a biosynthetic host. However, since *Saccharomyces cerevisiae* is a monocistronic organism, building complex metabolic pathways in it is challenging. The 2022 NEFU_China team provides a DNA assembly strategy, which standardizes and modularizes the DNA assembly process enough, with high positive rate, so that the strategy can be fully adapted to single and repeated mechanical operations, and take advantage of mechanization to achieve the assembly of a large number of DNA fragments in a short time. Our team has built a suite of automated DNA assembly hardware that is fully functional but at a low cost that most biology labs around the world can support. We have compiled the information above into a manual and made it publicly available to help iGEM teams around the world build automated DNA assembly platforms.

<https://2022.igem.wiki/nefu-china>

NEU_CHINA

Project Title: RTAC, ready for cancer attack.

 Remote Team Village

 Judging Session: October 26, 13:00-13:30 CEST, Room J6

RSPOs (R-spondins) belong to a family of secreted proteins that was the leading cause of various cancers. In iGEM2022, NEU_CHINA team focused on developing a novel cancer targeted-therapy against all RSPOs. We originally designed and characterized a chimeric protein RTAC (RSPO-Targeting Anti-cancer Chimeric protein) through protein engineering. RTAC showed satisfactory anti-cancer effect through inhibition of RSPO-mediated Wnt/β-catenin signaling activation. For further improvement, a *S.Cerevisiae*-based probiotic was engineered, named as R-yeast, to deliver RTAC to RSPO-hyperactivated colorectal cancer locally. The mating pathway of R-yeast was reprogrammed to specifically sense the tumor environment-specific molecules, thus expressing RTAC in a self-tunable manner. Meanwhile, a unique copper-dependent kill switch was implanted to avoid R-yeast from causing potential environmental hazard. Collectively, we have presented the proof-of-concept of a novel anti-pan-RSPO protein and a probiotic with self-controllable machineries for cancer targeted treatment. Our work thus promises great value in synthetic biological research and translational medicine.

<https://2022.igem.wiki/neu-china>

NFLS_Nanjing

Project Title: Indigo Dyengineers

 Remote Team Village

 Judging Session: October 26, 10:30-11:00 CEST, Room J1

Our project tries to use *Corynebacterium glutamicum* to produce indigodine dye. Comparing to traditional chemical dye, our biological dye is more environmental-friendly and money-saving. The bacteria will produce the dye directly and die from high temperature after the whole procedure of dyeing is done, causing no waste and leftovers, and the bacteria we use is of lower cost than the more commonly used substrate-- tryptophan. The biological dye can be used in fields such as medicine, agricultural industry and textile industry. We hope that our product can be put into industrial production.

<https://2022.igem.wiki/nfls-nanjing>

NJMU-China

Project Title: Engine of Starlight: Treating ASD through alleviating mitochondrial dysfunction

 Remote Team Village

 Judging Session: October 26, 15:30-16:00 CEST, Room J5

Autism spectrum disorder (ASD) is a neurodevelopmental disorder with an estimated incidence of 1 percent worldwide, and no current medication proved effective for its treatment. Emerging evidence has indicated that mitochondrial dysfunction plays a key role in the development of ASD. Our project, Engine of Starlight, aims at alleviating mitochondrial dysfunction to treat ASD and comprises three systems that go from assessment to treatment. The first is a biosensor sensitive to lactic acid levels for mitochondrial dysfunction detection, while the other two are probiotics engineered to alleviate mitochondrial dysfunction by increasing NAD⁺ expression and preventing heavy metal accumulation in cells. We have successfully verified their function and further developed the delivery technique for intestinal colonization. Meanwhile, engineering iteration is conducted in interaction with our human practices, and we were also able to promote the implementation of the project with the support of hardware and software.

<https://2022.igem.wiki/njmu-china>

NJTech_China

Project Title: Engineering PerR as a switch for the evolution of defenses against oxygen in obligate anaerobes

 Remote Team Village

 Judging Session: October 27, 16:00-16:30 CEST, Room J11

In the distant future, explorers may terraform another planet from anaerobic to aerobic to provide appropriate soil conditions and environments for humanity during interstellar voyages, and the changes of oxygen condition will require engineered soil modification bacteria to perform in both anaerobic and aerobic environments. In our project, obligate anaerobe *Clostridium tyrobutyricum* was used as an aerobically modified chassis to explore ways to achieve that goal. Peroxide response regulator, PerR, acting as a key regulator of the molecular oxygen and reactive oxygen species detoxification in *Clostridium* species, has been proven critical in bacterial oxidation sensitivity. Our project aims to enhance the oxidative-stress tolerance of *C. tyrobutyricum* via engineering PerR regulator. The perR gene was deleted and then overexpressed under microaerobic induced promoters like Pvgb. Then, several promoter engineering strategies were employed to achieve the fine regulation of PerR expression.

<https://2022.igem.wiki/njtech-china>

NJU-China

Project Title: Treatment of Alopecia by Genetically Engineered Small Extracellular Vesicles (sEV)

 Remote Team Village

 Judging Session: October 27, 9:30-10:00 CEST, Room J6

Alopecia is a skin disorder occurs in a wide population, often causing damaging psychological consequences. The NJU-China iGEM team chose to focus on androgenetic alopecia (AGA), which exhibits the highest prevalence. Current drugs on the market for treating AGA produce unstable results and cause various side effects. Our team began with a comprehensive study of its molecular mechanism then selected several genetic targets. Our goal was to develop a drug with minimal side effects, stable results, and ease of use. On the one hand, we applied RNAi technique and mRNA embedding elements to regulate gene expression particularly. On the other hand, we used sEV (extracted by Tangential Flow Filtration and bind-elute size exclusion chromatography) and microneedles to carry and deliver siRNA and mRNA to follicle cells. Furthermore, apart from AGA, our research may also pave the way for an sEV-mediated systemic delivery platform of therapeutic cargo for other dermatologic diseases.

<https://2022.igem.wiki/nju-china>

NJXDF-CHN

Project Title: Bring us closer by fragrance -- Refactoring *Yarrowia lipolytica* to high produce 2-phenylethanol

 Remote Team Village

 Judging Session: October 26, 10:00-10:30 CEST, Room J4

2-phenylethanol (2-PE) is a fatty alcohol with the aroma of rose, which is considered as an essential flavoring ingredient in the food and cosmetic industry because of its mild and elegant smell. In nature, 2-PE is mainly extracted from rose, jasmine, tomato, and buckwheat plants. However, the concentration of 2-PE in plants is deficient and susceptible to natural factors, such as weather and plant diseases, resulting in the cost of extracting 2-PE up to 3500-6000 USD/kg. Cheap 2-PE can be prepared by chemical synthesis, but the process of producing benzene ethanol by chemical synthesis is complicated. Therefore, we constructed an engineered strain utilizing synthetic biology, so that it can synthesize natural, green, and sustainable 2-PE to meet the needs of the food and cosmetics industry. We hope our obtained 2-PE can be developed to trend-leading and unique 2-PE products according to different people and scenarios.

<https://2022.igem.wiki/njxdf-chn>

NMU_China

Project Title: Whack-a-Mole: aim for a million targets, strike with a giant hammer

 Remote Team Village

 Judging Session: October 26, 13:30-14:00 CEST, Room J5

Cancer immunotherapies rely on one or few specific tumour-associated antigens. However, the adaptive immune system relies on a large and diverse repertoire of antibodies for antigen recognition. Here we proposed the development of libraries of genetically modified NK92 cells displaying diverse repertoires of chimaeric antigen receptors (CARs) that can recognize non-self antigens and display antigen-dependent clonal expansion, with the expanded population of tumour-specific effector cells to exert antitumour responses. In vitro experiments and mathematical models were used to prove the applicability and feasibility of synthetically generated CAR libraries. This work is similar to the game of Whack-a-Mole, where moles always pop up elsewhere (resistance cancer cell clones show up constantly based on traditional therapy); while we can use a giant hammer (synthetic cell library) to strike all the moles simultaneously.

<https://2022.igem.wiki/nmu-china>

NNU-China

Project Title: Omega-3 eggs - Start your brain and body building journey

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J13

As a daily nutritional food, how to improve the nutritional value of eggs has become a hot research topic in the food industry. Docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) are essential omega-3 long-chain polyunsaturated fatty acids, which have irreplaceable effects on human health. Therefore, if eggs are rich in DHA and EPA, they can be incorporated into the daily diet of humans. Currently, only DHA eggs are available on the market, and it is obtained by feeding flaxseed into the feed of laying hens, which has the disadvantage of low content and high cost. Here, we hope to construct an engineered *Yarrowia lipolytica* strain that can produce DHA and EPA. In addition, the ratio of DHA/EPA in eggs can be changed to meet the needs of various groups of people, so as to achieve low-cost input and efficient output.

<https://2022.igem.wiki/nnu-china>

NPU-CHINA

Project Title: Ligninolytic enzymes: a PAHs killer

 Remote Team Village

 Judging Session: October 27, 13:30-14:00 CEST, Room J8

Polycyclic aromatic hydrocarbons (PAHs) are a class of semi-volatile organic compound that is abundant in the environment. Ligninolytic enzymes such as laccases and lignin peroxidases are potential biological pathways for bioremediation of PAHs. However, there are few studies on the heterologous expression of ligninolytic enzymes in *Escherichia coli* to degrade PAHs. The present study investigated the oxidation of PAHs using laccase CotA from *Bacillus subtilis* and lignin peroxidase LipH8 from *Phanerochaete chrysosporium*. It was observed that recombinant CotA and LipH8 had significant oxidation effects on PAHs. Moreover, combined ligninolytic enzymes are a better candidate for the remediation of PAHs than a single ligninolytic enzyme. An arabinose-regulated suicide switch was built to induce suicide once the engineered bacteria were released from the environment for biosafety. Our work will allow the design of biocatalysts for ligninolytic enzyme engineering and provide new insight into the remediation of PAHs by combined ligninolytic enzymes.

<https://2022.igem.wiki/npu-china>

NTHU_Taiwan

Project Title: The Rational Design of Microneedle Wound Dressings and Synthetic Peptides Against Staphylococcus Aureus Skin Infections

 Booth: Therapeutics Village, D-14

 Village Presentation: October 27, 10:15-10:30 CEST, Plaza 2

 Judging Session: October 26, 10:00-10:30 CEST, Room J5

Staphylococcus aureus can cause skin infections, such as impetigo, furunculosis, or carbunculosis, and in severe cases, sepsis or cellulitis. Currently, based on clinical manifestations, the regular treatment is antibiotics like Bactroban Nasal. Consequently, it is necessary to find a way to diagnose and treat them quickly and effectively. The aim of project is to create a multi-functional dressing using the microneedle system (MN) and synthetic peptides composed by antimicrobial peptides (AMPs) to achieve rapid and effective detection and sterilization of S. aureus. Additionally, AMP can reduce the possibility of multi-drug resistance. For specificity, linker cleaved by V8 protease turn the antimicrobial peptide complex (AMPC) into AMPs. The MN is made of hyaluronic acid methacrylate (HAMA) and gelatin as the specific triggered coating and drug carrier, respectively. Herein, We developed a simple, rapid, and biosafe dressing prevent killing other bacteria on the skin and releases the drug once encountering S. aureus.

<https://2022.igem.wiki/nthu-taiwan>

NUDT_CHINA

Project Title: Designer Cell-based Biomedical Tattoo for Monitoring Glucocorticoid Levels Associated with Mental Stress

 Remote Team Village

 Judging Session: October 27, 10:00-10:30 CEST, Room J11

Prolonged exposure to mental stress is an important cause of the high incidence of depression and anxiety in academia. Though timely lifestyle intervention can reduce the risk of these mental diseases, early detection of chronic stress and monitoring stress levels remain difficult. Here we demonstrate a novel cell-based tattoo to detect the rising glucocorticoid level induced by chronic stress and respond with a visible output. We engineered a novel synthetic transcriptional factor that translocates from the cytosol into the nucleus upon glucocorticoid stimulation and initiates reporter gene transcription. We confirmed that the cells carrying this synthetic transcriptional factor and its reporter cassette could respond dose-dependently to glucocorticoid stimulation with either fluorescent or visible colorimetric signals. Our results demonstrate a novel cell-based strategy for monitoring the glucocorticoid levels associated with mental stress, which could help our peers to monitor their stress conditions and therefore assist them in producing better scientific discoveries.

<https://2022.igem.wiki/nudt-china>

NU_Kazakhstan

Project Title: Viraless: Rapid Detection of Emerging Biological Threats



Booth: Diagnostics Village, F-10



Village Presentation: October 26, 13:30-13:45 CEST, Plaza 4



Judging Session: October 27, 12:30-13:00 CEST, Room J10

Advances in synbio allow us to easily manipulate genes for shared benefit, yet it also makes it easier to engineer pathogens for malicious purposes. How can we utilize synbio to protect ourselves from its dangerous manifestations? With that in mind, we are focused on advancing the field of biosecurity, by developing fiber-optic-based biosensors for the rapid detection of engineered pathogens in the environment by virus-specific antibodies bound to the device. We will use a non-pathogenic strain of *E. coli* for the production of recombinant, highly conserved proteins of vaccinia virus, which will further be detected by monoclonal antibodies on functionalized optical fibers. These proteins of the vaccinia virus are cross-reacting with orthopox, monkeypox, and variola viruses, providing our tool with a wide range of detectable pathogens. As a result of the project, a novel, specific, and sensitive device for the fast detection of poxviruses in various fluids will be constructed.

<https://2022.igem.wiki/nu-kazakhstan>

NWU-CHINA-A

Project Title: The Battle of Red and Blue: Biosensors to Detect Microbleeds



Remote Team Village



Judging Session: October 27, 14:00-14:30 CEST, Room J10

The symptoms of intestinal microbleeding are too hard to be noticed, and by the time the patients notice, the disease has caused great pain to their body. Our project is committed to using engineering probiotics to make a biosensor suitable for detecting intestinal micro bleeding, and to design a device that can easily cultivate bacteria under non-experimental conditions to achieve convenient self-test. By introducing double plasmids into *EcN*, *ChuA* (heme transporter), *HrtR* (Lactococcus heme reactive transcription inhibitor), promoter *HrtO* and pigment genes were introduced into engineering probiotics. By taking probiotics to act on the intestines, when there is a small amount of intestinal bleeding, *ChuA* will transport the heme in the intestines to *E. coli* and combine with *htrR* to affect the transcription and expression of the *hrtO* promoter, and express the pigment gene. Finally, detect whether there is pigment to determine whether there is trace bleeding.

<https://2022.igem.wiki/nwu-china-a>

NYCU-Taipei

Project Title: E. color: Precise and Automatic Detection of Cellular Status for Basic, Industrial, and Medical Applications

-  Booth: Foundational Advance Village, A-10
-  Village Presentation: October 27, 9:30-9:45 CEST, Plaza 1
-  Judging Session: October 26, 15:30-16:00 CEST, Room J12

Determining the time point of specific phases within the E. coli growth curve is vital for gene cloning and protein expression purposes. Until now, there have been a variety of methods developed, all with advantages but as well as downsides. Our project works on developing fluorescent growth status indicators with real-time detection and inform system. We aim to improve the working environment of scientists and researchers and the efficiency of experiment. By making tracing of the bacteria remotely available, saving time, reducing manpower, slashing cost down, and lowering technical criterion are the likely future. This optimized foundational advance would increase the convenience and efficiency in experiments using E. coli as a host-vector system. We believe that E. color can further be used in microbial basic research, industrial settings, and can even benefit the whole scientific community.

<https://2022.igem.wiki/nycu-taipei>

NYCU_Formosa

Project Title: Ubenefactrix

-  Booth: Biomanufacturing Village, B-19
-  Village Presentation: October 26, 15:45-16:00 CEST, Plaza 1
-  Judging Session: October 27, 10:30-11:00 CEST, Room J9

Protein-based materials are currently leading to promising applications in various fields. With the advent of biotechnology, diverse assembly approaches have been developed to further acquire biomaterials with desired functionalities. Self-assembled protein Ultrabithorax (Ubx) from Drosophila melanogaster has been investigated as building blocks to construct material attributing to its inherent biocompatibility and mechanical properties. However, current yielding of Ubx has not achieved satisfactory results due to stress response. The aim of our work was to develop a novel biomaterial by engineering the Ubx functional domain. We first identified Y167 and Y240 domains, dityrosine containing motifs contributing to the linkings forming self-assembly, and engineered them with mRFP afterwards to test its functions. It is concluded that Ubx has the potential to successfully incorporate diverse functional proteins for wide applications in various fields.

<https://2022.igem.wiki/nycu-formosa>

NYC_Empire_State

Project Title: NeuroTrojan: A fusion protein therapeutic that crosses the Blood-Brain Barrier and promotes post-stroke neural repair

 Booth: High School Village, C-13

 Village Presentation: October 26, 16:00-16:15 CEST, Plaza 3

 Judging Session: October 27, 16:30-17:00 CEST, Room J1

A stroke occurs when blood flow within the brain is blocked. Existing therapies remove blockages but don't rehabilitate neurons. This is because the Blood-Brain Barrier (BBB), a lining of endothelial cells on the artery, prevents drugs from accessing neurons. We deliver beneficial proteins to neurons by fusing them with HIRMAb (Human Insulin Receptor Monoclonal Antibody), a "biological trojan horse." NT-3 (Neurotrophin 3) and FGF-2 (Fibroblast Growth Factor 2) are fused to HIRMAb via PCR cloning and Gibson assembly. HIRMAb binds to the insulin receptor on endothelial cells, and through receptor-mediated transcytosis, delivers NT-3/FGF-2 across the BBB. NT-3 or FGF-2 then binds to its respective receptor. We developed a transwell assay to test that our fusion proteins cross the BBB and an interaction assay to determine their interaction with their receptor. Our research demonstrates a relevant mechanism for crossing the BBB and can be adapted to other neurodegenerative diseases.

<https://2022.igem.wiki/nyc-empire-state>

NYU_Abu_Dhabi

Project Title: Development of an early diagnostic device for Alzheimer's disease using surface functionalized aptamers

 Booth: Diagnostics Village, F-11

 Village Presentation: October 26, 13:45-14:00 CEST, Plaza 4

 Judging Session: October 27, 10:00-10:30 CEST, Room J10

Alzheimer's disease—a progressive neurological disorder that leads to brain atrophy and neuronal loss—is the most common cause of dementia worldwide. It affects about 6.5 million people aged 65 or older in the United States alone. The condition is also notoriously difficult to diagnose early, especially before onset of clinical symptoms such as memory loss and cognitive decline. Addressing this gap, we have built a portable, plasmonic biosensor-based device using the self-assembly of gold nanoparticles (AuNP) that produce wavelength extinction shifts via a localized surface plasmon resonance (LSPR) signal. The LSPR chip, viewed under a UV/Vis Spectrometer, provides absorbance signals to confirm the detection of our peptides of interest. Compared to currently available diagnostic methods, our device has lower cost and detection time and improved sensitivity. As a result, our device would enable early detection of Alzheimer's disease, and the adoption of efficient management strategies, from lifestyle changes to symptomatic treatments.

<https://2022.igem.wiki/nyu-abu-dhabi>

OhioState

Project Title: Phinder & Phighter - a phage oriented plan to combat sepsis



Booth: Diagnostics Village, F-12



Village Presentation: October 27, 14:00-14:15 CEST, Plaza 4



Judging Session: October 26, 15:30-16:00 CEST, Room J11

Many types of bacteria can lead to an infection and an overreaction to any infection may lead to devastating tissue damage and potential death. This extreme immune response is termed as sepsis and is associated with 1 in 5 deaths worldwide. Our solution is to use an engineered phage therapy that directly targets the infectant, after detection with a phage reporter assay. Phages are advantageous because they are bacteria specific, a phage can be used to target a specific bacteria. Once a blood sample is obtained, our library of engineered phage will carry a fluorescent gene that will result in fluorescent bacteria once the phage inserts in its DNA. Phage types that lead to fluorescence will be administered to the patient in the phage therapy step. Additionally, interactive exhibits were held at local museums to engage the community on synthetic biology and how it could be used to address sepsis.

<https://2022.igem.wiki/ohiostate>

OUC-China

Project Title: DISP-Directional Intelligent Screening Platform



Remote Team Village



Judging Session: October 26, 15:00-15:30 CEST, Room J9

Nowadays, strain quality has become a major factor limiting the yield of fermentation industry. The engineering bacteria degenerate into wild-type due to mutation or some unknown endogenous regulation. They have more growth advantages than the production engineering bacteria and gradually occupy resources to become the dominant species. The production genes introduced into the engineering bacteria are copied and lost in the process of DNA replication during cell proliferation. At the same time, some products accumulate in the engineering bacteria, which has a negative feedback regulation effect on the production of enzymes. Moreover, the extraction process of the products by breaking the engineering bacteria is very complicated. We plan to design a software and hardware platform that automatically regulates the production and screening of strains to extract product simply to ensure high-quality strains and improve the fermentation yield.

<https://2022.igem.wiki/ouc-china>

Paris_Bettencourt

Project Title: A synthetic biology toolkit to interface genetic circuits with electronics

-  Booth: Foundational Advance Village, A-11
-  Village Presentation: October 26, 9:15-9:30 CEST, Plaza 1
-  Judging Session: October 27, 10:30-11:00 CEST, Room J12

Language originating from the field of electronics is often employed in synthetic biology to describe genetic logic circuits, meanwhile, the real intersection of electronics with genetics remains largely unexplored. Our iGEM team is developing a toolkit of genetic parts with the concomitant open-source hardware to enable synthetic biologists to interface bacterial gene expression with electronics. Our toolkit incorporates a multitude of genetic parts from previous research in electro-microbiology that have been standardised to allow for a wide variety of applications. We are conversely researching new means of bioelectronic control using hyperpolarization of bacterial membranes for gene induction. Our toolkit will open doors for foundational research in gene expression and control while finding applications in manufacturing, robotics, arts and new media.

<https://2022.igem.wiki/paris-bettencourt>

Patras

Project Title: PAGGAIA: An innovative Precision Agriculture approach, using Genomics, Artificial Intelligence and Aero-transportable equipment

-  Booth: Food & Nutrition Village, E-15
-  Village Presentation: This team has switched to remote attendance
-  Judging Session: October 26, 14:00-14:30 CEST, Room J13

The interactions between various soil microorganisms are challenging to study and thus remain unknown. A major issue in the field of Agriculture is the inability to collect essential data, regarding soil quality for cultivation purposes in large areas. Precision Agriculture is an innovative farming management concept, combined with Data Analysis and AI/Machine Learning models, which aims to revolutionize agriculture and soil improvement, by increasing crop yield and preserving natural resources. The goal of PAGGAIA - Precision AGriculture, using Genomics, Artificial Intelligence and Aero-transportable equipment- is to make a sustainable and positive environmental impact, by optimizing fertilizers' use, seeking quantity and quality yield increase, and modernizing agricultural practices, in a bio-sustainable and consumer-friendly manner. This is accomplished by creating a protocol that includes genomic, physicochemical, and agronomic characteristics, using soil-sampling drones, portable DNA sequencing, and innovative analysis through the lens of Machine Learning to propose tailor-made interventions to farmers and specialists.

<https://2022.igem.wiki/patras>

Patras_Medicine

Project Title: syn-PNOIA: Redefining Lung Cancer Diagnosis



Booth: Diagnostics Village, F-13



Village Presentation: October 27, 14:30-14:45 CEST, Plaza 4



Judging Session: October 26, 9:30-10:00 CEST, Room J11

Lung Cancer (LC) is the deadliest type of cancer worldwide. In 2020, WHO estimated 1.8 million deaths. This high mortality rate is caused by the late diagnosis of the disease since patients often do not get examined until the late stages. In addition, in the early stages, no severe symptoms arise. Thereby, we aspire to develop a non-invasive diagnostic tool based on Liquid Biopsies to target a panel of three circular RNAs (hsa_circ_070354, hsa_circ_0102533, hsa_circ_005962). Using Rolling Circle Amplification and fluorescent hairpin probes, we attempted to create a Linear DNA Nanostructure to identify and quantify the biomarkers in a complex blood sample in 70 minutes. Furthermore, we suggest applying our technique through modeling work in other disease diagnoses via different panels of circular RNAs as distinct biomarkers. Finally, as LC ascertains to be a leading cause of cancer death, we propose to implement our tool in people with increased risk.

<https://2022.igem.wiki/patras-medicine>

Patras_Uni_Hellas

Project Title: M.Er.Cure - Marble erosion Cure



Booth: Conservation Village, H-3



Village Presentation: October 27, 17:30-17:45 CEST, Plaza 5



Judging Session: October 26, 13:00-13:30 CEST, Room J14

Bioerosion is defined as the decomposition of the materials of an object by (micro) organisms, which either nest and grow, or feed on it. This phenomenon is threatening the marble monuments all over the world, so its limitation is matter of great importance. Tachyplesin is an antimicrobial peptide, with action against Gram+ and – Bacteria, Firmicutes, Fungi and Viruses. It will be the major ingredient of M.ER.CURE, a biological biocide against the marble microflora. The experimental procedures will involve the transformation of E. coli strains with recombinant plasmids containing the desired nucleotide sequence. Following the characterization of the expression and purity of the peptide under study, the efficacy of tachyplesin as a biocidal product will be evaluated in microorganisms found in marble. The use of the antimicrobial peptide prevents the development of resistance of microorganisms, thus eliminating the need to create ever more modern biocides, constituting a useful tool for combating biodegradation and preserving cultural heritage.

<https://2022.igem.wiki/patras-uni-hellas>

Peking

Project Title: DEEPI, a new paradigm of antibiotic resistance

 Remote Team Village

 Judging Session: October 26, 15:00-15:30 CEST, Room J5

Nowadays, antibiotic resistance is one of the top ten global public health threats. Among many solutions against this crisis, EPI (Efflux Pump Inhibitor) is a potentially efficient kind of medicine in response to drug resistance generated by efflux pumps, the most important mechanism of antibiotic resistance. However, most of current EPI have several disadvantages: Difficult to synthesize, Toxic and Low effect commendably, which hinders its further clinical application. Our project aimed to develop a standardized modular short-peptide EPI optimization procedure based on directed evolution and Yeast-E.coli co-culture system. Through this procedure, as long as we know the structure of an efflux pump, we could generate an efficient EPI that could be synthesized by microorganisms easily. For security reasons, we used AcrB pump in E.coli as a demonstration of our project and successfully constructed the co-culture system this summer. We hope to come up with a new solution to the antibiotic crisis.

<https://2022.igem.wiki/peking>

PINGHE

Project Title: Biosynthesis of medium-chain fatty acid (MCFAs) by Reversing the Fatty Acid β -Oxidation Cycle

 Remote Team Village

 Judging Session: October 26, 9:30-10:00 CEST, Room J4

The most of the MCFAs people use now are extracted from tropical plants, which limit the amount of medium chain triglyceride. Our goal is to strengthen the MCFAs synthesis pathway and optimize T7 initiation by over-expressing key enzymes in the reverse fatty acid β -oxidation cycle in E. coli to increase the production of MCFAs. We constructed the pET28a-EGFP plasmid with a fluorescent protein. In order to find the mutation that works the best, we designed point mutations C1, C2, C3, and C4 on the T7 promoter, and constructed these four T7 promoter mutants on plasmids. We found out that the C1 mutation was the strongest promoter, which hooked up the selected mutations to the four enzymes that build the medium-chain fatty acids. This mutated promoter was then applied to the four enzymes used in our pathway to increase the amount of medium-chain fatty acids production. Key Words: MCFAs, β -oxidation cycle

<https://2022.igem.wiki/pinghe>

Portland

Project Title: Detection of Exogenous c-Myc mRNA Using Genetically Modified E. coli



Booth: Diagnostics Village, F-14



Village Presentation: October 26, 14:30-14:45 CEST, Plaza 4



Judging Session: October 27, 16:30-17:00 CEST, Room J10

Current early cancer detection methods are inaccessible for many people due to the cost of materials and instruments (1). Therefore, finding more accessible alternative early cancer detection methods is a top priority. One current method is through the detection of cancerous miRNA in plasma, however, this comes with significant barriers such as high cost related to miRNA sequencing. To address these problems, this project focuses on developing E. coli bacteria that contain conditionally active guide RNA (gRNA) and CRISPR Cas12a aimed at detecting cancerous mRNA in plasma samples. These modified bacteria have the potential to be accessible at any standard diagnostic laboratory, and expected to be cheaper than current equipment.

<https://2022.igem.wiki/portland>

PuiChing_Macau

Project Title: Supporting hydroponic farming using engineered bacteria： hormone-targeting and pH-adjusting systems



Remote Team Village



Judging Session: October 27, 15:00-15:30 CEST, Room J3

Due to the increasing food shortage caused by global warming, populated cities, including Macau, need alternative sustainable food sources to stabilize the supply. While hydroponics can be used to increase food supply, the yield of such a system is relatively low. One of the reasons is that the nutrition solution needs to be discarded regularly, to prevent pH changes. Here, we engineered E. coli to include a genetic pH Shooting (GPS) system which can neutralize the solution from time to time. To further increase the yield, we also created the hormone binding systems (HBDs), as some plant hormones like abscisic acid (ABA) are known to slow down plant growth. We here engineered E. coli to produce hormone binding proteins, T2R4 and PYL8, to inhibit ABA. By using HBD and GPS, we hope to establish a sustainable hydroponic agriculture system in the near future.

<https://2022.igem.wiki/puiching-macau>

PUMC_CHINA

Project Title: Unsupervised lineage clustering for revealing expression patterns toward EMT of HCC

 Remote Team Village

 Judging Session: October 26, 15:00-15:30 CEST, Room J14

The single-cell RNA sequencing (scRNA-seq) technology provides a powerful tool for dissecting heterogeneous tumor tissue at single cell resolution. However, it still remains challenging to reconstruct cell differentiation dynamics on the expression spectrum. Here, we develop a new method combining lineage clustering and generalized additive model (GAM). Validating this method on hematopoietic cell lineage and real hepatocellular carcinoma (HCC) samples, we find our method have a greater potential to build differentiation pseudotime with a higher resolution. We also find that enrichment of specific lineage and differential expression patterns are associated with worse clinical outcomes. Combining these together, we believe our method could provide better a tool for studying heterogeneous biopsies such as tumor.

<https://2022.igem.wiki/pumc-china>

Qdai

Project Title: Bio Gas

 Remote Team Village

 Judging Session: October 27, 13:00-13:30 CEST, Room J7

Our goal is artificial methane production. The production of methane from livestock waste, which is currently a depleting resource, will lead to a sustainable society. Methane production involves three steps These are the decomposition of cellulose, the synthesis of acetic acid, and the synthesis of methane from acetic acid. We will focus on the synthesis of acetic acid in particular.

<https://2022.igem.wiki/qdai>

Queens_Canada

Project Title: LAMPogen



Booth: Diagnostics Village, F-15



Village Presentation: October 27, 14:45-15:00 CEST, Plaza 4



Judging Session: October 26, 15:00-15:30 CEST, Room J11

The Canadian Indigenous drinking water crisis has been an ongoing issue for decades affecting thousands of Indigenous Canadians. After meeting with representatives from the Queen's Office of Indigenous Initiatives and the Chief of Tyendinaga, we learned that there isn't a reliable drinking water diagnostic that could be used by communities. LAMPogen aims to develop a point of care water pathogen detection and filtration device. We used an emerging nucleic acid amplification technique called Loop Mediated Isothermal Amplification (LAMP) to detect conserved 16s rRNA regions within pathogenic *E. coli*, *Salmonella*, *Shigella* and *Campylobacter*. We have optimized the reaction through the re-engineering the polymerase responsible for LAMP via mutagenesis and protein fusion. Our device consists of 3 attachable lids to a kettle component, one lid for LAMP, one for filtration and one for drinking. We have also devoted a great focus on educating the general public about the breadth of this issue.

<https://2022.igem.wiki/queens-canada>

RBHS_SanDiego_CA

Project Title: Modeling *Pteris Vittata*'s Arsenic Sequestration Mechanism



Remote Team Village



Judging Session: October 26, 16:30-17:00 CEST, Room J3

Our project is to model an important part of *Pteris Vittata*'s fern sequestering mechanism in order to evaluate the feasibility of implementing it in other plants for phytoremediation as a way to tackle the issue of arsenic toxicity. *Pteris Vittata*, also known as the Chinese Brake Fern, is an arsenic hyperaccumulator that absorbs arsenic from the soil and transfers it from root to shoot for sequestration in vacuoles. Our model consists of three critical enzymes: PvARC2, PvPHT1;3, and PvACR3. Arsenic, when in the form of arsenate, travels through PvPHT1;3, which is a phosphate transporter in the cell membrane, into the cytosol of the cell. After that, PvACR2, a reductase in the cytosol, reduces the arsenate to arsenite; PvACR3, an antiporter, then induces arsenic sequestration in the vacuoles. By modeling this arsenic sequestering mechanism, our goal is to provide a solution for arsenic contamination in the environment.

<https://2022.igem.wiki/rbhs-sandiego-ca>

RDFZ-CHINA

Project Title: Slimbiotic

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J4

Obesity is a serious problem that can lead to several health consequences such as cardiovascular diseases, musculoskeletal disorders, and depression. Today, more than 2 billion people are suffering from overweight and obesity worldwide. Meanwhile, existing drug therapy such as Orlistat and Liraglutide has a series of side effects. Therefore, we try to find out an alternative way to treat obesity. Through research, we found that there is a relationship between obesity, microorganisms in the human intestine, and the intestine's absorption. In our project, we aim to use synthetic biological ways to solve this problem. We engineered E.coli Nissle 1917 and plan to place it in patients' intestines in the future. These E.coli with enhancing the ability of expression of long-chain fatty acid transporter protein and acetyl-CoA synthetase can intake fatty acid in the intestines, preventing FA to be absorbed by the intestine, therefore losing weight.

<https://2022.igem.wiki/rdfz-china>

REC-CHENNAI

Project Title: CURLIM

 Booth: Environment Village, I-14

 Village Presentation: October 27, 10:15-10:30 CEST, Plaza 5

 Judging Session: October 26, 15:30-16:00 CEST, Room J8

Heavy metals potentially threaten human health, causing various ailments such as kidney failure and liver malfunctions. Industries release untreated effluents into water bodies that affect the terrestrial and marine ecosystems. Team REC-CHENNAI proposes the project 'CURLIM' intending to reduce the exposure to heavy metal toxicity in industrial wastewater. We plan on developing a biological system with longer life, by genetically engineering E. Coli biofilm with suffused phosphate enzyme to eradicate heavy metals from industrial effluents. Substrates added in the moving bed biofilm reactor would dephosphorylate the phosphate monomers into free phosphates and alcohol. These compounds form complexes with heavy metals and sediment them. Our approach for this process will be on a laboratory scale with a small-scale prototype reactor. The method is cost-efficient when compared to other wastewater treatments. We aim to establish a healthy and happy ecosystem with mutual development between industries and mankind.

<https://2022.igem.wiki/rec-chennai>

Rochester

Project Title: Saptasense: Saving Syrup

-  Booth: Food & Nutrition Village, E-16
-  Village Presentation: October 26, 10:30-10:45 CEST, Plaza 3
-  Judging Session: October 27, 15:30-16:00 CEST, Room J13

The billion-dollar maple syrup industry produces syrup-based products with values 20 times that of crude oil. However, one in twenty gallons of syrup contains defects that make it unfit for human consumption. Defects include buddy syrup, which has a cabbage-like taste due to metabolic changes in the maple tree, and ropy syrup, which has a stringy texture due to bacterial contamination. These defects are only detected once the sap has been boiled into syrup, wasting valuable resources. Due to inefficient measurement standards, resources are also wasted when measuring glucose levels needed to produce ancillary products. In response, Team Saptasense has developed three sugarmaker-targeted tools to help alleviate financial and environmental costs of syrup and sap defects: a novel method for repurposing ropy syrup into dextran, a sensor kit that detects buddy sap before it is boiled into syrup, and a high-sensitivity glucometer that accurately shows producers precise syrup glucose levels.

<https://2022.igem.wiki/rochester>

RS_Joint_China

Project Title: The Devourer: Project-Realising the efficient absorption of lead ions in soil.

-  Remote Team Village
-  Judging Session: October 26, 15:00-15:30 CEST, Room J4

Lead is causing severe pollution. It has a negative impact on normal agricultural and forestry production, and crops contaminated by heavy metals can lead to diseases that threaten human's health. No obvious solution has yet been proposed. Our project is designed to solve this issue by extracting the PtoMYB46, sequence of genes that is proved to have the function of absorbing the lead ions in previous detection, and converting it into poplars' genes. We firstly extracted genes from the poplars' DNA and amplified the target genes using PCR technique after the detection of its purity and concentration. The cloning vector and expressing vectors were constructed in the second step. Finally, we transferred the gene to the agrobacteria to infect the poplars' leaves. The transgenic poplar improved and perfected the function of absorbing lead ions in poplar. We use directed evolution to further perfect the function of genes.

<https://2022.igem.wiki/rs-joint-china>

RS_United_China

Project Title: Melabios: A New Friendly Way to Increase Melatonin Production from Plants

 Remote Team Village

 Judging Session: October 27, 16:00-16:30 CEST, Room J3

The number of people have insomnia keeps increasing for many reasons. Such as colossal workload or addiction to their electronic devices. Taking melatonin, a natural hormone produced in the pineal gland of our brains, will affect one's sleeping cycle. Our project aims to develop an environmental-friendly and natural way to synthesize melatonin. Melatonin can be found in plants. However, the yield is relatively small. What we try to improve is the yield. We first extract PtoCOMT gene, related to melatonin production, from the poplars' DNA, run gel electrophoresis to test its purity, and then amplify it using polymerase chain reaction. Afterward, we transformed our target gene into two different carriers for storage and expression and transferred them into E.coli. Finally, we changed extracted plasmid into agrobacteria to infect the poplars' leaves, over-expressing our target gene, therefore increasing productivity. we use directed evolution to further perfect the function of genes.

<https://2022.igem.wiki/rs-united-china>

RUBochum

Project Title: BioSpatch: Synthetic Spidersilk-Proteins Plasters for Chronic Wounds

 Remote Team Village

 Judging Session: October 27, 13:00-13:30 CEST, Room J6

Chronic wounds are an increasing problem, especially for the elderly and people with pre-existing health conditions. It's estimated that 8.2% of the population are affected by chronic wounds in the United States alone. We aim to produce wound-healing 'plasters' with particularly high biocompatibility for poorly healing open wounds from synthetically produced spider threads. To accomplish this, we produce spidroins (spider silk proteins) with modified Escherichia coli. After protein purification, the threads would be spun to bundle them. The tissue would be applied directly to the previously cleaned and disinfected affected area. Promotion of wound healing in the inflammation, granulation and regeneration phases would be achieved by incorporating the moist wound environment through the patch as part of a synthetic skin.

<https://2022.igem.wiki/rubochum>

RUM-UPRM

Project Title: R-DetoX: Biodegradation of 1,3,5-trinitro-1,3,5-triazine to mitigate contamination of the Anones Lagoon in Vieques, Puerto Rico.

 Booth: Environment Village, I-15

 Village Presentation: October 27, 10:30-10:45 CEST, Plaza 5

 Judging Session: October 26, 16:00-16:30 CEST, Room J8

Levels of the military-grade explosive RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) exceeding the EPA's established limits have been detected at the Anones Lagoon in Vieques, Puerto Rico. RDX has shown adverse effects to humans, flora, and fauna, thus posing a risk to the Vieques ecosystem and its inhabitants. We propose a biosensing, cell-signaling module inducible by presence of RDX and coupled to a biodegradation module via the quorum-sensing signal molecule, AHL. We identified two possible biosensing elements in previous works: a transcriptional fusion of two promoters from nitric oxide (NO) detoxification-associated genes, and a synthetic aptamer riboswitch with high affinity for RDX. For the biodegradation module, we identified a P450 cytochrome and reductase duo, XplA/XplB, isolated from bacterial isolates with RDX-degrading capabilities. Unfortunately, we were unable to complete the wetlab work due to an unanticipated meteorological event that left the island without power. We hereby demonstrate our proof of concept and future works ahead.

<https://2022.igem.wiki/rum-uprm>

SCU-China

Project Title: ERYbiotic

 Remote Team Village

 Judging Session: October 27, 12:30-13:00 CEST, Room J5

Engineered probiotics are the next-generation biotherapeutics that are edited to target specific diseases. However, there are no reasonable solutions to several problems, such as colonization failure, low population density, and irregular expression of exogenous genes in vivo. Therefore, we designed an engineered probiotic platform based on the sugar substitute erythritol in order to solve the problems mentioned above. We introduce erythritol breaking down gene clusters and providing an exclusive metabolic niche in probiotics. When supplemented with erythritol stably in the diet, engineered probiotics will increase population density and colonization time in the intestinal microbiome. In addition, we precisely characterized the promoter of ery operon model, building an erythritol-induced regulatory system. Except for the platform, we introduced an erythritol utilization pathway downstream to synthesize small therapeutic molecules such as pyrroloquinoline quinone and L-erythrulose, giving this platform more therapeutic functions.

<https://2022.igem.wiki/scu-china>

SCUT-China

Project Title: FUNCDYES

 Remote Team Village

 Judging Session: October 26, 16:00-16:30 CEST, Room J9

Silk is an important representative of Chinese handicrafts. Silk is light and thin, with comfortable texture when wearing as garment. However, after being stained with sweat or exposed to direct sunlight, it may turn fragile and dull. During the dying process, lots of energy is consumed and many pollutants are produced, which is extremely harmful to the environment. As a result, our team produce special dyes, lycopene and patchoulol, with synthetic biology, which providing the silk with colors and antibacterial properties. These two terpenoids can be produce in vivo using pichia pastoris. We do promoter screening to select the best modified promoter and do epPCR to mutate the key enzyme PTS to improve its efficiency. We also build up an optogenetic system to achieve an elaborate regulation on the production of lycopene and patchoulol. Besides, a quick and accurate visualization method is presented to screen out the target strains.

<https://2022.igem.wiki/scut-china>

Seoul_Korea

Project Title: “Pine-sorb”- creating an Eco-friendly and biodegradable oil absorbent using synthetic biology

 Booth: High School Village, C-14

 Village Presentation: October 27, 15:30-15:45 CEST, Plaza 3

 Judging Session: October 26, 13:00-13:30 CEST, Room J3

Oil spills have always been one of mankind's most environmentally damaging acts since the 19th century. However, traditional biodegradable oil absorbents are hardly ideal due to their low cost-efficiency and poor oil adsorption capacity. One promising alternative material is brown rot fungi-decomposed pine trees, which has extremely high hydrophobicity and oleophilicity due to its high lignin content. However, the decomposition process takes up to 10 years in nature, making the mass production of the material impractical. To tackle this problem, we used E. Coli and Bacillus Subtilis to mass produce 4 types of cellulose-degrading enzymes. Treating pine tree powder with these genetically modified organisms secreting enzymes of interest resulted in an increase of lignin content from 25~30% to 39~47% while also showing significant improvement in oil adsorption. Our novel approach speeded up the decomposition process to 12 weeks, providing the potential for mass production of promising alternative oil absorbent material.

<https://2022.igem.wiki/seoul-korea>

Sesame_Shenzhen

Project Title: Uric Acid Lowering Probiotic

 Remote Team Village

 Judging Session: October 26, 14:00-14:30 CEST, Room J4

Uric acid ($C_5H_4N_4O$) is the end-product of purine catabolism. The increased consumption of foods such as red meat, seafood, and alcoholic beverages is directly associated with high uric acid blood levels and a higher prevalence of hyperuricemia. Hyperuricemia can lead to the formation of urate stones and gout and is an independent risk factor for hypertension, chronic kidney disease, cancer, and mortality. Adverse side effects and disadvantages have been identified for existing treatment methods, which confirm the need for a much safer uric acid-lowering treatment therapy with no adverse side effects. Our project introduces exogenous uricase as a novel treatment method. We utilized molecular cloning technologies to insert the gene encoding for urate oxidase into Escherichia Coli, uricase oxidase can decompose uric acid. Our method is associated with various long-term, sustainable benefits, and does not correlate with any adverse side effects.

<https://2022.igem.wiki/sesame-shenzhen>

ShanghaiTech_China

Project Title: Mini Bioproduction Circle System(MBCS)

 Remote Team Village

 Judging Session: October 26, 9:30-10:00 CEST, Room J9

This year, ShanghaiTech_China developed an autotrophic sustainable multi-microbial production platform named Mini Bioproduction Cycle System (MBSC). We customized the platform for Martian conditions and launched the MBCS-Mars version. In this project, we introduced three microorganisms to build a ternary microbial symbiosis system. By genetic modification, symbiosis was strengthened and stabilized under feedback regulation. Furthermore, a novel “Separate-Immobilized” fermentation model was proposed to put the multi-microbial system into practical use. The MBCS-Mars is believed to be able to effectively use the atmospheric resources and light energy resources of Mars to continuously produce nutrients for human beings.

<https://2022.igem.wiki/shanghaitech-china>

Shanghai_city

Project Title: Fish tank scavenger

 Remote Team Village

 Judging Session: October 27, 12:30-13:00 CEST, Room J3

This research aims to find an alternative solution to bacterial inhibition. Currently, antibiotics are popular choices due to their effectiveness against microorganism infection, while their abuse leads to bacterial resistance issues thus posing a huge threat to global health. Antimicrobial peptides (AMPs) are alkaline polypeptides that can inhibit bacterial activity without causing bacterial resistance. For this issue, we developed five types of AMPs based on the following functional genes: Hydramacin-1, Spheniscin-2, Spamosin26-54, LL-37, and fusion. The target gene was integrated into plasmid pET28a(+), expressing AMPs in E.coli BL21(DE3) competent cells. Besides the development of bacterial inhibition functions, the fusion AMP has antifungal abilities. Because the aquariums regularly replace a lot of water, we hope that the AMPs created can shed light on a more convenient method of fish tank cleaning to save water resources. Key Words: AMPs, gene

<https://2022.igem.wiki/shanghai-city>

Shanghai_HS

Project Title: Dual Oral Vaccines

 Remote Team Village

 Judging Session: October 27, 14:30-15:00 CEST, Room J3

Enteroviruses and rotaviruses are the main gastrointestinal pathogens affecting the health of infants and young children. This project intends to target two viruses, explore dual oral vaccines, and use the bifidobacteria expression system to obtain recombinant proteins expressed by the fusion of two antibodies, achieve immunity from two viruses by eating a sugar pill, and protect the health of infants and young children. The principle is to construct a VR-vp7 and EV71-vp1 fusion expression vector, import it into Escherichia coli BL21 (DE3), and then transfer it into Bifidobacterium after expression verification to verify the possibility of constructing a rotavirus/EV71 combined antibody. The oral vaccine has broad clinical application prospects. Key Words: Enteroviruses, Rotaviruses, oral vaccines

<https://2022.igem.wiki/shanghai-hs>

Shanghai_Metropolis

Project Title: Fruit wine brewing Plus

 Remote Team Village

 Judging Session: October 27, 10:30-11:00 CEST, Room J3

The high content of higher alcohol in beverages can easily lead to symptoms such as headache, which is the main reason for the slow drunkenness. This project finely regulates the metabolic pathways of higher alcohols in *Saccharomyces cerevisiae* through genetic engineering to reduce the production of higher alcohols. First, the intracellular homologous recombination technology was used to knock out the branched-chain amino acid aminotransferase encoded by the BAT2 gene, and at the same time, the alcohol acetyltransferase ATF1 gene was used to replace the position of the BAT2 gene. Secondly, the ATF1 gene is placed on the expression vector of *Saccharomyces cerevisiae* and then transferred to *Saccharomyces cerevisiae*, to achieve the purpose of reducing the level of higher alcohol in *Saccharomyces cerevisiae*. This project makes the brewed beverage have less high alcohol content so that the drinker is not uncomfortable in the head. Key Words: BAT2, ATF1, high alcohol

<https://2022.igem.wiki/shanghai-metropolis>

Shanghai_United

Project Title: Mixed Feed Additives

 Remote Team Village

 Judging Session: October 26, 9:30-10:00 CEST, Room J1

Pasture feed mainly includes silage and grain feed. Silage contains a large amount of lignocellulose, which is difficult to digest and absorb, while grain feed is composed of a large amount of hemicellulose xylan, which is not easily absorbed by animals. This project plans to adopt the multi-enzyme synergistic degradation strategy to construct engineering bacteria that can hydrolyze lignocellulose and hemicellulose xylan at the same time. Firstly, the recombinant plasmids of cellulase PKC and xylanase xynA were constructed and transformed into *P. pastoris* and the positive transformants were screened to obtain the recombinant bacteria group with high enzyme production, and the enzyme activity and extracellular protein secretion were measured. This project can improve the utilization rate of silage and grain mixed feed and the applicable breeds of livestock, and improve the economic value of mixed feed. Key Words: Mixed Feed, PKC, xynA

<https://2022.igem.wiki/shanghai-united>

SHBS-BANZ

Project Title: Genetic stapler

 Remote Team Village

 Judging Session: October 27, 15:30-16:00 CEST, Room J3

CRISPR-Cas9 is the third-generation gene editing technology after the introduction of ZFN, TALENs, and other gene editing technologies. In just a few years, it has swept the world and become the most mainstream gene editing system today. As research progresses, CRISPR gene-editing technology carries an implied risk of off-target, the accidental editing of other genes in the genome with unpredictable consequences. In this project, the common tool plasmids in prokaryotic expression systems are transformed, and TSD and TIR elements that can be recognized by Casposons are added to achieve site-directed insertion, which is verified by sequencing. This technology can not only play a role in the study of disease treatment methods but also become an efficient tool for upstream gene cloning. Key Words: CRISPR-Cas9, TSD, TIR, gene cloning

<https://2022.igem.wiki/shbs-banz>

Sheffield

Project Title: rEvolver – Vivo La Evolution

 Booth: Foundational Advance Village, A-12

 Village Presentation: October 27, 9:45-10:00 CEST, Plaza 1

 Judging Session: October 26, 12:30-13:00 CEST, Room J12

Naturally-occurring proteins are often repurposed by synthetic biologists for a wide range of applications, but the performance of these genes typically leaves much to be desired. With rational protein engineering only possible for well-studied genes, directed evolution provides an attractive alternative for real-world optimization. Unfortunately, the labor and time-intensive nature of this approach makes it impractical for smaller labs. To make this technology more widely accessible, we developed rEvolver — a kit for continuous, in vivo directed evolution. At the heart of this kit is a modular plasmid system for both targeted mutagenesis using polymerase-guided base editors and continuous growth-rate-based selection. Complementing the plasmid system is an inexpensive, open-source turbidostat designed to reduce the labor-cost of long-running directed evolution experiments. Finally, to further accelerate evolution, our parts and media have been optimized for use with *Vibrio natriegens*, a novel chassis organism with a doubling time of less than 10 minutes.

<https://2022.igem.wiki/sheffield>

SHSBNU_China

Project Title: SynFlora7

 Remote Team Village

 Judging Session: October 27, 14:00-14:30 CEST, Room J2

Eye protection problems have become the one of biggest worries for Chinese teenagers. Reactive oxygen species (ROS) are assumed to damage eye cell proteins. Sunlight and electronic screens emit blue light, that is assumed to penetrate the human lens to the eye macular area and lead to oxidative damage. Anthocyanins are natural pigments widely found in plants, mostly flowers. They are reported as healthcare products to assist many physiological functions, including eye protection and anti-oxidative effects. This year, SHSBNU-China aims to construct an intact metabolic pathway in E.coli, to give them the ability to produce anthocyanins. The whole pathway to producing anthocyanins contains seven enzymes. We used molecular biology and synthetic biology methods to express enzymes in E.coli and verified the production of anthocyanin. We attempted to characterize the enzyme production quality under different experiment conditions to optimize the yield and proposed products using anthocyanins to protect students' eyes.

<https://2022.igem.wiki/shsbnu-china>

SHSID

Project Title: Caries Prevention Plus

 Remote Team Village

 Judging Session: October 26, 15:30-16:00 CEST, Room J1

Caries is a bacterial infection that occurs in dental tissue. This project upgrades genetically engineered bacteria, which can not only specifically kill Streptococcus mutans that cause caries, but also effectively prevent the Formation of biofilm and dissolution of biofilm that has already formed, preventing caries. The principle of this project is by constructing the DexA plasmid and the ClyR plasmid, using the Escherichia coli Nissle 1917 strain to obtain DexA and ClyR engineering strains, measure the enzyme secretion and enzyme activity by SDS-PAGE and reducing sugar method, and testing its ability to inhibit the formation of Streptococcus mutans biofilm and break the biofilm achieves the dual effect of removing the biofilm barrier and lysing caries bacteria. This project has great potential in the prevention and treatment of dental caries. Key Words: Caries, DexA, ClyR

<https://2022.igem.wiki/shsid>

Shym_BIL_NIS

Project Title: Plastikaiensis

 Booth: High School Village, C-15

 Village Presentation: October 27, 15:45-16:00 CEST, Plaza 3

 Judging Session: October 26, 10:30-11:00 CEST, Room J4

Plastic has become an integral part of our lives. The United Nations Environment Programme (UNEP) reports that, as of 2022, estimated 400 million tonnes of plastic waste are generated annually. Non-degradable pollutant polyethylene terephthalate (PET) is extensively used in plastic products, and the overwhelming volume of its discharge in the environment has become a global issue. To mitigate the ongoing problem, we have designed the 'Plastikaiensis' that facilitates rapid plastic decomposition. Enzymes found in *Ideonella sakaiensis* PET hydrolase and MHET hydrolase that work in synergy to achieve complete plastic degradation have been inserted into *Pseudomonas putida* KT2440 strain. The peculiarity of our system is that it allows plastic degradation whilst *P. putida* rapidly adapts to the harsh climatic conditions of the region (Kazakhstan) to proceed with its newly acquired function.

<https://2022.igem.wiki/shym-bil-nis>

SJTU-BioX-Shanghai

Project Title: ODYSSEY

 Remote Team Village

 Judging Session: October 27, 14:00-14:30 CEST, Room J12

In the era of mankind striding towards the deep space, we are exploring the intriguing combination of DNA data storage technology and the novel application scenario of interstellar communication with the help of synthetic biology. To achieve it, we will firstly establish an improved method derived from Yin-Yang Codec System to encode massive information that will be transported within bacterial genome. Secondly, spore display technology and bioengineering transformation system are employed to engineer spores from *B. subtilis* with Dsup proteins and melanin to establish an information container with stronger resistance to radiations, especially GCR which may break DNAs when exposed. Finally, information retrieval rate will be analyzed by specific algorithm after experiments simulating the cosmic environment on those information-stored spores for a substantive demonstration of our design.

<https://2022.igem.wiki/sjtu-biox-shanghai>

SJTU-software

Project Title: DL-ecGEM Reconstruction of Actinomycetes

 Remote Team Village

 Judging Session: October 27, 12:30-13:00 CEST, Room J14

Actinomyces can produce α -glucosidase inhibitors and the anti-diabetic drug acarbose. To improve the production of acarbose, our project intends to develop a generalized modeling software, by adding constraints to the genome-wide metabolic model of actinomycetes and combining deep learning to predict model parameters, it provides a feasible solution for the reconstruction of Deep Learning-based Enzyme-Constrained Genome-scale Metabolic model (DL-ecGEM) for actinomycetes. The model can also be used for simulation experiments. Through that, some hotspot identification tools can be used to find directional transformation plans for cells. Combined with the transformation recommendations given by the software, the deep learning network will be updated and can re-predict the parameters in the model. Thus, the phenotypic changes in acarbose production can be observed through simulation. At the same time, the model parameters can be optimized based on experimental data to make the model more accurate.

<https://2022.igem.wiki/sjtu-software>

SMS_Shenzhen

Project Title: α -galactase genetic engineering modification

 Remote Team Village

 Judging Session: October 27, 10:00-10:30 CEST, Room J3

Lactose intolerance indicates intestinal discomfort caused by decreased beta-galactosidase to digest lactose. Since lactase hydrolyses lactose into glucose and galactose, when the expression of lactase declines due to genetic disorder or natural ageing, the amount of lactose people can tolerate will decrease. It is a worldwide health problem that about 70% of the world population suffered from lactose intolerance. Notably, the incidence is particularly high in Asia because the downward trend of expressing lactase is strengthened by diets rarely containing lactose. In the dairy industry, *Aspergillus oryzae* is one of the most widely used fungal sources of beta-galactosidase (lacA) to produce lactose-free products for people with lactose intolerance. To allow people with lactose intolerance to enjoy dairy products, our project aims to express lacA heterologously in *Pichia pastoris*, quantify the enzymatic property of lacA, and optimise the culture conditions of recombined *Pichia pastoris*.

<https://2022.igem.wiki/sms-shenzhen>

Sogang_Korea

Project Title: SynBioBot - A Robotic Arm System for Cell Culture and Viral Transduction with Remote Control

-  Booth: Foundational Advance Village, A-13
-  Village Presentation: October 26, 9:30-9:45 CEST, Plaza 1
-  Judging Session: October 27, 13:30-14:00 CEST, Room J12

In a cell culture lab, skilled researchers perform delicate routines in an environment designed for human work. Due to limited lab access during the pandemic, it has been challenging to maintain live cells that require operations around the clock. Sogang_Korea aims to build SynBioBot, a robotic system capable of remote and automated cell culture processes as well as synthetic biology experiments. A 6-axis robotic arm was used to perform autonomous cell culture work, which included cell seeding, media transfer, incubator storage, and cell passage. Along with system programming for precise equipment positioning and control, we designed the mechanical interfaces, allowing the robot arm to use various lab tools (e.g., pipettes) designed for human hands without modification. SynBioBot has further carried out genetic modification protocols like lentiviral transduction in mammalian cells. This system can be used as a remote education platform, allowing students from underprivileged areas to practice biological experiments.

<https://2022.igem.wiki/sogang-korea>

Sorbonne_U_Paris

Project Title: The NAWI project

-  Booth: Food & Nutrition Village, E-17
-  Village Presentation: October 26, 10:45-11:00 CEST, Plaza 3
-  Judging Session: October 27, 13:00-13:30 CEST, Room J13

In today's world, feeding humanity is a key issue. That's why our team offers NAWI: New Algae for World Improvements. The project transforms a green microalgae in order to create a new food source, rich in iron to fight malnutrition problems like anemia. Biologically, our project consists of overexpressing THB1 in *Chlamydomonas reinhardtii*. This protein binds to iron molecules and increases the iron's bioavailability. To control and improve THB1 expression, our team worked on the development of insulator sequences compatible with the MoClo kit, the cloning tool we used for *Chlamydomonas*. These sequences isolate genes from their genomic context. Our THB1 transgene therefore includes an inducible promoter, the gypsy insulator sequence from *Drosophila* as well as the associated protein Su(Hw) essential to the insulator mechanism. Finally, the production of the GMO uses bioreactors as an alternative to polluting and soil-destroying methods of agriculture.

<https://2022.igem.wiki/sorbonne-u-paris>

Stanford

Project Title: MORPH: Mutation-Optimized Reactor for PET Hydrolysis

-  Booth: Environment Village, I-16
-  Village Presentation: October 26, 13:00-13:15 CEST, Plaza 5
-  Judging Session: October 27, 16:30-17:00 CEST, Room J7

Polyethylene Terephthalate (PET), accounts for 12% of solid waste worldwide thus making PET processing a top priority. Recently, an enzyme was discovered in bacteria that breaks down PET and following this, several studies have used the wild-type protein to improve its efficiency and stability for enzymatic degradation in vitro. Although these recent achievements are incredible advances, having optimized PETases for conditions that microbes prefer will essentially make PET biodegradable. To produce PETases that function under different conditions (e.g. fermentation), our team is building a platform for producing PETases through continuous directed evolution called “OrthoRep”. To achieve this, we’ve developed a system that selects for yeast mutants with improved activity in user-defined conditions. Our workflow can be used to evolve PETases that work optimally for different species based on the pH and temperature used in our evolution and could be used to evolve enzymes that break down many other materials.

<https://2022.igem.wiki/stanford>

Stockholm

Project Title: B12-intake Gastric Intrinsic Factor (BiGIF): Treating Pernicious Anaemia

-  Booth: Therapeutics Village, D-15
-  Village Presentation: October 27, 13:15-13:30 CEST, Plaza 2
-  Judging Session: October 26, 12:30-13:00 CEST, Room J6

Pernicious Anaemia (PA) is an autoimmune disease that causes vitamin B12 deficiency which lacks efficient treatment. Patients with PA develop autoantibodies against Intrinsic Factor (IF) or IF-producing parietal cells.. Both of these types result in malabsorption of dietary B12 and result in B12 deficiency in the long term. Currently, high dosage B12 is administered to patients intravenously, intramuscularly and to a lesser extent orally, to circumvent malabsorption. Our solution aims to treat PA with a protein therapeutic consisting of an engineered IF which has phenotype-improving mutations in the autoantibody-binding epitope. Successful mutants were generated using site-directed mutagenesis and were surface displayed in mammalian cells to validate the autoantibody and B12 binding. In the future, we are aiming to offer our treatment in the form of pills which include IF bound to B12 for optimised absorption of vitamin B12 and thus, increasing the quality of life for the patients.

<https://2022.igem.wiki/stockholm>

Stony_Brook

Project Title: PROS: Intravenous Administration of Recombinant Human Protein S

 Booth: Therapeutics Village, D-16

 Village Presentation: October 26, 13:15-13:30 CEST, Plaza 2

 Judging Session: October 27, 16:30-17:00 CEST, Room J4

Protein S deficiency is a condition that leads to the formation of fatal blood-clots, contributing to widespread disorders including deep vein thrombosis and pulmonary embolism, which kill ~900,000 Americans annually. Treatments for these disorders are limited to blood thinners with multiple side-effects. Our project, PROS, proposes the first injectable delivery of a recombinant human protein S therapy. Intravenously administered protein S can help treat protein S deficiency, and other disorders including TBI and severe COVID-19. In order to accomplish this, our team optimized PCR reactions, LIC reactions, and protein S expression in a prokaryotic system. We also streamlined the diagnostic procedure for protein S deficiency, establishing an algorithm which cuts the cost of testing by >40%. Overall, we were successful in creating an accessible and inclusive platform that can be further built upon to manufacture and deliver our PROS injectable as a therapeutic for protein S deficiency and related disorders.

<https://2022.igem.wiki/stony-brook>

SubCat_China

Project Title: Probiotics with efficient heterologous expression of lipase for dietary supplement

 Remote Team Village

 Judging Session: October 26, 14:00-14:30 CEST, Room J1

Nowadays, many people face the problem of incomplete digestion of fats in food, which can lead to health problems such as malnutrition. In our project, we used genetic engineering techniques to create bacteria that overexpress lipase. Lipase is an enzyme that helps digest fats in the body's small intestine, which means that it may provide some relief from this health problem. We performed experiments to test enzyme activity under different conditions, helping to confirm the possibility of incorporating this technology into human practice. In the future, our project could be a dietary supplement used in a probiotic drink to benefit people who help digest fat. Key Words: malnutrition, lipase

<https://2022.igem.wiki/subcat-china>

SubCat_Shanghai

Project Title: Say “goodbye” to tumor resistance

 Remote Team Village

 Judging Session: October 27, 12:30-13:00 CEST, Room J2

Glioma is the most common malignant tumor of the adult central nervous system, with high malignancy and mortality. The combination of temozolomide (TMZ) chemotherapy and radiotherapy is currently the standard first-line regimen for high-grade gliomas, but with the progress of chemotherapy, most patients will eventually develop resistance to TMZ which leads to glioma treatment failure. The results of this study provide TMZ-resistant glioma cell lines for basic and clinical research and provide potential molecular targets for reversing TMZ resistance and enhancing the effectiveness of TMZ therapy, which are of great significance for the treatment of gliomas and the improvement of patient prognosis. Key Words: Glioma, TMZ

<https://2022.igem.wiki/subcat-shanghai>

SUNY_Oneonta

Project Title: CyanoSpectre

 Booth: Foundational Advance Village, A-14

 Village Presentation: October 27, 10:00-10:15 CEST, Plaza 1

 Judging Session: October 26, 16:00-16:30 CEST, Room J12

Cyanobacteria are fast-emerging as effective chassis for the sustainable synthesis of organic compounds. They are currently being used to produce plastics, proteins, biofuels, and more. Cyanophages are cyanobacteria-infecting viruses that regulate cyanobacterial populations in nature. This makes them a promising vehicle for cyanobacterial engineering. To aid scientists and iGEM teams who work with cyanobacteria, this project aims to create a cyanophage toolkit for their use. Our project will create a “ghost phage” that can recognize and bind marine cyanobacteria. A minimal set of cyanophage genes will be assembled into a phagemid vector that can replicate in *E. coli* and produce the structural proteins of the phage. To allow our phage to be utilized to immobilize modified cyanobacteria, a biotin-tagged variant of the capsid will be created. Further development of the phage toolkit will enable it to be used as a DNA delivery vehicle in cyanobacterial engineering.

<https://2022.igem.wiki/suny-oneonta>

SUSTech_EMB

Project Title: Intellectual diagnosis and exosome-based target therapy of NSCLC

 Remote Team Village

 Judging Session: October 26, 14:00-14:30 CEST, Room J6

It is head-scratching when mentioned lung cancer, especially non-small cell lung cancer (NSCLC), which comprises 85–90% of lung cancers. This year SUSTech_EMB developed a system called ExMart to provide NSCLC patients with personalized intellectual diagnosis and accurate treatment. Our machine learning-based algorithm can give accurate and rapid diagnosis using lung CT images of patients. Once diagnosed with NSCLC, patients will receive engineered exosomes containing monobody which has been biosafety-checked, can specifically inhibits tumor growth by inhibiting KRAS. Mathematical models of exosome secretion and exosome-mediate drug delivery are built to evaluate and maximize the efficiency of our system. SUSTech_EMB wants to help NSCLC patients with early diagnosis and accurate treatment to improve their living condition.

<https://2022.igem.wiki/sustech-emb>

SUSTech_Shenzhen

Project Title: Tyrian Purple Evolution

 Remote Team Village

 Judging Session: October 26, 15:00-15:30 CEST, Room J10

We produce tyrian purple dye in E.coli by 3 enzymes: Trp 6-halogenase (Trp 6-Hal), tryptophanase (TnaA) and monooxygenase (MO). Due to TnaA can react with both tryptophan and the first step product bromotryptophan, Fre-SttH and TnaA has to be in two different strains. So the two-cell system, ΔTnaA E. coli strain without endogenous TnaA expression and another ΔTnaA E. coli strain with extra TnaA expression, are used to produce tyrian purple with less byproduct indigo. We optimize to one-cell system by developing a synthetic phylogeny of programmable Trp repressor with directed evolution to simplify the process of reacting with bromotryptophan not tryptophan. Iterative rounds of positive and negative compartmentalized partnered replication (CPR) led to the exponential amplification of variants that responded with high affinity and specificity to halogenated tryptophan analogs and novel operator sites. We empower cells to perceive the relative ratio of bromotryptophan to tryptophan to control TnaA synthesis.

<https://2022.igem.wiki/sustech-shenzhen>

SuZhou_Union

Project Title: Luzhou-flavor liquor cell factory

 Remote Team Village

 Judging Session: October 26, 10:30-11:00 CEST, Room J3

Baijiu is one of the most famous distilled spirits in the world, among which Luzhou-flavor liquor is the most popular and best-selling liquor among various flavors, accounting for more than 70% of China's liquor production. This project will build an engineering strain of *Saccharomyces cerevisiae*, increase the content of ethyl caproate, an aroma substance, improve the quality of Luzhou-flavor liquor, reduce food consumption, shorten fermentation time, and optimize the production process of Luzhou-flavor liquor. By constructing an overexpression vector by overexpressing ACC1, FAS1, and FAS2 genes, using lithium acetate transformation technology to transfer it into yeast cells, and using gas chromatography to analyze ethyl acetate after fermentation. This project can improve ethanol and produce a large amount of ethyl hexanoate, which can improve the quality of liquor, and the flavor and taste of liquor are improved. Key Words: Luzhou-flavor liquor, overexpression

<https://2022.igem.wiki/suzhou-union>

Sydney_Australia

Project Title: Developing new in vitro methods for directed evolution of nanobodies for diagnostic and therapeutic applications

 Booth: Foundational Advance Village, A-15

 Village Presentation: October 26, 9:45-10:00 CEST, Plaza 1

 Judging Session: October 27, 10:00-10:30 CEST, Room J12

Nanobodies are epitope-binding fragments from camelid heavy-chain antibodies. They possess antigen-binding qualities typical of whole antibodies but are smaller, more robust, with lowered immunogenicity. Hence, nanobodies are frequently used in medical and research applications like tumour-targeting therapies and ELISA assays. However, nanobody technologies are limited by the requirement of live animal hosts for development and the extensive research time for producing new nanobodies in response to rapidly mutating or diverse antigens (e.g. SARS-CoV2). Our project proposes using synthetic biology for novel nanobody discovery in vitro through DNA-shuffling. This method uses homologous recombination to generate extensive mutant nanobody gene libraries which are screened for useful affinities or specificities using an E.coli surface display system passaged over target antigens immobilised on cellulose via cellulose-binding domains. This removes animals from the development process, allowing for faster, ethical nanobody deployment, for use in technologies like lateral-flow tests to detect emerging coronavirus variants.

<https://2022.igem.wiki/sydney-australia>

All times are stated in CEST – Central European Summer Time
This is the same as Paris Local Time (UTC +2)

SYSU-CHINA

Project Title: ACCESS: Animalcule Co-catalytic Engineering for Salidroside Synthesis

 Remote Team Village

 Judging Session: October 27, 14:30-15:00 CEST, Room J8

Mountaineering is a challenging journey. With the rising elevation, the insufficient oxygen level may lead to a series of syndromes, which is called high-altitude illness. Experienced mountaineers usually take Salidroside, the extracts of Rhodiola for preventing discomfort. However, unrestricted exploitation imperils the living of wild Rhodiola, which is currently listed as China national category-II protected plant. This year, we wish to achieve de novo synthesis of Salidroside in E.coli as an alternative to wild Rhodiola extracts in order to protect this precious plant. In order to avoid metabolic burden and toxicity of metabolic intermediate, we put forward the concept of modularized co-catalysis. Besides, we also conduct direct evolution using TADR system for improving the catalytic efficiency of different types of glycosyltransferases. With synthetic biology, we hope to make our contribution to biomanufacturing of Salidroside.

<https://2022.igem.wiki/sysu-china>

SYSU-Software

Project Title: LOUPE

 Remote Team Village

 Judging Session: October 27, 13:00-13:30 CEST, Room J14

The arms race between prokaryotes and viruses drives the evolution of various defense systems, like CRSIPR-Cas system and RM system, the genes of which account for a large proportion of the genome. Studies show that these defense genes tend to cluster, forming the so-called defense islands. Inside the defense island exist many currently unknown genes which might turn up to be novel defense genes. However, the huge amount of data and skills of multiple bioinformatic tools required can be quite unfriendly to researchers new to the fields, and the rapidly progress made in the fields makes it hard for the existing databases to catch up. Therefore, our project LOUPE focuses mainly on the discovery of the currently unknown defense genes in prokaryotes by exploiting the idea of defense islands. It consists of an online database coupled with a local prediction and evaluation platform of defense genes with optimized protocol.

<https://2022.igem.wiki/sysu-software>

SZ-SHD

Project Title: CanFix-Light Controlled Oral Tumor Vaccines

 Remote Team Village

 Judging Session: October 27, 10:00-10:30 CEST, Room J4

We develop a live oral cancer vaccine by modifying E coli to secrete recombinant OMVs containing antigenic proteins that stimulate the immune system to provide cancer immunity. Our aim was specifically to stimulate immune cells in the intestines. To create this level of specificity we incorporated the SulAp optogenetic promoter and a micro-swallowable auto-positioning capsule UVC light source which we trained to recognize that it is in the right location by utilizing a convolutional neural network exposed to a large dataset of endoscopic video footage. And a self-lysis system based on arabinose induction was designed to remove the modified bacteria from the body after completion of OMV secretion.

<https://2022.igem.wiki/sz-shd>

SZPT-CHINA

Project Title: Beauty G. hansenii -- A Self-growth Multifunctional Film for Cosmetic Use

 Remote Team Village

 Judging Session: October 26, 10:00-10:30 CEST, Room J12

Everyone has a love for beauty, but people have different needs for skin care. To achieve multiple efficacy at the same time, various skincare products are often required. To this end, we focused on developing a live bacterial skincare product with multiple efficacy, and the 'Beauty G. hansenii' with high glutathione production was constructed in our project. Moreover, an optogenetic system was designed to control the 'Beauty G. hansenii'. Within the system, NIR light is used to regulate the production of bacterial cellulose for moisturizing, while blue light is used to regulate the release of glutathione and bacterial lysate for brightening, anti-spot, repairing, anti-aging and skin microbiome maintenance. Our product is presented in the form of live bacterial emulsion, committed to providing users with the freshest glutathione and a brand-new skincare experience. We hope this product can better demonstrate the unique beauty of each user and shine their lives.

<https://2022.igem.wiki/szpt-china>

SZU-China

Project Title: RiceAide- A Comprehensive Solution to Rice Sheath Blight Based on RNAi Pesticide

 Remote Team Village

 Judging Session: October 26, 16:30-17:00 CEST, Room J9

Rice sheath blight is a fungal disease due to the infection of *Rhizoctonia solani* (R.solani) and is one of the most serious diseases of rice with the highest incidence and resulting in 6 billion kilograms of rice yield reduction every year in China. This year, we developed a comprehensive solution, which was integrated from three strategies functioning on prevention, detection and treatment of R.solani respectively. To prevent the infection of R.solani, we cut off the water and air transmission routes of R.solani, by using biocontrol fungi - *Trichoderma atroviride*. For the early detection of rice sheath blight, we developed LAMP and E-nose detection systems. And we also developed stabilized RNAi effector molecules binding with nanomaterials to specifically inhibit and kill R.solani. In brief, we hope to build an efficient and comprehensive system, thereby contributing our strength to the prevention and control of rice sheath blight.

<https://2022.igem.wiki/szu-china>

TAMU

Project Title: PET-X: Living Biocatalysts for Plastic Degradation

 Remote Team Village

 Judging Session: October 26, 16:00-16:30 CEST, Room J7

Our team is tackling the critical challenge of plastic pollution, specifically from polyethylene terephthalate (PET) materials. The bacterial enzymes PETase and MHETase work synergistically to degrade PET into the environmentally benign monomers terephthalic acid and ethylene glycol. Although there has been much effort toward highly efficient plastic degradation, a systematic approach using protein engineering and strain engineering to improve plastic degradation is still required to achieve practical applications. Our first completed goal was the surface display of PETase and MHETase enzymes in *E. coli* using transporter proteins for the creation of whole-cell biocatalysts, eliminating the need for costly and time intensive enzyme purification. Secondly, to evaluate changes in effectiveness we developed qualitative and quantitative high-throughput kinetic assays. Finally, we used small trials of DNA mutagenesis to create and evaluate modified enzymes as a proof of concept for improving enzyme functions including PETase in future works.

<https://2022.igem.wiki/tamu>

TAU_Israel

Project Title: TrigGate - A computational tool for cell-specific mRNA translation by 5' UTR engineering

-  Booth: Foundational Advance Village, A-16
-  Village Presentation: October 27, 10:30-10:45 CEST, Plaza 1
-  Judging Session: October 26, 17:00-17:30 CEST, Room J12

The use of RNA as a therapeutic tool is a new frontier of disease treatment, but for it to be safe, therapeutic mRNA translation must be limited to a specific cell type. Commonly, delivery vehicles are used to target cells according to cellular membrane characteristics, but such methods have many limitations, including insufficient specificity. A switch module on the 5' UTR of the mRNA that senses and responds to a specific endogenous RNA trigger in the target cell, can be used in parallel to enhance specificity. To date, such a switch module has been used successfully in prokaryotes, including by many IGEM teams, but not in eukaryotes, and tools to design them efficiently are lacking. We are creating an innovative, user-friendly, generic software tool for designing switch modules in both prokaryotes and eukaryotes using new algorithms and models which will assist in generating efficient, selectively translated mRNA molecules.

<https://2022.igem.wiki/tau-israel>

Tec-Chihuahua

Project Title: Agrocapsi: An antimicrobial peptide and iRNA technology-based fungicide against wilting

-  Booth: Food & Nutrition Village, E-18
-  Village Presentation: October 26, 12:45-13:00 CEST, Plaza 3
-  Judging Session: October 27, 16:00-16:30 CEST, Room J13

Chilli is responsible for substantial economic gains worldwide and is a key element in Mexican gastronomy. Unfortunately, this crop has reported losses of up to 100% due to wilting. This disease is caused by a phytopathogen complex consisting mainly of *Phytophthora capsici* and *Fusarium oxysporum*. Current treatments use different agrochemicals, which put environmental and human health at risk and promote pathogen resistance. We propose a biofungicide containing siRNAs designed to inhibit the production of essential proteins for these pathogens. The defensin DrsB1 with an added chitin binding domain and osmotin PcOSM which destabilize *P. capsici* and *F. oxysporum* membranes are also included. These antimicrobial peptides (AMPs) and siRNAs will be expressed in *Escherichia coli* BL21 (DE3) and HT115, respectively. AMPs will be coexpressed with DsbA chaperone to enhance disulfide bond formation. Agrocapsi protects food accessibility and an icon of our identity.

<https://2022.igem.wiki/tec-chihuahua>

Tec-Monterrey

Project Title: RNair: An optimized gene silencing mechanism for resensitizing resistance bacteria.

 Booth: Therapeutics Village, D-17

 Village Presentation: October 27, 13:30-13:45 CEST, Plaza 2

 Judging Session: October 26, 15:30-16:00 CEST, Room J4

It is estimated that by 2050 antibiotic resistance will cause around 10 million deaths per year, being one of the 10 main public health threats. This resistance has developed due to unnecessary prescription, self-medication and incomplete treatment. In this scenario *Pseudomonas aeruginosa* is one of the most frequently isolated microorganisms in critically ill patients in Mexico. Our solution is a gene silencing system delivered via modified M13 bacteriophages that are nebulized and microfluidically stabilized by liposome-phage complexes to deliver sRNAs to *Pseudomonas aeruginosa*. This gene silencing is based on computationally optimized sRNAs that combine the use of 2 different bioinformatic score protocols and which are evaluated through Machine Learning algorithms.

<https://2022.igem.wiki/tec-monterrey>

TecCCM

Project Title: iMoAge. Inflammatory Monitor of Aging

 Booth: Diagnostics Village, F-16

 Village Presentation: October 26, 14:45-15:00 CEST, Plaza 4

 Judging Session: October 27, 15:30-16:00 CEST, Room J10

Life expectancy has increased in the last century, thus populations will age at faster rates in the near future. This means that age-related diseases will be frequent among society, imposing serious strains in the health sector. One major hallmark of aging is a gradual increase in chronic low-grade inflammation levels, a process called inflammaging. Knowing that it is a complex process that involves the interaction of several molecules, the goal of TecCCM is to measure the ratio between 3 proinflammatory markers (CRP, TNF- α & CXCL9) and an anti-inflammatory marker (IL-10). We have developed a PoC biosensor that consists of a multiplex lateral flow assay for easy semiquantitative results. The design involves 2 different aptamers for each biomarker, in order to create a sandwich assay able to detect each protein. By creating this geroscience tool we want to empower the health sector and civil society to promote a healthy aging culture.

<https://2022.igem.wiki/tecccm>

TecCEM

Project Title: Hydro-defense: defending crops against disruptors



Booth: Environment Village, I-17



Village Presentation: October 27, 10:45-11:00 CEST, Plaza 5



Judging Session: October 26, 16:00-16:30 CEST, Room J6

Endocrine Disrupting Chemicals (EDCs) have concerning effects on plants, livestock and humans health, finding their way into the water via plastic, pesticide, and drug waste pollution. iGEM TecCEM 2022 aims to address this issue with two closely related projects. First, contributing to quality regulations with an electrochemical biosensor capable of quantifying the amount of EDCs in crop irrigation water, comprised by Human Estrogen Receptor Alpha protein for a biological recognition, gold nanoparticles and a piezoelectric for signal transduction to be shown on the developed software. Then, solving the problem with our degradation system consisting of various types of immobilized recombinant laccases encased by zeolite, which oxidize EDCs and degrade them into less toxic photosensitive compounds. Our third project addresses the antibiotic resistance concern due to their use as selection markers. Isoeugenol monooxygenase as an alternative selection marker for *Escherichia coli* strains was proposed, implementing isoeugenol as an inhibitory growth substance.

<https://2022.igem.wiki/teccecm>

Technion-Israel

Project Title: Angel Roots: From plants to bacterial cells, biomanufacturing decursin to treat chemotherapy-induced alopecia



Booth: Biomanufacturing Village, B-21



Village Presentation: October 27, 15:30-15:45 CEST, Plaza 1



Judging Session: October 26, 10:00-10:30 CEST, Room J9

Angelica Gigas is a plant well known in Asia for its medicinal properties, which are attributed to decursin. Decursin was identified as a novel agent for the treatment of many medical conditions, as well as a promising candidate for the treatment of chemotherapy-induced alopecia (hair loss), one of the most distressing side effects for cancer patients. Nowadays, decursin is expensive and inaccessible due its low-yielding and polluting extraction, alongside the seasonal nature of the plant. To address this issue, we chose to bio-manufacture decursin in bacteria. We designed a synthetic circuit encoding for three enzymes that catalyze the two penultimate reactions in the anabolic pathway. This will make the production of decursin cheap and sustainable and enable therapeutic applications to be further explored. Finally, we engineered a biosensor that could quantify decursin. This can be used by future teams that investigate molecules that affect the Hippo signaling pathway.

<https://2022.igem.wiki/technion-israel>

TecMonterrey_GDL

Project Title: Enzymatic system for monitoring of emerging contaminants in water bodies



Booth: Environment Village, I-18



Village Presentation: October 27, 13:00-13:15 CEST, Plaza 5



Judging Session: October 26, 16:30-17:00 CEST, Room J7

Water scarcity is a major constraint to socio-economic development. Therefore, research has been focused to evaluate water quality through the measurement of different contaminants. Among them, the presence of emerging contaminants (ECs), principally micropollutants, such as pesticides, pharmaceuticals, and hormones are an important matter due to the negative impact its presence could have on aquatic life, the ecosystem and human health. In order to effectively monitor and determine ECs, there is a need to create fast, responsive analytical procedures. Nowadays, major approaches include liquid or gas chromatography and mass spectroscopy. Thus, with the purpose of building a sensible kit to ECs able to measure concentrations in the magnitude of nanoMolar, an enzymatic system was developed to detect the presence of erythromycin, rifampicin and pentachlorophenol present in a variety of water bodies in Jalisco, Mexico.

<https://2022.igem.wiki/tecmonterrey-gdl>

Thailand_RIS

Project Title: Bacteria-Battling Bombolitin



Booth: High School Village, C-16



Village Presentation: October 27, 16:30-16:45 CEST, Plaza 3



Judging Session: October 26, 10:30-11:00 CEST, Room J2

Ralstonia solanacearum bacteria causes bacterial wilt which causes yield loss of up to 90% in solanaceous crops. These bacteria block water uptake from the plant's xylem, causing the plant to die. Chemical pesticides are currently used, but there are detrimental effects to the environment and consumers. We aim to contribute to SDG's 15th goal of life on land by decreasing the usage of pesticides by providing a substitute: Modified Bombolitin Antimicrobial Peptide. The modified bombolitin peptide, with attached amino acids to increase hydrophobicity, is expressed through competent *Escherichia coli* cells. Gene cloning and overexpression of bombolitin was done. To test the efficiency of plant protection, in-vitro testing of the peptide on *Ralstonia* bacteria is applied. Additionally, peptides with similar properties to the bombolitin are also identified through biopanning, allowing for future improvements. By expressing modified bombolitin, we wish to find a possible alternative to certain pesticides.

<https://2022.igem.wiki/thailand-ris>

TheKingsSchool_AU_HS

Project Title: Sweet Genes: E. coli with Improved Xylose Utilisation

 Booth: High School Village, C-17

 Village Presentation: October 26, 16:30-16:45 CEST, Plaza 3

 Judging Session: October 27, 13:00-13:30 CEST, Room J3

A large amount of bio-waste is burnt or deposited in landfill, releasing harmful greenhouse gases. Much of agricultural bio-waste contains plant dry matter, or lignocellulose, approximately half of which is glucose and 18-30% is xylose. Synthetic biologists can engineer E. coli to grow on lignocellulosic biomass and produce clean bio-energy. However, carbon catabolite repression and diauxic growth controls the order in which different carbon sources are metabolised, and so E. coli preferentially utilises glucose over xylose, meaning xylose content in lignocellulose is not utilised to its full potential. We have increased the xylose uptake of E. coli by inducing a yeast-derived XR-XDH pathway in E. coli to provide an alternative route for catabolising xylose to xylulose-5-phosphate (X5P). We also induced phosphoketolase to alleviate the flux of X5P through glycolysis. We envision our improved E. coli strain to serve as a chassis organism that optimises the efficiency of sustainable bio-energy production.

<https://2022.igem.wiki/thekingsschool-au-hs>

Thessaloniki

Project Title: THERIAC: Theranostics using RNA interference with applications in cancer

 Booth: Therapeutics Village, D-18

 Village Presentation: October 26, 13:30-13:45 CEST, Plaza 2

 Judging Session: October 27, 14:30-15:00 CEST, Room J5

Glioblastoma multiforme is the most common malignant brain tumour. It is considered a rare disease and has the lowest survival rate among all types of cancer. The high recurrence rate and poor prognosis are cause for concern. Is it not tragic, the quality of life glioblastoma patients have! Due to the emerging need for better treatment, our team dedicated itself to finding a precise and effective treatment for GBM. 'Theriac', our project, is a molecular tool that aims to target cancer cells with high accuracy, through the detection of two overexpressed microRNAs. The detection of GBM biomarkers leads to the release of two different therapeutic molecules (siRNAs) that will lead to the reduction of the tumour. For the release of siRNAs, we are utilising the Hybridization Chain Reaction (HCR) technique. Theriac is designed to reach glioblastoma cells and cancer stem cells located in brain areas that cannot be accessed surgically.

<https://2022.igem.wiki/thessaloniki>

Thessaloniki_Meta

Project Title: DIAS: A CRISPR/Cas13a- based In Vitro Diagnostic Device for the early detection of Lung Cancer

 Booth: Diagnostics Village, F-17

 Village Presentation: October 26, 15:45-16:00 CEST, Plaza 4

 Judging Session: October 27, 9:30-10:00 CEST, Room J10

Lung cancer is the leading cause of cancer death worldwide, affecting both the patient's psychology and quality of life, as well as the sound operation of the healthcare systems. Poor lung cancer prognosis due to the delayed diagnosis in advanced stages inspired our team to design DIAS, a low-cost, non-invasive in vitro diagnostic (IVD) device for the early detection of Non-Small Cell lung Cancer. DIAS detection platform is based on the CRISPR/Cas13a system as a nucleic acid amplification (NAA)-free platform for the highly sensitive detection of specific miRNA biomarkers elevated in patients' blood. To further enhance the system's sensitivity, we imitated the bioinspired confinement effect by performing the Cas13a detection assays in picoliter-scale microreactors generated via 3D-printed droplet microfluidics. During DIAS project conceptualization our team developed innovative synthetic biology-based methodologies, harnessed engineering tools and applied state-of-the-art technologies towards implementing a Point-of-care IVD device for the early detection of lung cancer.

<https://2022.igem.wiki/thessaloniki-meta>

Thessaly

Project Title: Navanthus: A monitoring and phytoremediation system against eutrophication

 Booth: Environment Village, I-19

 Village Presentation: October 26, 13:15-13:30 CEST, Plaza 5

 Judging Session: October 27, 12:30-13:00 CEST, Room J7

The Thessalian plain was one of the most fertile valleys of ancient Greece. Today, its intensive exploitation has led to the eutrophication of both Lake Karla and the Pinios River. Inorganic phosphate accumulation in water causes the formation of harmful algal blooms that produce cyanotoxins, leading to aquatic ecosystem deterioration. Our team aims to develop a universal monitoring and phytoremediation approach for eutrophic waters. The monitoring system will evaluate the ecological status of the water body and, wherever it indicates critical levels of eutrophication, a constructed floating wetland (CFW) will be implemented. The CFW will be made of biodegradable mycelium carrying genetically engineered plants. Once plant roots detect cyanotoxins via a novel synthetic riboswitch, they will overexpress PHT1 transporters that will enhance phosphate uptake. Plant shoots and leaves will stand over the CFW and will be eventually harvested and converted into fertilizer.

<https://2022.igem.wiki/thessaly>

Thinker-Shenzhen

Project Title: ChDe

 Remote Team Village

 Judging Session: October 27, 9:30-10:00 CEST, Room J3

Dermatomycosis is a skin disease caused by fungi, which is common and diverse in humans and pets. If not treated in time, it may trigger serious consequences. According to a survey, one billion people worldwide are suffering from fungal skin diseases today. Therefore, finding an innovative and efficient way to treat fungal skin diseases is urgent. To kill the fungi on the skin, we intend to degrade the chitin in the fungal cell wall by using chitinase to destroy its structure. However, most common chitinases on the market have only one degradation domain and thus have a weak binding ability. In this case, they cannot work efficiently. To solve this problem, our team used synthetic biology to bind chitinase binding domains extracted from two bacteria to the N and C ends of our chitinase, respectively, to obtain modified chitinase with strong binding ability.

<https://2022.igem.wiki/thinker-shenzhen>

THINKER_CHINA

Project Title: LysTech DETR, a pioneering chromogenic detection system

 Remote Team Village

 Judging Session: October 27, 13:30-14:00 CEST, Room J3

The primary detection methods are effective but are expensive and require heavy machines with complex operations. Therefore, we, THINKER_CHINA, with biosensors as our core, are working on designing a better, cheaper, more efficient detection module and reporting module that can be market-oriented. Our biosensor is essentially based on the high specificity of E coli's operons and the function of SRRz lysis gene. SRRz is a kind of gene extracted from phages, and the expression of which has the effect of lysing the bacterial cell wall. Bacterial endogenous β -galactosidase can catalyze the chromogenic reaction of the colorless substrate x-gal. The chromogenic reaction demonstrates a clear pattern of different greyscale values, positively correlated with the intensity of SRRz gene expression. And this operon-induced expression is correlated with the intensity of the objective factors, so different concentrations of the factors result in different greyscale values.

<https://2022.igem.wiki/thinker-china>

Tianjin

Project Title: Micro Nuwa — Base Editor and Ultra Long gRNA Array Enable DNA Data Re-editing

 Remote Team Village

 Judging Session: October 27, 15:30-16:00 CEST, Room J11

DNA storage is a new opportunity to address the challenges of data storage. The project of iGEM Tianjin2022 aims to explore more possibilities of DNA storage technology. Through reasonable and unique coding algorithm, we transformed the data to be stored, such as images, music and texts, into DNA sequences that satisfy the editing needs. And then our multiplex information editing system(Micro nuwa) which contains base editor and ultra -long gRNA arrays, rewrites the data pre-stored in DNA. Ultimately, We successfully transformed one image into another image and transformed one piece of music into another piece of music. Micro nuwa serves as a powerful tool efficiently modifying the information stored in DNA.

<https://2022.igem.wiki/tianjin>

TJUSLS_China

Project Title: Capsid ripper! Rational designed mutated Proteinase K with ultra thermostability at RT

 Remote Team Village

 Judging Session: October 27, 10:30-11:00 CEST, Room J11

As a broad spectrum protease, Proteinase K has extremely high enzyme activity and extensive substrate specificity, which is widely used in various fields. Proteinase K is used in nucleic acid extraction to degrade the protein and promote the release of nucleic acid. However, its easy self-degradation and poor stability at room temperature limit its large-scale application. Supported by extensive computer modeling, we applied a series of rational protein engineering strategies to rationally design Proteinase K to enhance its stability. A variety of software and modeling methods including autodock vina and gromacs were used to superimpose and screen multiple mutation points, experimental verification was carried out in the laboratory. Our project makes it possible to use and transport Proteinase K at room temperature, and greatly reduces the cost of using Proteinase K. We are actively seeking commercialization possibilities to expand the impact of our projects and bring benefits to more people.

<https://2022.igem.wiki/tjusls-china>

TokyoTech

Project Title: Dengnosis

 Booth: Diagnostics Village, F-18

 Village Presentation: October 26, 16:00-16:15 CEST, Plaza 4

 Judging Session: October 27, 9:30-10:00 CEST, Room J11

Dengue fever is an infectious disease caused by the dengue virus (DENV), which is transmitted by mosquitoes. There are four serotypes and infections with multiple serotypes can often cause severe dengue. It is crucial to predict serotypes for prevention because it contributes to the research of treatments or supplements for vaccines, but the low local diagnosis rate is a problem. Therefore, we create DENV serotype infection detection kit, fluorescent measurement device and epidemic serotype prediction system. In the detection kit, we created single-round infectious particles (SRIP) and SRIP infection detecting cells, which can be detected for infections by measuring fluorescent. In the fluorescent measurement device, which is portable, fluorescent data is sent to the prediction system. In the prediction system, epidemic serotype is predicted by analyzing the accumulation data with mathematical methods and machine learning. These systems can be used in field for epidemiological studies and applied to other viruses.

<https://2022.igem.wiki/tokyotech>

Tongji_China

Project Title: Bplant: A Microbial Cell Factory that Produces Bromelain of High Quality

 Remote Team Village

 Judging Session: October 27, 10:00-10:30 CEST, Room J9

Bromelain is a plant protease which has a variety of properties, including anti-cancer activity, anti-inflammatory effect, antimicrobial effect, antibiotic potentiation, skin protection, postsurgery recovery and so on. It has a wide range of applications in the medical and food fields. Even though bromelain has great application potential, the traditional production process has issues of inefficiency, unstable source and low enzyme activity. Bplant replaced the traditional technique by synthetic biology and improved both enzymatic activity and stability by directed evolution. In the field of fodder processing, bromelain can transform protein in feed into polypeptides and small peptides that are easy for animals to digest and absorb. It brings a variety of benefits like improving feed conversion efficiency, enhancing animal disease resistance and reducing the use of antibiotics as antibiotic substitute. In this application scenario, we hope to use *Bacillus subtilis* as bromelain production plant for safety consideration.

<https://2022.igem.wiki/tongji-china>

Tongji_Software

Project Title: AcrGPS（Anti-CRISPR Genome-based Predicting Software）

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J14

As a product of the viral resistance defense mechanism, Anti-CRISPR proteins can effectively inhibit the operation of the CRISPR-Cas immune system. This kind of protein has the advantages of diverse intrinsic mechanisms, broad-spectrum, ease of use, and is genetically encodable. Therefore, it not only improves gene editing safety by reducing off-target effects but also has great potential for development and use in the field of synthetic biology. Our software constructs a prediction model based on the Random Forest algorithm by computing, extracting, and integrating features in the protein itself as well as in the genomic sequence to find the most likely candidates from the input complete genome, hoping to provide biology researchers and synthetic biologists with an integrated and convenient Anti-CRISPR protein mining tool.

<https://2022.igem.wiki/tongji-software>

Toronto

Project Title: On-site early diagnostic tool for oak wilt disease using LAMP

 Booth: Conservation Village, H-4

 Village Presentation: October 27, 17:45-18:00 CEST, Plaza 5

 Judging Session: October 26, 17:00-17:30 CEST, Room J5

Oak wilt is a disease caused by the fungus *Bretziella fagacearum* that can devastate oak tree populations. According to the Canada Oak Wilt Response Framework, one of the ways to conserve wildlife dependent on oak trees is through early detection and monitoring. The current methodology requires examination of live xylem tissue which is time-consuming, costly, and prone to false negatives. With oak wilt found near the Ontario-Michigan border, there is an urgent need for a rapid, low cost point-of-care diagnostic device to detect oak wilt in Canada. We propose a portable device to extract and detect fungal DNA on site combined with colorimetric loop-mediated isothermal amplification (LAMP), thus, enabling our stakeholders to identify infected oak trees in a timely manner and help slow down the spread of oak wilt. Our work contributes to promoting the conservation of our ecosystems.

<https://2022.igem.wiki/toronto>

Toulouse_INSA-UPS

Project Title: DAISY : find out everything you could be allergic to!

 Booth: Diagnostics Village, F-19

 Village Presentation: October 26, 16:15-16:30 CEST, Plaza 4

 Judging Session: October 27, 12:30-13:00 CEST, Room J11

Due to multi-environmental factors, allergies have been a rising problem over the last decades and even our team members are at risk. Today, the number of detected allergens is still limited, resulting in undiagnosed allergies. Our project proposes an innovative approach to detect Immunoglobulins E (IgE) in the patient's blood and so, the predisposition to any allergy. This method is based on the specific aggregation of engineered Escherichia coli strains in presence of IgE. We produced the strains, modeled interactions and used state-of-the-art technologies for high-throughput screening. While there is still room for optimization, the method is a major step towards detection of any allergy and the production of custom-made treatments. We identified that patients and their relatives seldomly know what allergies are about. So, we engaged in a deep educational effort including a series of videos named "Cracking Allergies", as it is what we firmly intend to do!

<https://2022.igem.wiki/toulouse-insa-ups>

Tsinghua

Project Title: Run Sperm Run

 Remote Team Village

 Judging Session: October 26, 10:00-10:30 CEST, Room J11

Reproductive health has become a hotspot of concern since recent years have witnessed a continuous decline in fertility rates in China. Among all physiological factors, low sperm quality is considered as the major cause. Currently, sperm quality can be examined through hospital appointments which are time-consuming and may place psychological burden on patients, adding additional challenge to tackling the issue of reproductive health. Therefore, our team has proposed a novel diagnostic method to test sperm quality for household use. Our chip-based product is designed to measure sperm motility and fertility simultaneously, and present results in a visual way. We believe our home-use sperm quality test chip could contribute to self-examination and large-scale preliminary disease screening of sperm quality, increasing the medical attendance rate of reproductive diseases. Perhaps the hardest part of solving reproductive health dilemma is to confront it directly. We hope our product will be the first step.

<https://2022.igem.wiki/tsinghua>

TU-Eindhoven

Project Title: Designing a modular and personalized autoimmune cell therapy for ANCA-associated vasculitis



Booth: Therapeutics Village, D-20



Village Presentation: October 26, 14:30-14:45 CEST, Plaza 2



Judging Session: October 27, 13:30-14:00 CEST, Room J5

Worldwide 400 million people suffer from autoimmune diseases, of which 1 million are affected by the inflammatory disorder ANCA-associated vasculitis (AAV). Current therapies against AAV are based on unspecific immunosuppressive drugs causing burdensome side effects, high healthcare expenditures and workloads, while not excluding disease relapses. To overcome these shortcomings, we designed !MPACT: a Modular and Personalized Autoimmune Cell Therapy. The design was made together with relevant stakeholders, a proof-of-concept was developed in the laboratory, and a kinetic model was built. We engineered mammalian cells that detect the autoantibodies (ANCAs) and subsequently produce the anti-inflammatory cytokine interleukin-10, which results in suppression of the autoimmune response. The activity of !MPACT depends on the ANCA concentration, hence, it adjusts to the disease activity, leading to fewer side effects than current therapies, preventing relapses, and reducing healthcare expenditures and workloads. The modularity of the used technology offers great potential to treat many autoimmune diseases.

<https://2022.igem.wiki/tu-eindhoven>

TU Delft

Project Title: SPYKE: Detect to Protect



Booth: Diagnostics Village, F-21



Village Presentation: October 27, 15:15-15:30 CEST, Plaza 4



Judging Session: October 26, 13:30-14:00 CEST, Room J10

The occurrence of drink spiking with so-called rape drugs has been increasing over the past years, reaching new heights in the past year. Most cases involve the drug gamma-hydroxybutyric acid (GHB). To protect people from drink spiking, we need a sensor that can detect GHB rapidly, continuously, in-situ, and accurately. With such a device, it will be possible to detect GHB in a spiked drink and alert users to prevent them from drinking it. We have designed a new kind of sensor for the detection of GHB in drinks by combining the specificity of biomolecules with the reliability of electronics. The sensor is integrated in a cup you can drink from, with a compartment in the bottom that holds the electrode and the electronic hardware. Our research involved the assembly of a working prototype from existing parts, as well as engineering new parts to improve the sensor.

<https://2022.igem.wiki/tudelft>

Tuebingen

Project Title: Anatoxic



Booth: Environment Village, I-20



Village Presentation: October 27, 13:15-13:30 CEST, Plaza 5



Judging Session: October 26, 10:30-11:00 CEST, Room J7

Anatoxin-a is a cyanobacterial toxin which can be found in freshwater sources when numbers of cyanobacteria increase. Ingestion of the toxin may lead to death by suffocation by overstimulating the muscles responsible for breathing. Mainly dogs and farm animals consuming the contaminated water are affected. The current detection methods are laborious and require expensive chromatography and mass spectrometry equipment. This why in our project we aimed to develop an E.coli biosensor for a cheaper and easier detection of Anatoxin-a. We created a hybrid chemoreceptor which upon binding of the ligand induces the expression of GFP in the engineered E.coli. A plate reader can then be used to detect this signal.

<https://2022.igem.wiki/tuebingen>

TU_Braunschweig

Project Title: Lion Detect: Self-amplifying detection system



Booth: Diagnostics Village, F-20



Village Presentation: October 27, 15:00-15:15 CEST, Plaza 4



Judging Session: October 26, 9:30-10:00 CEST, Room J10

Early detection offers the best chances of cure'. This statement is true for many diseases. However, early detection of disease is not always possible and is often limited by inadequate diagnostic methods and technologies. We, the iGEM team Braunschweig, have set ourselves the goal of developing a system that can detect minute amounts of disease-relevant antigen using a self-amplifying system. LionDetect consists of three components. The detection component which recognizes and binds antigens by using scFv fragments. This component forms an active protease, which activates the following amplification component and reporter component. As soon as the reporter component is activated, a signal is detectable by a FRET pair. In addition, a large part of our work is dedicated to raising awareness about esophageal cancer. Individuals suffering from this disease show symptoms at a late stage, which in many cases are not associated with esophageal cancer at first.

<https://2022.igem.wiki/tu-braunschweig>

TU_Dresden

Project Title: WunderBand: a Bioresponsive Hydrogel Platform for Phage and Yeast-derived Growth Factor Therapy of Chronic Wounds

 Booth: Therapeutics Village, D-19

 Village Presentation: October 27, 13:45-14:00 CEST, Plaza 2

 Judging Session: October 26, 14:30-15:00 CEST, Room J5

Chronic wounds are wounds that cannot progress through the normal stages of healing. They represent a growing problem, especially amongst aging populations and affect millions of patients each year. Chronic wounds are susceptible to bacterial infections and treatment relies heavily on antibiotics. Because of this, antibiotic-resistant bacterial strains are on the rise, increasing patient morbidity and mortality. To combat resistant bacteria-infections, we have adopted phage therapy. Our team has developed a bioresponsive hydrogel wound dressing for the treatment of chronic wounds. The bioresponsive hydrogel releases bacteriophages upon stimulation of the gel by proteases produced by the infected wound. Moreover, we have created new genetic parts and screened signal peptides to transform yeast into an efficient biofactory for the secretion of human growth factors. Using the same principles as in our bioresponsive phage-hydrogel, the secreted growth factors are released and can help chronic wounds to overcome inflammation and aid in healing.

<https://2022.igem.wiki/tu-dresden>

UAM

Project Title: SPIDICIDE

 Booth: Food & Nutrition Village, E-19

 Village Presentation: October 27, 10:00-10:15 CEST, Plaza 3

 Judging Session: October 26, 16:00-16:30 CEST, Room J13

Mexico has enormous agricultural biodiversity, producing and exporting various vegetables, fruits, and grains. However, several pests attack Mexican crops impacting the sustain of families in rural communities, the economy, and the country's food supply. In particular, the order Coleoptera presents critical pests in native crops. Some of these pests are the avocado, agave, and cactus weevil, which damages their host plant. Sadly, these are only three of the numerous affected Mexican crops. Therefore, our team designed a biopesticide using a holistic perspective capable of efficient coleopteran control. This cell-free product is based on two spider venom peptides as their active ingredients, AcTx-Hv2 and OAIP-1. These peptides have a high selectivity to Coleoptera order and don't impact human health. We used *Pichia pastoris* to produce these peptides taking advantage of its capability to express complex molecules in high yields.

<https://2022.igem.wiki/uam>

UBC-Okanagan

Project Title: Life Bulb: An Autobioluminescent Lighting System in Cyanobacteria using Fungal Genes

-  Booth: Climate Crisis Village, G-10
-  Village Presentation: October 27, 9:45-10:00 CEST, Plaza 4
-  Judging Session: October 26, 17:30-18:00 CEST, Room J7

Autobioluminescent organisms are the future of lighting. Electrical light contributes to 20% of energy consumption and 6% of global CO₂ emissions, which are projected to increase 60% by 2030. Thus, we propose an autobioluminescent lighting system to tackle the climate crisis by reducing energy consumption and greenhouse gas emissions. We will engineer the cyanobacteria *Synechocystis* sp. PCC 6803 with a cyclical bioluminescent pathway elucidated from fungi, which has previously only been expressed in eukaryotes. Our genetic circuit was designed based on the analysis of genomic differences and field observations of different species of luminous fungi. With these fungal genes we will create a scalable, versatile, and carbon-negative lighting source. We engineered *E. Coli* with a codon optimized version of this pathway as a stepping-stone for expression and characterization of the system in *Synechocystis*. This proof-of-concept study will open the doors for an adaptable and efficient way of growing light.

<https://2022.igem.wiki/ubc-okanagan>

UBC_Vancouver

Project Title: Synaestivum: a heat-inducible genetic plant system in wheat to strengthen tolerance to elevated temperatures

-  Booth: Food & Nutrition Village, E-20
-  Village Presentation: October 27, 10:30-10:45 CEST, Plaza 3
-  Judging Session: October 26, 16:30-17:00 CEST, Room J14

Elevated temperatures are a worldwide phenomenon of increasing severity that negatively affects crop yields. Common wheat (*Triticum aestivum*) is a crop that is both severely affected by heat and vital for global nutrition; therefore, producing heat-tolerant wheat varieties would be an essential step toward global food security. Synaestivum aims to reach this objective through the heat-inducible expression of enzymes that offset metabolic stress under heat conditions, prevent protein misfolding, and increase yield through an optimized photosynthetic rate. As a proof of concept, we optimized the isolation of wheat protoplasts to validate the expression of this genetic system. As complementary efforts to validate our design and implementation, we built a hardware device that detects activation of our constructs for implementation in the field, and utilized bioinformatic analyses to confirm that the gene pathways in our design are significantly overexpressed in heat conditions.

<https://2022.igem.wiki/ubc-vancouver>

UCAS-China

Project Title: FitYo: Customizable Meal Replacement System Based on Synthetic Biology

 Remote Team Village

 Judging Session: October 26, 13:00-13:30 CEST, Room J13

FitYo is comprised of two components: the engineered fermentative bacteria and a meal replacement making system. They combine to provide a user-friendly and on-demand nutritional solution for anyone looking for a highly diverse and customizable meal replacement product. Using synthetic biology approaches, we constructed a fermentation system that can be controlled by light and temperature simultaneously, allowing regulated selective production of different compounds. To put our vision into action, we developed a set of hardware and software tools that allowed customers to tailor their meal replacement milkshakes based on their preferred flavors and functions. Furthermore, surveys into various customer groups as well as other human practices activities aided in shaping the design and final aim of our project. Essentially, FitYo supports the notion of healthful eating and free choices, with the goal of providing limitless possibilities for future diets.

<https://2022.igem.wiki/ucas-china>

UChicago

Project Title: Perfluorosense: Biosensor for the detection of perfluorooctanoic acid

 Booth: Environment Village, I-21

 Village Presentation: October 27, 13:30-13:45 CEST, Plaza 5

 Judging Session: October 26, 14:30-15:00 CEST, Room J7

Perfluorooctanoic acid (PFOA) is a common water contaminant. Detection of this chemical requires liquid chromatography and mass spectrometry, which is not easily accessible due to the high cost and extensive training needed. Therefore, efforts to develop a more accessible detection method are crucial. The UChicago iGEM 2022 team has begun developing a bacterial biosensor using a T7 polymerase to amplify a fluorescent signal upon PFOA detection. A promoter found in bacterial species *Rhodococcus jostii*, known as *prmA*, responds to the presence of PFOA in the environment. Previous work by USAFA iGEM 2019 showed that driving red fluorescent protein expression using only *prmA* yielded low RFP expression. Therefore, our designed system uses *prmA* to drive expression of a T7 polymerase. By placing a T7 promoter upstream of a green fluorescent protein gene, our design aims to amplify GFP to visible levels, allowing for easy, inexpensive water testing in the field.

<https://2022.igem.wiki/uchicago>

UCL

Project Title: Biocrafter: The future of sustainable construction



Booth: Climate Crisis Village, G-11



Village Presentation: October 27, 10:00-10:15 CEST, Plaza 4



Judging Session: October 26, 17:00-17:30 CEST, Room J7

Climate change is the most pressing problem of our generation, causing ecosystem collapse. One of the main contributors that has escaped significant public scrutiny is the construction industry, which accounts for 40% of global CO₂ emissions, with 8% due to production of cement. To produce cement, fossil fuelled furnaces heat limestone to 1400 °C to produce various calcium oxides, releasing 600 kg of CO₂ for every tonne of cement produced. To tackle this challenge, we engineered *Bacillus subtilis* to overexpress urease and carbonic anhydrase enzymes. These enzymes produce carbonate ions from atmospheric or waste stream CO₂, which when exposed to free calcium form stratified formation of calcite crystals at the bacterial cell outer surface. The precipitated crystalline calcium carbonate acts as the binding agent within our material, giving it properties comparable to concrete. Using engineered *B. subtilis* we produced a drop-in replacement of traditional cement to decarbonise this critical industry.

<https://2022.igem.wiki/ucl>

UCopenhagen

Project Title: Netlantis: Making a sustainable impact in the fishing industry by developing novel net fibres



Booth: Conservation Village, H-5



Village Presentation: October 26, 17:30-17:45 CEST, Plaza 5



Judging Session: October 27, 14:30-15:00 CEST, Room J14

Fishing is one of the biggest industries in the world, yet it is not the most sustainable one. Fishing nets made of nylon take 600-800 years to fully degrade. Lost nets are estimated to constitute at least 46% of the Great Pacific Garbage Patch and they can injure or kill around 650.000 animals each year. Therefore, a more environmentally friendly approach is urgent and paramount to ensure the stability of the industry and the environment it affects. By using spider silk, which has strength and flexibility comparable to nylon, and combining it with mussel foot protein, we aim to create fibres that can be twinned into biodegradable fishing nets. We foresee that further work in the line of our research and innovation will not only make a great impact and contribution for the development of a sustainable fishing industry but also to meet the UN SDGs.

<https://2022.igem.wiki/ucopenhagen>

UCSC

Project Title: Helo: Accessible Type 2 Diabetes medication through stable expression of Exendin-4 in *S. cerevisiae*

 Booth: Therapeutics Village, D-21

 Village Presentation: October 27, 14:45-15:00 CEST, Plaza 2

 Judging Session: October 26, 16:30-17:00 CEST, Room J4

Diabetes Mellitus affects roughly 1 in 10 people globally and is the world's seventh leading cause of death. However, 50 to 85% of all chronic complications are preventable by treatment and medication. Glucagon-like peptide 1 receptor agonists, such as Exendin-4, are one of the leading forms of Type 2 Diabetes Mellitus (T2D) treatments but are exceedingly expensive. Our initial studies used *E. coli* as an experimental model for Exendin-4 production; successes in those experiments led to homologous integration of Exendin-4 in *Saccharomyces cerevisiae* (*S. cerevisiae*). As *S. cerevisiae* is Generally Regarded As Safe (GRAS) by the U.S. FDA, we hypothesize that Helo, once bio-encapsulated, can be administered as an oral T2D therapeutic. Our goal is for Helo to become an affordable T2D medication that can be propagated in as little as one square meter of space and distributed globally for communities and pharmacies to produce.

<https://2022.igem.wiki/ucsc>

UESTC-BioTech

Project Title: Chlipid: a highly productive biofuel factory

 Remote Team Village

 Judging Session: October 26, 9:30-10:00 CEST, Room J14

Climate crisis caused by combustion of fossil fuels has been aggravating for a long time, and the world is desperate for more sustainable, clean, renewable energy. Here in Chlipid, by utilizing transcriptome analysis and CRISPR/Cas9 system to modify the metabolic pathways of *Chlamydomonas reinhardtii*, we expect to cultivate genetically engineered microalgae for more efficient lipid production for biofuel manufacture. We tried out 7 different pressure conditions to culture *C. reinhardtii*, and detect their lipid production, growth path and differential gene expression to locate target genes that can be knocked out to form a mutant bank. We construct CRISPR off-target model and Genome-scale Metabolic models to stimulate and direct experiment designs. We also produce a series of lectures called Algae classes and design a card game called Algal Lab, to enrich our scientific education activities. We collaborate with more than 10 iGEM teams to fulfil the project and broaden our impact.

<https://2022.igem.wiki/uestc-biotech>

UFlorida

Project Title: In-Vitro Analysis of Lentiviral Vectors with a CRISPR-Cas9 Complex to Target EGFRvIII Receptor in GBM

 Remote Team Village

 Judging Session: October 27, 16:00-16:30 CEST, Room J4

Glioblastomas are fast-growing and aggressive tumors which can lead to an array of fatal symptoms. Their morphological features, including thread-like tendrils that mesh themselves within the brain's tissue, make them almost impossible to surgically resect. Although current treatment plans include various surgical and chemical procedures, the prognosis for these treatments remains cumbersome. To address this issue, we've aimed genetically modify a second-generation lentivirus coupled with a CRISPR-Cas9 Exon containing-complex to target and reverse an in-frame deletion of the EGFR gene that results in the loss of the ability of the cell to properly regulate proliferation. Ultimately, this may lead to the development of cancerous cells within the brain. In addition, we troubleshooted and created a detailed user guide for an sgRNA prediction software created by GunnVistaPingry_US in 2020. By reintroducing these missing exons to the genome via our lentiviral vector, we hope to introduce a novel treatment for GBM.

<https://2022.igem.wiki/uflorida>

UFMG_UFV_Brazil

Project Title: ProChi - a new biodrug to treat helminth infections

 Booth: Therapeutics Village, D-22

 Village Presentation: October 27, 15:00-15:15 CEST, Plaza 2

 Judging Session: October 26, 16:30-17:00 CEST, Room J5

Intestinal parasites are among the most prevalent infectious diseases in the world. According to the World Health Organization, the world has about 1,5 billion infected people. These neglected diseases severely affect children and adolescents from vulnerable social groups in Brazil. The current strategy to control infections is administering anthelmintic drugs to at-risk populations, especially school-age children. Although this recommendation efficiently reduces cases, it can lead to increased resistance of parasites to current therapeutic options. Additionally, the diseases leave behind intestinal damage that can intensify malnutrition scenarios. So, we propose a new treatment: ProChi, which consists of genetically engineered *Lactobacillus acidophilus* that produces and secretes chitinase, an enzyme that cleaves chitin - a polysaccharide in the cuticles and eggs of nematodes. Therefore, it can kill these parasites and promote a quicker reconstitution of the intestinal tissue, contributing to the re-establishment of the nutritional absorption compromised by the disease.

<https://2022.igem.wiki/ufmg-ufv-brazil>

UIncheon

Project Title: Algene

-  Booth: Environment Village, I-22
-  Village Presentation: October 26, 13:45-14:00 CEST, Plaza 5
-  Judging Session: October 27, 10:30-11:00 CEST, Room J7

Our project develops an intrinsic biosensor to detect the leakage of genetically modified microalgae from wastewater treatment process. The manipulated microalgae is assumed to be co-cultured with microbes due to many benefits. Once the purified water is released to the outer environment, the signal communication from microbes to microalgae through quorum sensing will be disconnected. The microalgae perceive this disconnection and can inform this by its fluorescence. This project will enable the application of gene modification into wastewater treatment by guaranteeing biosafety. In addition, focusing on co-culture, we made a bioreactor to purify wastewater and collect microalgae pellets for extraction of biomass, which will provide the net cost reduction of wastewater treatment.

<https://2022.igem.wiki/uincheon>

UiOslo_Norway

Project Title: CelluALT: A copolymer of glucose and chitin for manufacturing medical biomaterials for sustainable space exploration.

-  Booth: Therapeutics Village, D-23
-  Village Presentation: October 26, 14:45-15:00 CEST, Plaza 2
-  Judging Session: October 27, 10:30-11:00 CEST, Room J5

Deep space exploration requires careful resource and capacity management. Manufacture is limited. Based on previously published literature, bacterial cellulose (BC) produced by *K.xylinus* can be functionalized with chitin by using genes from *C.albicans*. Thus, we decided to expand on the idea by using bioinformatic analysis to identify and clone homologous genes from *S.cerevisiae* that should produce a similar end product with broader applications. We propose to make space travel sustainable by using degraded organic waste for the bacteria to synthesize this co-polymer. The process is light independent and space efficient. This new BC could be used as a biodegradable polymer with pharmaceutical and biotechnological applications, as well as an additional source of food. Space Exploration has long inspired scientists to come up with solutions that have uses on Earth, like solar cells, LEDs, etc. The biomanufacturing of our modified BC could also be a means for sustainable waste management.

<https://2022.igem.wiki/uioslo-norway>

UIUC_Illinois

Project Title: Curli Capture: Engineering bacterial biofilms to reduce nitrate pollution.

 Remote Team Village

 Judging Session: October 26, 16:30-17:00 CEST, Room J8

Nitrate runoff, or the loss of nitrate nitrogen from agricultural systems, can lead to issues such as unsafe drinking water and overgrowth of plant life. To combat this issue, we have designed a nitrate-capture system utilizing curli proteins, which are self-assembling amyloid fibers secreted by *E. coli* that will form a mesh-like structure upon secretion. Our goal is to fuse the nitrate-capturing protein native to cyanobacteria, nrtA, to the curli monomeric unit, csgA. This fusion will be done with the SpyTag/SpyCatcher system, a two-part system that, upon contact, spontaneously forms an isopeptide bond. We are planning our capture system to be a cell-free mesh that can be encapsulated and placed near waterways in agricultural communities. However, we eventually want to modify our construct into a cellular system under the control of an inducible promoter that produces nitrate-capturing curli only in the presence of nitrate.

<https://2022.igem.wiki/uiuc-illinois>

ULaval

Project Title: PheroSynth: A biosynthetic approach for pheromone production

 Booth: Conservation Village, H-6

 Village Presentation: October 26, 17:45-18:00 CEST, Plaza 5

 Judging Session: October 27, 15:00-15:30 CEST, Room J14

The mountain pine beetle (MPB) is a ravaging insect that infects and kills various species of pine trees. In British Columbia, 40 million acres of forest have been recently ravaged, leading to a huge economic impact. This infestation is migrating to the east, which increasingly hurts more forests in Canada as well as affecting biodiversity. Our goal is to biologically produce (-)-trans-verbenol (the mating pheromone of the MPB) in an engineered *Saccharomyces cerevisiae* strain. This allows for an exclusively acellular delivery of the pheromone in the environment, making our solution safe and respectful towards bioethical standards. Ultimately, one could produce, extract and purify the pheromone for use in monitoring and prevention. Our project adds to the limited tool set used against MPB and is a versatile tool for the synthesis of other insect pheromones. This could represent a huge step forward in the fight against ravaging species.

<https://2022.igem.wiki/ulaval>

UManitoba

Project Title: ZebraZap: A Smart Bio-Based Device for Controlling Invasive Zebra Mussels



Booth: Environment Village, I-24



Village Presentation: October 26, 14:45-15:00 CEST, Plaza 5



Judging Session: October 27, 16:00-16:30 CEST, Room J7

This year the Prairie iGEM team, hosted here at the University of Manitoba, aims to develop a novel solution to control the invasive populations of zebra mussels (*Dreissena polymorpha*). The invasive zebra mussels (*Dreissena polymorpha*) pose threats to many water bodies in North America and create a burden for local communities. Zebra mussels can clog up a pipeline supplying water to communities, damage infrastructure, and disrupt ecosystems. We aim to build a proof-of-concept for a smart bio-based device that can lay dormant and express molluscicide to specifically target zebra mussels. Our project is comprised of two parts. Firstly, we explored the iGEM registry for methods to sense zebra. Secondly, we optimize the expression and secretion of certain molluscicides in our model chassis. Finally, we combined the two parts to get a final bio-based device that can express and secrete molluscicide only in the presence of zebra mussels.

<https://2022.igem.wiki/umanitoba>

UMaryland

Project Title: Nitrate Neutralizer



Remote Team Village



Judging Session: October 27, 14:30-15:00 CEST, Room J6

The rapidly deteriorating health of the Chesapeake Bay is a consistent problem in Maryland. An overabundance of nutrients directly leads to harmful algal blooms (HABs) and contaminates the water that both wildlife and we depend on. Increased nutrient pollution and the toxins associated with HABs are harmful to the environment, human health, and the economy. Having previously targeted phosphorus in 2021, our team seeks to target the most soluble nutrient pollutant; however, current strategies do not prioritize reuse, which is problematic since nitrogen synthesis contributes to agricultural unsustainability. UMaryland iGEM's solution is to engineer *E. coli* to increase its capacity for storing nitrogen as cyanophycin granule polypeptides (CGP). Our design also includes the ability to hydrolyze CGP into nitrogen-rich amino acids for reuse. To ensure our design efficacy and its utility, our team engaged with experts and stakeholders who want to decrease nutrient pollution and promote agricultural sustainability.

<https://2022.igem.wiki/umaryland>

UMA_MALAGA

Project Title: Innovative starch production from vegetal wastes mediated by a glucose-sensing mechanism in Escherichia coli.

 Booth: Environment Village, I-23

 Village Presentation: October 27, 13:45-14:00 CEST, Plaza 5

 Judging Session: October 26, 10:00-10:30 CEST, Room J8

From the StarchSTEM team of the University of Malaga we have always been very aware of the growing problem of vegetal wastes, not only in our country but also in all around the world. Due to this urgency to propose a solution to this adversity, our project has emerged which, thanks to synthetic biology, we have been able to carry it out. Thus, we have designed a specific protocol for obtaining plasmids containing the genes necessary for cellulose degradation and starch synthesis, as well as their corresponding fluorescent markers. The different cassettes have been integrated using the BioBrick Assembly method. The performance of the enzymes has been verified by colorimetric and enzymatic methods. With all this, we have come with the creation of bacterias capable of degrading plant residues and transforming them into starch have been obtained.

<https://2022.igem.wiki/uma-malaga>

UM_Macau

Project Title: AcidOceanus: Resolving water acidification

 Remote Team Village

 Judging Session: October 27, 14:00-14:30 CEST, Room J6

With the continual release of vast amounts of carbon dioxide, the water on Earth, particularly saltwater, faces acidification. Fortunately, we found the magical inward H⁺ pump, the Xenorhodopsin, expressed on the membrane of some archaea in some literatures. In our project, a genetically engineered E. coli, the AcidOceanus, is planned to be constructed and applied to absorb H⁺ in the water body. Integrating the Xenorhodopsin gene, AcidOceanus produce Xenorhodopsin and constantly transport H⁺ from water into intracellular space under light conditions. Furthermore, as an approach to recycle H⁺, we are about to coordinate will some companies to design a device where E. coli release the H⁺ in dark condition. Our project is devoted to providing a feasible direction, for water acidification in a small range of areas and at the same time educating the public, especially teens, to realize its hazards to marine life and the urgency to resolve it.

<https://2022.igem.wiki/um-macau>

Uni-Hamburg

Project Title: SPEAR - Sensing Pathogens and Emerging Antibiotic Resistances

-  Booth: Diagnostics Village, F-22
-  Village Presentation: October 26, 17:00-17:15 CEST, Plaza 4
-  Judging Session: October 27, 13:00-13:30 CEST, Room J10

Antibiotic resistant pathogens pose an emerging risk in modern medicine causing millions of deaths every year. Antibigrams are used to detect those pathogens and depend on bacterial growth, stalling the diagnosis. We developed SPEAR - Sensing Pathogens and Emerging Antibiotic Resistance, a point-of-care diagnostic method detecting antibiotic resistances, allowing more accurate treatment. Resistance genes are detected using a split ribozyme fused to guide RNAs (gRNA). The gRNAs bind to the target resistance gene mRNA, activating the ribozyme. It fuses a ribosome binding site and coding sequence of a reporter gene by self-excision, inducing translation of a protein for visible readout. SPEAR robustly and precisely detects several genes of interest. Modular architecture enables fast adaptation to novel resistance genes through exchange of gRNAs. SPEAR may be delivered by phages, simplifying storage and extending shelf-life.

<https://2022.igem.wiki/uni-hamburg>

Unicamp_Brazil

Project Title: Cellulopolis: paving the ground for low-cost bacterial cellulose production

-  Booth: Biomanufacturing Village, B-22
-  Village Presentation: October 26, 16:15-16:30 CEST, Plaza 1
-  Judging Session: October 27, 16:00-16:30 CEST, Room J8

Bacterial cellulose (BC) is a versatile biomaterial with multiple applications: from packaging to biomedical uses. Different acidophilic bacteria, such as *Komagataeibacter* spp, naturally produce BC, however, high production costs hamper its widespread utilization. To minimize BC production costs, the Unicamp_Brazil team created the Cellulopolis project, which used genomic-scale metabolic model for cellulose production optimization from FBA simulations; these results indicated a set of key genes which lead to BC production increase. The group developed and optimized a toolkit and a methodology for engineering *K. rhaeticus* AF1 wild-type strain, allowing a light-inducible BC production circuit design. Furthermore, we constructed a low-cost two-step bioreactor for culture growth and BC production destined for countless applications, such as tissue culture scaffolds. With this project, we aim to unveil new horizons in the BC production fields, enabling cost reduction and a new toolkit for *Komagataeibacter* engineering.

<https://2022.igem.wiki/unicamp-brazil>

UNILausanne

Project Title: Quagg'out, A fresh solution to a freshwater problem



Booth: Environment Village, I-25



Village Presentation: October 26, 15:00-15:15 CEST, Plaza 5



Judging Session: October 27, 9:30-10:00 CEST, Room J7

Quagga mussel (*Dreissena bugensis*) is an invasive species unintentionally introduced in Switzerland in 2014. Its damages include pipes clogging, inducing millions of Swiss francs of costs in Switzerland, and altering the local ecosystems of Swiss lakes. Our project aims to stop the spread of this species in two ways: by overexpressing the FitD toxin which has molluscicide and insecticides properties, naturally produced by *Pseudomonas protegens*. Then by engineering *Escherichia coli* to produce zosteric acid, an antifoulant compound that will prevent mussels' attachment to surfaces. We successfully created plasmids expressing enzymes for zosteric acid production. They are now ready for testing and optimization. We also cloned several constructs to overexpress FitD. In our experiments with the mussels, we demonstrated that our engineered bacteria can indeed kill the mussels and we identified the most potent construct. Our results promise an efficient and ecological way to address the quagga mussel's invasion.

<https://2022.igem.wiki/unilausanne>

UniofBath

Project Title: Pho-Bac: Closing the Loop on Phosphorus Use



Booth: Food & Nutrition Village, E-21



Village Presentation: October 27, 10:45-11:00 CEST, Plaza 3



Judging Session: October 26, 10:30-11:00 CEST, Room J13

Phosphorus is an essential element that makes up the backbone of life in DNA, cell membranes and ATP. Application to soil as phosphate fertilizer drives plant photosynthesis and growth, but the mines that keep the world fed are set to run out, threatening to drive up already unaffordable fertilizer prices. Simultaneously, current use is inefficient as phosphate is lost as runoff and organic waste, eutrophication waterways and threatening ecosystems and human health. We have developed Pho-Bac, a strain of bacteria *Bacillus subtilis*, successfully engineered to release phosphate in response to the plant phosphate stress signal malate, thereby acting as an ecologically sensitive biofertilizer. We also attempted to couple release with luxury phosphate uptake, giving Pho-Bac the potential to capture and recycle wastewater phosphate, curbing nutrient pollution and supplying crops with sustainable and locally-sourced phosphate fertilizer, creating a circular phosphate bioeconomy.

<https://2022.igem.wiki/uniofbath>

UNSW_Australia

Project Title: Catching a Cereal Killer: Developing Antifungal Peptide Candidates for the Treatment of Cereal Rust Infections

 Booth: Food & Nutrition Village, E-22

 Village Presentation: October 26, 13:15-13:30 CEST, Plaza 3

 Judging Session: October 27, 10:30-11:00 CEST, Room J13

Cereal rust infections caused by fungi of the *Puccinia* genus presents a significant global burden resulting in the loss of wheat yields, posing implications for international economies and risks the issue of food insecurity. With growing concerns of the increased incidence of more virulent strains resistant to commonly used antifungal drugs, the search for novel alternatives to treating this problem is a priority. Recently, antifungal peptides have been shown to be promising and powerful candidates due to their specificity and efficacy. In alignment with this current research, we employed bioinformatic approaches to scour the highly understudied fungi genome databases and published literature to identify two potential fungal targets, PstSCR1 and Pst_12806, known to be involved in the fungal pathogenesis. After locating known binding partners found naturally in plants, SERK3B and TaISP, respectively, we aimed to design and measure the binding affinity of our predicted peptide sequences as potential antifungal treatments.

<https://2022.igem.wiki/unsw-australia>

UOregon

Project Title: No title

 Booth: Diagnostics Village, F-23

 Village Presentation: October 26, 17:15-17:30 CEST, Plaza 4

 Judging Session: October 27, 16:00-16:30 CEST, Room J10

No abstract

<https://2022.igem.wiki/uoregon>

UPenn

Project Title: Photocrete: an optogenetic toolbox to study intercellular communication

-  Booth: Foundational Advance Village, A-17
-  Village Presentation: October 26, 10:00-10:15 CEST, Plaza 1
-  Judging Session: October 27, 16:30-17:00 CEST, Room J11

Intercellular communication is primarily studied using synthetic protein-level circuits. These circuits currently lack the spatial and temporal control necessary for targeted and time-sensitive applications. To address this gap, we developed Photocrete, a toolbox of protein constructs for light-inducible control of protein display, secretion, and shedding. We expanded upon RELEASE (Vlahos et al.), a modular and generalizable protein circuit which utilizes an ER retention motif and an exogenous protease to control protein secretion. We optogenetically modified RELEASE by replacing different components with the photocleavable protein PhoCl, allowing us to control the mammalian secretion pathway at distinct nodes with finely-tuned light administration regimens. Preliminary results indicate integration of Photocrete into the secretion pathway, but more research is necessary to determine optimal light administration settings. The potential for high spatial and temporal control of Photocrete could allow researchers to perform various signaling studies and develop therapeutics at a new level of precision.

<https://2022.igem.wiki/upenn>

UPNAvarra_Spain

Project Title: Zero: A circular economy solution to fight depression

-  Booth: Therapeutics Village, D-24
-  Village Presentation: October 27, 16:00-16:15 CEST, Plaza 2
-  Judging Session: October 26, 13:00-13:30 CEST, Room J5

The lately arousal on the relevance of mental health has gained prominence, especially after the COVID-19 pandemic and due to lockdowns. Serotonin, along with dopamine, are both neurotransmitters associated with an individual's mental well-being. Serotonin in particular serves the functions of mood and sleep regulation, peristaltic movement regulation, sexual function modulation and blood coagulation management. Synthetic biology can take part in the development of novel alternatives to tackle said mental illnesses. By means of circular economy strategies and via innovative DNA constructions, UPNAvarra_Spain team has started a project that will be continued in future editions, aiming the nano-encapsulation of serotonin precursors to be used as dietary supplements to fight these conditions.

<https://2022.igem.wiki/upnavarra-spain>

Uppsala

Project Title: PETerminator: Enzymatic upcycling of polyethyleneterephthalate (PET) into higher value chemicals

 Remote Team Village

 Judging Session: October 27, 12:30-13:00 CEST, Room J8

Plastic is a very useful material. However, plastic pollution has world-wide effects on our environment. At the same time, only 9% of all plastic ever made has been recycled. We need to develop better techniques for recycling and upcycling plastic in order to reverse the effects that plastic pollution has caused our environment. Therefore we decided to focus on degradation of polyethylene terephthalate (PET) plastics since it is one of the most abundant types of plastic, has the largest number of characterized enzymes (40) that can act on it, and its degradation is arguably the best studied of all the synthetic polymers. Our overarching goal was to build upon previous work surrounding plastic degradation, membrane transport and bacterial upcycling to develop an E. coli strain whole cell catalyst system with a fully integrated metabolic pathway that could degrade PET plastics and further turn them into the chemical protocatechuic acid (PCA).

<https://2022.igem.wiki/uppsala>

USAFA

Project Title: Bioengineering and Optimization of Biocementation for Potential Space Applications (Sili Sand)

 Booth: Biomanufacturing Village, B-23

 Village Presentation: October 27, 15:45-16:00 CEST, Plaza 1

 Judging Session: October 26, 17:30-18:00 CEST, Room J9

Mars is an exciting frontier that beckons exploration. While space technology enables expeditions to the red planet, dust clouds generated upon landing complicate missions and damage equipment. To mitigate dust, we aim to genetically engineer Escherichia coli for use in biocementation, a process that uses urease enzymes to initiate calcium carbonate precipitation to bind sand and particles into cement. Studies indicate that precipitating silica during biosilicification creates silica spheres that stabilize enzyme activity and provide UV protection. We hypothesize that silicification will stabilize urease enzymes and enable biocementation on extraterrestrial surfaces. Therefore, we seek to genetically engineer E. coli to express silicatein genes from sea sponges that will enable silica precipitation. We also aim to improve expression of functional urease enzyme from Sporosarcina pasteurii to generate functional urease activity in E. coli. Producing silica-stabilized urease enzymes (Sili Sand) will yield a sustainable, lightweight, biological solution for dust mitigation on Mars.

<https://2022.igem.wiki/usafa>

USC_Dornsife

Project Title: Toxigone



Booth: Environment Village, I-26



Village Presentation: October 26, 15:15-15:30 CEST, Plaza 5



Judging Session: October 27, 16:30-17:00 CEST, Room J6

USC iGEM proposes to harness the power of synthetic biology to create a biofilter that requires minimal upkeep cost after deployment while providing similar performance when compared against conventional chemical/mechanical filters for deployment into developing countries where the most serious EDCs population tend to occur. Our engineered biofilter is composed of three genetic modules: (1) a sensing module in which the human estrogen receptor protein is produced by *Saccharomyces cerevisiae*, (2) a degrading module in which an estrogen degrading pathway from *Novosphingobium tardaugens* will be cloned into *Escherichia coli*, and (3) an inter-domain communication module between the sensing module and the degrading module mediated by chemical signals emitted from our engineered *S. cerevisiae* and received by our engineered *E. coli*. Additionally, our filter will be housed in a calcium alginate hydrogel that will allow easy deployment in wastewater streams and in situ detection and degradation.

<https://2022.igem.wiki/usc-dornsife>

USP-EEL-Brazil

Project Title: Honorato 2.0



Booth: Therapeutics Village, D-25



Village Presentation: October 26, 15:00-15:15 CEST, Plaza 2



Judging Session: October 27, 15:30-16:00 CEST, Room J4

According to the World Health Organization, ophidism is considered a neglected disease. It is estimated around 5 million cases of snakebites per year resulting in more than 100,000 cases of death and 400,000 irreversible damage, including amputations and reduced mobility. In Brazil, most ophidic accidents are caused by snakes of the *Bothrops* genus. This study aims the heterologous expression of Bj46a, which act as an inhibitor of the hemorrhagic metalloprotease jararhagin. The goal of this study is the evaluation of the efficacy of recombinant inhibitor in first aid application in order to reduce the damage caused by the eventual delay in the conventional treatment by *B. jararaca* antiophidic serum. The expression of the gene encoding the inhibitor is performed using the methylotrophic yeast *Pichia pastoris* and the assay will be conducted in the presence of jararhagin to measure its efficiency.

<https://2022.igem.wiki/usp-eel-brazil>

USTC

Project Title: Optimized Lipid Nanoparticle Pharmaceutical Drug Delivery System through Borneol Modification

 Remote Team Village

 Judging Session: October 26, 14:00-14:30 CEST, Room J5

Lipid nanoparticle (LNP) is a novel pharmaceutical drug delivery system and a novel pharmaceutical formulation. But this promising drug delivery system has no effect on many cerebral diseases due to the difficulty in drug delivery across the blood–brain barrier (BBB). In our project, we developed Bor-NP, a novel nanoparticle modified by borneol, which has been proved with the ability to enhance other drugs' transport across the BBB. At the same time, we tried to establish a system which can mass-produce this kind of Bor-NP. We took advantage of *Yarrowia lipolytica* to boost the borneol production, and then conjugate these borneol to the succinimide group of N-hydroxy succinimide–poly(ethyleneglycol)–poly(lactic-co-glycolic acid) (NHS-PEG-PLGA) to produce the Bor-NP. In a conclusion, our project focused on producing nanoparticles to get through the BBB and establishing an effective bio-manufacturing system to produce this kind of nanoparticle to lower the cost and achieve better therapeutic effect.

<https://2022.igem.wiki/ustc>

USTC-Software

Project Title: MEI：Modified Enzyme Interface

 Remote Team Village

 Judging Session: October 26, 14:00-14:30 CEST, Room J14

Usually, a complete metabolic pathway contains multiple 'nodes' and multi-step reactions. Sometimes there is no readily suitable enzyme in the database for the catalysis of the reaction, which brings some difficulties to the study. Although some pathway design software, such as PathPred, can predict the entire metabolic pathway, it is still inevitable that intermediate reactions will be disconnected. Therefore, Modified Enzyme Interface (MEI) is designed to provide enzyme candidates to catalyze unknown reactions. With the premise of single step reaction, MEI screened out the potential enzymes by using a structure comparison algorithm. On this basis, users can select the enzyme for further modification, which is more likely to obtain efficient enzymes that can catalyze the target reaction. With MEI, we hope to help synthetic biologists shorten the experimental time and find the desired enzyme more quickly.

<https://2022.igem.wiki/ustc-software>

UTokyo

Project Title: OPTOPASS - Optogenetic Passcode System for Greater Safety & Security -

-  Booth: Foundational Advance Village, A-18
-  Village Presentation: October 27, 10:45-11:00 CEST, Plaza 1
-  Judging Session: October 26, 13:00-13:30 CEST, Room J12

Biosafety and security is the key to the new generation of synthetic biology. Genetically Modified Organisms (GMOs) have shown us much potential for solving global issues. Yet, the release of GMOs in the natural environment has been a huge safety concern, inhibiting the implementation into the wider society. Also, to encourage innovation, It is crucial to protect the intellectual property, in particular the gene sequence of GMOs, and GMOs themselves, from malicious interest and dual-use. This year, we present OPTOPASS, an optogenetic passcode system for microorganisms. In this system, *S.cerevisiae* produces the target substances only when exposed to the correct color of light in the correct order. However, when the light is applied in the wrong order or the culture is left under the sunlight, a kill switch is activated. Using our unique approach combining “Light” and “Order”, OPTOPASS proposes greater safety and security for the future of synthetic biology.

<https://2022.igem.wiki/utokyo>

UZurich

Project Title: IBD NanoBiotics

-  Booth: Therapeutics Village, D-26
-  Village Presentation: October 27, 16:15-16:30 CEST, Plaza 2
-  Judging Session: October 26, 15:00-15:30 CEST, Room J6

Inflammatory Bowel Disease (IBD) comprises conditions in which the lining of the gastrointestinal tract is chronically inflamed leading to symptoms like diarrhea, abdominal pain, bloody stools and fatigue. The exact etiology of IBD is a topic of extensive research whereby first hints point towards a multifactorial pathogenesis. Current treatment options are systemic and aim at modulating the immune system causing severe side effects. We, the UZurich iGEM Team, want to tackle the lack of targeted treatment options by developing a new microbe based therapy: IBD NanoBiotics. We modified *E. coli* Nissle 1917 by introducing a genetic circuit that can produce and secrete anti tumor necrosis factor (TNF) nanobodies upon selective induction by nitric oxide (NO) at the inflammation site. Along with our laboratory research, we have developed a predictive mathematical model and dedicated ourselves to outreach and education with a special focus on IBD patients.

<https://2022.igem.wiki/uzurich>

Vilnius-Lithuania

Project Title: NanoFind: a novel way to detect nanoplastics in water samples

 Booth: Environment Village, I-27

 Village Presentation: October 27, 14:45-15:00 CEST, Plaza 5

 Judging Session: October 26, 14:00-14:30 CEST, Room J7

The NanoFind project aims to combat challenges regarding detection of newly recognised environmental pollutants - nanoplastics - the smallest fraction of plastic waste. Nanoplastics have already been found in water-based beverages and aquatic organisms. Current attempts to investigate nanoplastics rely on expensive optical equipment which is hardly applicable to the frequent monitoring of the abundance of plastic nanoparticles in the environment. The promising work of Rübsam and the colleagues (2017) inspired our project to focus on the binding affinities between specific peptides and plastic materials. To facilitate detection, we engineered two types of plastic-binding peptides that can either bind cellulose or produce a fluorescent signal as an easy-to-interpret result. Together, these molecules create a complex that captures and recognizes nanoplastic particles. This system enables lowering the cost of the detection process while maintaining high accuracy results. Therefore, efficient and frequent monitoring can be achieved in a more convenient way.

<https://2022.igem.wiki/vilnius-lithuania>

Virginia

Project Title: AtheroSHuffle: A Novel Point-of-Care Detection Method for Early Atherosclerosis

 Booth: Diagnostics Village, F-24

 Village Presentation: October 27, 15:45-16:00 CEST, Plaza 4

 Judging Session: October 26, 14:30-15:00 CEST, Room J11

Over 27.6% of the global population suffers from atherosclerosis, a plaque buildup in arteries that causes acute dangerous events like heart attack and stroke after lying dormant for years. Despite high prevalence, current detection methods are costly, time-consuming, and unused during medical visits unless individuals present signs of cardiovascular complications, at which point atherosclerosis is largely irreversible. We describe a method of early, accessible atherosclerosis detection: a lateral flow assay test strip that detects oxidized low-density lipoprotein (oxLDL), a biomarker correlated with early and middle stages of atherosclerosis. Our device provides a rapid, proactive, point-of-care approach to evaluating atherosclerosis risk, allowing early treatment and potential reversal of disease. We employ SHuffle E. coli to produce anti-oxLDL antibodies that integrate into easy-to-read test strips to detect the presence of oxLDL in blood. Our device will provide a sorely-needed low-cost, early detection method for atherosclerosis, improving healthcare globally, especially for under-resourced communities.

<https://2022.igem.wiki/virginia>

VIT_Vellore

Project Title: Tetonin to the Rescue-Superior Small Laccase to Combat Tetracycline Resistance

 Booth: Environment Village, I-28

 Village Presentation: October 26, 15:30-15:45 CEST, Plaza 5

 Judging Session: October 27, 10:30-11:00 CEST, Room J8

The growing presence of antibiotic resistance that spreads through manure (via cow dung) in agricultural fields is a pertinent issue in India. Tetracycline is one such heavily used antibiotic. Oxytetracycline is, in fact, called the gold standard treatment in veterinary practice. Thus, to degrade residual antibiotics at their source i.e in cow dung, we use small laccase from *Streptomyces coelicolor*. By overexpressing it using a double promoter system, OmpA signal peptides and site directed mutagenesis, we developed Tetonin-a small laccase with a greater efficiency of degrading tetracycline in the cow dung. With Tetonin, agricultural stakeholders now have a way to reduce the presence of residual antibiotics in the cow dung that is eventually used as manure.

<https://2022.igem.wiki/vit-vellore>

Wageningen_UR

Project Title: Colourectal; a living diagnostic tool for colorectal cancer

 Booth: Diagnostics Village, F-25

 Village Presentation: October 27, 16:00-16:15 CEST, Plaza 4

 Judging Session: October 26, 12:30-13:00 CEST, Room J11

Colorectal cancer is the second most deadly cancer worldwide. Currently employed screening methods, suffer from low detection rates and result in frequent false positives, leading to missed diagnoses or unnecessary follow-up treatments. We created Colourectal, an easy-to-use living diagnostic tool. We engineered the probiotic strain *Escherichia coli* Nissle 1917 to bind to tumour cells, detect two distinct cancer biomarkers, and secrete a coloured protein in the stool. We modelled and constructed a threshold-based circuit that detects the lactate biomarker, resulting in expression of a signal protein at significantly elevated lactate levels. The second biomarker, matrix metalloproteinase 9, activates the colour of our signal protein. Additionally, we have implemented biosafety circuits to limit viability of *E. coli* Nissle 1917 to the colon, by creating a dependence on temperature and mucin, and introduced an inducible kill-switch. Finally, we have modelled the potential persistence of our living diagnostic in the gut.

<https://2022.igem.wiki/wageningen-ur>

Warwick

Project Title: Aptamer-based detection and whole-cell catalysis of pyrethroid pesticides for bioremediation of watercourses and agricultural land

 Booth: Environment Village, I-29

 Village Presentation: October 26, 16:00-16:15 CEST, Plaza 5

 Judging Session: October 27, 14:00-14:30 CEST, Room J7

Pyrethroids are commonly used to combat aphid pests, making up 84% of all insecticides used in UK agriculture. However, they are toxic to bees and run-off from fields poisons fish and aquatic invertebrates. Here we report the successful development of a cheap in-field biosensor for lambda-cyhalothrin based on aptamer technology which produces an easy-to-read colour change. We demonstrated our biosensor's target could be extended to fenitrothion, a second pesticide, with only minor changes. To enhance pyrethroid breakdown, we engineered a whole cell catalyst utilising a carboxylesterase from *Bacillus velezensis*. To improve activity and improve membrane insertion, we linked the carboxylesterase to a modified anchor protein isolated from *Pseudomonas syringae*. To explore growth-production trade-offs we developed an ordinary differential equation model of microbial gene expression and growth. Working under guidance from farmers and other stakeholders, we developed a spatial model to enable the optimisation of potential deployment strategies in the field.

<https://2022.igem.wiki/warwick>

Waseda_Tokyo

Project Title: Cell Freedom ~Expanding the possibility of cell-free system~

 Booth: Foundational Advance Village, A-19

 Village Presentation: October 26, 10:30-10:45 CEST, Plaza 1

 Judging Session: October 27, 13:00-13:30 CEST, Room J12

Cell-free system is a robust and versatile tool in synthetic biology. Cell-free biosensors allow targeting wider range of substances than living cells. This year, we aimed to implement the cell-free detection system in the real world. The main targeted stakeholder was women undergoing fertility treatment. Fertility treatment method with higher success rate is strongly desired particularly in Japan with declining birthrate and increasing late-life marriages. This issue is also expected to be serious in other developed countries. The primary goal was to detect two types of female hormones, progesterone and estrogen in the cell-free system. In addition, as for the outputs, we devised a small household sensing device, and a capsule treatment device designed to be driven in uterus. The function of the devices were investigated thorough dry lab modeling. The compatibility of the devised sensors for other substances was also investigated.

<https://2022.igem.wiki/waseda-tokyo>

Washington

Project Title: WaMel

 Remote Team Village

 Judging Session: October 26, 16:00-16:30 CEST, Room J11

There are nearly 100,000 cases of melanoma in the United States (US) each year. When diagnosed early, 98% of melanoma patients survive. However, in the US 9,000 people each year die from the disease. Early detection of melanoma is very important as early detection can drastically increase treatment efficacy and thus survivability. We have worked on developing a paper-based point of care (POC) diagnostic test for early detection of melanoma. Additionally, we have also designed peptide-based anti-cancer therapeutics for treating advanced stage melanoma.

<https://2022.igem.wiki/washington>

Waterloo

Project Title: Pinene Express

 Booth: Biomanufacturing Village, B-24

 Village Presentation: October 26, 17:00-17:15 CEST, Plaza 1

 Judging Session: October 27, 16:30-17:00 CEST, Room J9

The Canadian government legalized recreational cannabis in 2018 and since then, both demand and the cannabis industry have grown at unimaginable rates. Unfortunately, cultivating and processing cannabis is an unsustainable and resource-intensive process. Pinene Express makes use of bio-engineered yeast to produce the main cannabinoids and select terpenes found in the cannabis plant. Our project seeks to establish a competitive edge over existing practices for manufacturing cannabis-based molecules. We did this by using a pre-engineered strain with higher flux through the mevalonic acid pathway, designing an extraction method for the cannabinoids, and using modelling to identify further improvements in the production process. We hope that our work destigmatizes prescription cannabinoids and promotes a more efficient and greener alternative to cultivation.

<https://2022.igem.wiki/waterloo>

Wego_Taipei

Project Title: Eutro in Vitro: Synthetic Biological Reduction of Phosphate Concentration to Resolve Eutrophication

 Remote Team Village

 Judging Session: October 27, 9:30-10:00 CEST, Room J1

In various water bodies, the overabundance of nutrients from agricultural chemicals, including fertilizers and biocides, resulted in the process of eutrophication. The increase of phosphate and nitrogen amounts leads to algal bloom followed by the decline in sustainability of lives in the water bodies. The physical and chemical solutions that currently exist are limited to certain conditions and could potentially disturb the ecosystem. Our project presents a new method to solve the issue of eutrophication from its roots. By engineering bacteria that overexpress organophosphorus hydrolase (OPH) and antisense PhoU mRNA (AsPhoU), we can hydrolyze organic phosphates into inorganic phosphate (Pi) for detoxification, enhance the efficacy of Pi transport, and fix the excess of Pi into polyphosphate (polyP), respectively. The implementation of a filtering device containing the engineered bacteria with biosensors for the detection of polyphosphate accumulation could reduce phosphate levels in water bodies to ultimately prevent the cycle of eutrophication.

<https://2022.igem.wiki/wego-taipei>

WHU-China

Project Title: Reach for Light

 Remote Team Village

 Judging Session: October 27, 14:30-15:00 CEST, Room J4

Depression, a common but serious mental disorder, is characterized by constitutive sorrow, loss of interest, guilt and more. Traditionally, patients suffering from depression are treated with different kinds of antidepressants, which may cause side effects and economic and/or mental burden. So our team aims to engineer the probiotic *Bifidobacterium longum*, which has been demonstrated to reduce depression, to periodically generate a natural metabolite and antidepressant S-adenosylmethionine (SAME) in the gut. To enhance the antidepressant effect of *Bifidobacterium longum*, Sam2 and Pet8p, the synthetase and transporter of SAME, respectively, were overexpressed. To mimic drug uptake behavior and regulate plasma concentration, the expression of Sam2 was controlled by an oscillator which is periodically activated. Meanwhile, to ensure safety, a temperature-sensitive redundant kill switch kills the engineered probiotic when it exits human digestive tract, and an AHL-induced kill switch allows the bacteria to be eliminated by AHL ingestion when no longer needed.

<https://2022.igem.wiki/whu-china>

William_and_Mary

Project Title: ChassEASE: Data-Driven Chassis Selection for Fieldable Synthetic Biology

-  Booth: Foundational Advance Village, A-20
-  Village Presentation: October 26, 13:30-13:45 CEST, Plaza 1
-  Judging Session: October 27, 13:30-14:00 CEST, Room J14

To address the broadest array of global problems, synthetic biology will need to move beyond the laboratory and into the field. However, multiple barriers impede the deployment of fieldable systems in soil, water, or living tissues. One initial barrier is selecting an optimal and safe chassis for a specific environment. While computational tools provide data-driven predictions to inform other aspects of the synthetic biology design process, mathematical models and associated software to assist with chassis selection for a specific environment are lacking. To meet this need, the W&M iGEM team designed a predictive model using multivariate regression and neural networks to help scientists with chassis selection for soil, water, air, and the gut microbiome. Based on input type, our software predicts the optimal chassis for a specific environment or the most favorable environment for a predetermined chassis, leading to safer, more effective, fieldable, and robust genetic circuits.

<https://2022.igem.wiki/william-and-mary>

WLC-Milwaukee

Project Title: The Dirt Detective

-  Remote Team Village
-  Judging Session: October 26, 15:30-16:00 CEST, Room J7

Wisconsin Lutheran College is located in Milwaukee, Wisconsin but is within only a few miles of abundant farmland. Agriculture is one of the biggest industries in the state and these products go all over the world. One important component in agricultural success is soil composition. It is essential to have the appropriate nutrients in the soil for crops to grow and provide a maximal return. Our team has engineered *Escherichia coli* to sense specific soil nutrients and provide a colorimetric readout of concentration. Our goal is to be able to measure the concentration of phosphate, nitrate, nitrite, and copper using nutrient-specific promoters controlling the expression of Beta-lactamase. While the nitrate and nitrite sensors did not work well, the phosphate and copper sensors have provided promising results. We aim to design a kit using these sensors to help farmers measure nutrients in the soil simply, affordably, and accurately.

<https://2022.igem.wiki/wlc-milwaukee>

Worldshaper-HZ

Project Title: A portable breast cancer diagnosis kit based on CRISPR-Cas technology

 Remote Team Village

 Judging Session: October 26, 13:30-14:00 CEST, Room J2

Breast cancer has become the most common cancer in the world with the highest mortality in female cancers in 2020. Early diagnosis of breast cancer and individualized optimization of treatment strategies can greatly improve survival. Our project offers a sensitive, cheap, noninvasive, and widely applicable alternative way of sensing circRNA biomarkers for breast cancer. Our detection tool combines a CRISPR-Cas12a technology with a cell-free system to identify two circRNA biomarkers, hsa_circ_0001785 and hsa_circ_0001982, for the diagnosis and prognosis of breast cancer patients, respectively. The detection is sensitive for minimally invasive samples like blood and can be further extended to other circRNA biomarkers with ease. We aim to reduce the mortality rate of devastating diseases by providing a convenient method to screen them early.

<https://2022.igem.wiki/worldshaper-hz>

Worldshaper-HZBIOX

Project Title: Boost Colorectal Cancer Treatment: Arginine Probiotics

 Remote Team Village

 Judging Session: October 26, 13:30-14:00 CEST, Room J3

Colon cancer is a relatively common digestive tract malignant tumor with a high mortality rate and is one of the three major cancers in the world. The main idea of our project is to use the non-pathogenic bacteria E. Coli Nissle 1917 to produce L-arginine to boost colorectal cancer immunotherapy. To overcome the arginine inhibition mechanism, the ArgR gene was knocked out and the ArgJ gene was inserted. To ensure biosafety, we inserted the Lysin gene into our engineered EcN so that it would be lysed after the bacteria had done their work. The engineering bacterium EcN in the project is designed to use the metabolite ammonia of cancer cells as a substrate to continuously produce a large amount of L-arginine in tumors. Long-term stay in the tissue has great potential for the treatment of digestive system tumors.

<https://2022.igem.wiki/worldshaper-hzbiox>

Worldshaper-Nanjing

Project Title: Probiotics-Livestock-Grassland: Dual Healing for Gut and Soil

 Remote Team Village

 Judging Session: October 26, 15:30-16:00 CEST, Room J3

The long-existing problem of soil salinization has worsened in recent years. As a novel class of microbial feed additives, *Clostridium tyrobutyricum* has great development prospects. We wish to tackle the worsening issue while contributing to the reduction of antibiotic use. We improved the oxygen tolerance of *C. tyrobutyricum* during feed additive production and after emission into the environment, through heterologous expression of DNA protection proteins Dps together with pyruvate dehydrogenase AceE, to increase the yield of its additives and develop its application as an acid fertilizer used for the solutions for soil salinization. We wish our project could help reduce the overusing of antibiotics and meanwhile further to improve the soil salinization problems, achieving dual healing for gut and soil.

<https://2022.igem.wiki/worldshaper-nanjing>

Worldshaper-NJBIOX

Project Title: Regeneration of shrimp and crab shells waste: an innovative way to produce biofuel

 Remote Team Village

 Judging Session: October 26, 14:30-15:00 CEST, Room J1

Global energy exhaustion has been a serious issue all over the world. Until now, the world has made many efforts on developing new energy sources and technologies, but many of refacing various problems, such as expensive raw materials and the inability of mass-production. Butyl butyrate is a new class of biofuels with high performance. We engineered *Clostridium tyrobutyricum* to produce both butyric acid and butanol at the same time, and esterify it to form butyl butyrate under the catalysis of lipase. The aldehyde alcohol dehydrogenase AdhE2 gene were introduced into *C. tyrobutyricum* to convert butyryl-CoA to butanol, and the expression of Thl and Hbd were also strengthened at the same time to improve the yield of butyryl-CoA. Using discarded shrimp and crab shells as a kind of nutrient source, the green production process of butyl butyrate from kitchen waste to biofuels is realized.

<https://2022.igem.wiki/worldshaper-njbiox>

Worldshaper-Shanghai

Project Title: The Smurfs: Anti-aging anthocyanins produced in hairy root cultures

 Remote Team Village

 Judging Session: October 26, 15:00-15:30 CEST, Room J2

With the property to eliminate free radicals, anthocyanins have become popular anti-aging natural products which can be used as edible colourants. However, traditional anthocyanin industry requires intensive farming that occupies a lot of arable land, relies on climates and seasons and is also inefficient and wasteful during anthocyanin extracting. In our project, a beta-estradiol inducible system was employed for expression of two transcription factors regulating anthocyanin biosynthesis from *Scutellaria baicalensis*. An anthocyanin synthesis pathway was constructed in carrot hairy roots and then the hairy roots were induced to produce anthocyanins with high stability, high effectiveness and less hazard. With the culturing of carrot hairy roots in vitro, a controllable way of anthocyanin production was developed. In the future, our project is committed to make anthocyanins into easily accessible food pigments so that anyone can delay people's aging processes.

<https://2022.igem.wiki/worldshaper-shanghai>

WrightState

Project Title: Deconta-Mn-ate

 Booth: Environment Village, I-31

 Village Presentation: October 27, 15:15-15:30 CEST, Plaza 5

 Judging Session: October 26, 16:30-17:00 CEST, Room J6

Manganese above World Health Organization limits is associated with neurologic dysfunction and Parkinson's-like disease. Despite the increase in manganese discharges from industrial runoffs and the resulting increase in manganese contamination of water sources, applications for the detection and bioremediation of manganese are not widely available, cost-effective, or easy to maintain. We are developing an E.coli expressed biosensor for the detection of manganese contamination in water samples. The sensor consists of a manganese-responsive promoter and riboswitch driving expression of a superfolder green fluorescent protein (sfGFP). The sensor is currently capable of detecting manganese down to 1mM, and efforts are underway to increase its sensitivity. Once the system is optimized, we plan to replace sfGFP with phytochelatin as a means of chelating manganese from drinking water. It is our hope that our system will provide a cost-effective and fieldable alternative to existing means of manganese detection and removal.

<https://2022.igem.wiki/wrightstate>

WVHS_SanDiego

Project Title: The De-Fluorinator

 Remote Team Village

 Judging Session: October 26, 16:30-17:00 CEST, Room J2

No abstract

<https://2022.igem.wiki/wvhs-sandiego>

WWU_Muenster

Project Title: MonChassis - Monoterpenoid production in yeast coupled with cell-free monooxygenase catalysation

 Booth: Biomanufacturing Village, B-25

 Village Presentation: October 27, 16:00-16:15 CEST, Plaza 1

 Judging Session: October 26, 17:00-17:30 CEST, Room J9

Monoterpenoids are versatile biomolecules with broad applications in healthcare, agriculture, and consumer products. However, large-scale applications remain rare, as traditional production methods rely on extraction from plants and chemical synthesis. This makes monoterpenoid production expensive and unsustainable. Microbial production of monoterpenoids is a promising alternative, but poor precursor availability, complicated expression of cytochrome P450 monooxygenases (CYPs), and product toxicity limit their potential. MonChassis is overcoming current limitations by increasing precursor availability in *Saccharomyces cerevisiae* and *Yarrowia lipolytica* by metabolic engineering, compartmentalization, and creating a cell-free, electrically-driven CYP system to circumvent product toxicity. With this, we established an adaptable platform for monoterpenoid production, allowing further deployment of monoterpenoids in unexplored areas. As a proof-of-concept, we produced verbenone, used to fight bark beetle invasion in forests locally, and globally. Thereby, MonChassis not only establishes a flexible production method for monoterpenoids without using plants but also contributes to the conservation of forests.

XHD-Wuhan-China

Project Title: An advanced copper sensor

 Remote Team Village

 Judging Session: October 26, 12:30-13:00 CEST, Room J1

Copper is a common heavy metal pollutant. Currently, copper from agricultural, industrial and mining waste is released into the aquatic environment, posing a serious threat to the stability of ecosystems. The lack of effective early warning tools for copper contamination has resulted in many negative impacts. For this purpose, *Escherichia coli* BL21 was genetically modified to carry the promoters *pcutR*, *OprF* and *ribB*, the cell membrane permeability of the engineered strain was increased, and its riboflavin production was positively correlated with the copper ion concentration, and then the biosynthetic strain was used for Biosensors based on microbial fuel cells provide a better method for the detection of copper ion-contaminated water bodies.

<https://2022.igem.wiki/xhd-wuhan-china>

XHD-Wuhan-Pro-China

Project Title: Zinc Dreamcatcher

 Remote Team Village

 Judging Session: October 27, 13:30-14:00 CEST, Room J1

Our project aims to provide a new answer to the problem of zinc contamination with zinc sensors. The modified instrument can sense the concentration of zinc ions in a solution, becoming a sensor similar to a galvanic cell. Depending on the concentration of zinc ions in the solution, the current and voltage in the circuit are changed to measure the concentration of zinc ions in industrial wastewater. In this experiment, we use two kinds of macromolecules, one is riboflavin, and another one is porin. The zinc sensor employs the basic principles of a simple cell. Both the electrodes from the zinc sensor are carbon fiber felt electrodes with *E.coli* attached to the anode exclusively. The potassium iron cyanide receives electrons in the cathode. The ammeter in the external circuit of electrons measures the magnitude of current due to electrical potential.

<https://2022.igem.wiki/xhd-wuhan-pro-china>

XJTLU-CHINA

Project Title: SolHM: Application of new biofilm in industrial wastewater treatment

 Booth: Environment Village, I-32

 Village Presentation: October 27, 16:00-16:15 CEST, Plaza 5

 Judging Session: October 26, 14:00-14:30 CEST, Room J8

We designed a water purification filter system to take full advantage of engineered bacteria to treat heavy metal emissions, culminating in the blocking and adsorption recovery of a variety of heavy metal ions in the process of industrial wastewater treatment, especially in the electroplating and mining sectors in China. Our approach demonstrates that the molecular dynamics and cell kinetics model, together with subsequent wet lab measurement. Engineering simulation can develop robust and precise living systems for potential applications in synthetic biology and further environmental studies.

<https://2022.igem.wiki/xjtlu-china>

XJTU-China

Project Title: An environmentally friendly bio-fertilizer-Controllable production and release of herbicide and exopolysaccharides by engineered bacteria

 Remote Team Village

 Judging Session: October 27, 9:30-10:00 CEST, Room J8

We provide an environmentally friendly bio-fertilizer, attempting to solve the problems caused by the widespread use of chemical herbicides by synthetic-biology. An engineered *E. coli* is constructed with the ability to produce a novel herbicide- aspartic acid and exopolysaccharides(EPS) under blue-light, and to controllably release them into soil triggered by heat, which will avoid excessive use and possible residue of herbicide, also promote water conservation and sand fixation by EPS. Our system consists of a precursor plasmid that converts the glucose to the key precursor GPP, and multiple functional plasmids with the ability to synthesize herbicide and EPS under the control of blue-light. Meanwhile, our engineered cells will release herbicide and EPS with the expression of a lysis gene under a higher temperature above 42°C. About 10% of the bacteria will escape the lysis procedure and recover, promoting a new round of controllable production and release of herbicide and EPS.

<https://2022.igem.wiki/xjtu-china>

XMU-China

Project Title: OMEGA (Operable Magic to Effectively Getting over AHPND)

 Remote Team Village

 Judging Session: October 27, 13:30-14:00 CEST, Room J13

Shrimp is a delicious seafood favored around the world. However, the threat of acute hepatopancreatic necrosis disease (AHPND) has caused a devastating impact on the shrimp aquaculture industry. AHPND is caused by *Vibrio parahaemolyticus* carrying pVA1 plasmid. The conventional approaches for preventing and curing AHPND either have limited success, or are unsustainable in the long-term. Also, a rapid detection method is in urgent need. Therefore, XMU-China offers OMEGA. It includes detection, treatment and prevention of AHPND. First, Recombinase Polymerase Amplification technology and cell-free system are employed to detect toxin genes in the water sample. Then engineered outer membrane vesicles (OMVs) are applied to target and deliver plasmids encoding endolysin into the pathogen, treating the disease. For prevention, OMVs with surface displayed receptors are further used to competitively bind to the PirA/PirB, preventing cell damage. CRISPR/Cas system is further utilized to destroy *pirA/pirB* gene, achieving the virulence loss of *Vibrio parahaemolyticus*.

<https://2022.igem.wiki/xmu-china>

Yale

Project Title: Biosynthesis of an Optimized (S)-equol Pathway in Gut Microbial Species for Probiotic Health Applications

 Booth: Therapeutics Village, D-27

 Village Presentation: October 26, 16:00-16:15 CEST, Plaza 2

 Judging Session: October 27, 16:00-16:30 CEST, Room J5

Menopause is a natural part of a healthy life marked by a decrease in estrogen levels. This transition can bring about uncomfortable, sometimes debilitating symptoms. Within the gut microbiome are bacteria that produce products such as equol, an isoflavandiol that mimics estrogen in the body. Equol has been shown to be an effective treatment to relieve menopause symptoms however, the monthly cost for the necessary dosage is unreasonably expensive. Additionally, gut microbiomes vary from individual to individual so not all individuals are able to naturally produce equol at effective rates. As the median age of women increases across the globe, issues which arise during menopause become more prevalent. To combat this issue, we sought to improve the rate at which *Adlercreutzia equolifasciens* and other gut microbial species produce equol. Demonstrated feasibility of these engineered organisms can then be utilized for future use in probiotic supplements as an affordable menopause treatment.

<https://2022.igem.wiki/yale>

YiYe-China

Project Title: Detecting dysregulation of RNA splicing for myelodysplastic syndromes diagnosis using RNA splicing sensors

 Remote Team Village

 Judging Session: October 27, 13:00-13:30 CEST, Room J1

Myelodysplastic syndromes (MDS) are the commonest hematologic malignancies in the elderly. Now, the accurate diagnosis of MDS still heavily rely on the experienced hematologists' morphological evaluation of peripheral blood and bone marrow cells. Therefore, it is urgent to develop more effective detection methods for MDS diagnosis. Aberrant splicing is strongly associated with MDS. Many RNA splicing-related genes have been found to mutate in around 50% of MDS patients, suggesting analysis of RNA splicing status should be used for diagnosis of MDS. It is reported that exons of mitogen-activated protein kinase kinase kinase 7 (MAP3K7) and zinc finger protein 91 (ZFN91) were skipped in MDS patients. This inspired us of constructing sensors fused the skipping exons into the plasmids containing reporter, which monitors the alteration of RNA splicing in cells. Our project provides a simple and effective method for early diagnosis and prediction of prognosis in MDS in the future.

<https://2022.igem.wiki/yiye-china>

YkPaO

Project Title: Gastric cancer detector

 Remote Team Village

 Judging Session: October 26, 15:30-16:00 CEST, Room J2

Helicobacter pylori is an anaerobic helicobacter parasitic in the human stomach, which was first isolated from the body of gastric ulcer patients by Marshall. It has been listed as a clear carcinogen. The detection of Helicobacter pylori has become an important physical examination item for the prevention of gastric cancer. The design idea of this project is to construct Helicobacter pylori 16s and cagA sequence vectors and transfer them into Escherichia coli to simulate Helicobacter pylori. Then, by constructing Cas12a and sgRNA vectors, isothermal amplification technology is used to identify the simulated Escherichia coli. This project will build a fast and convenient detection method for Helicobacter pylori, Shigella, and Salmonella based on CRISPR, help people to detect Helicobacter pylori, Shigella, and Salmonella conveniently and efficiently, and contribute to the prevention of gastric cancer. Key Words: Helicobacter pylori, CRISPR, gastric cancer

<https://2022.igem.wiki/ykpao>

Zhejiang_United

Project Title: 2'-fucosyllactose cell factory

 Remote Team Village

 Judging Session: October 26, 13:00-13:30 CEST, Room J2

2'-fucosyllactose (2'-FL) is an ingredient in infant milk formula and plays an important role in the growth and development of infants and children. This project expresses the genes and related transporters required in the synthesis pathway of 2'-FL through chromosomal integration. Large-scale production of 2'-FL is achieved by constructing a high-yield 2'-FL *Saccharomyces cerevisiae* cell factory to meet market demand. Key Words: 2'-FL, *Saccharomyces cerevisiae*

<https://2022.igem.wiki/zhejiang-united>

ZJU-China

Project Title: Story Light & restoration of stone relics by Microbial Induced Calcite Precipitation

 Remote Team Village

 Judging Session: October 27, 9:30-10:00 CEST, Room J9

Stone cultural relics are closely linked with human civilization. However, they are being threatened. Among all the damage factors, tiny cracks have received a lot of attention and are difficult to be restored by existing technologies. In order to overcome the challenges in restoring tiny cracks, ZJU-China is dedicated to developing technologies for the integrated conservation of stone artifacts based on engineered *Bacillus subtilis* induced biomineralization. Extracellular calcium carbonate precipitates are brought in for filling the tiny cracks of stone artifacts, with an extracellular scaffold system to further improve the physicochemical properties of the materials. We have also added a quorum sensing module and a biosafety module to make our materials environmentally friendly and efficient. Hopefully, Story Light will be a new technology for the integrated conservation of stone artifacts!

<https://2022.igem.wiki/zju-china>

ZJUintl-China

Project Title: Ambrosia-T

 Remote Team Village

 Judging Session: October 27, 15:30-16:00 CEST, Room J5

Massive cellular senescence is accompanied by the onset of various age-related diseases leading to irreversible aging. Previous studies have demonstrated that removal of senescent cells can reverse aging. Tissue fibrosis is a aging hallmark, characterized by senescent fibroblasts. Furthermore, based on single-cell data analysis and immunochemistry, DPP4 were highly expressed on the surface of aged fibroblasts rather than on young fibroblasts. To address the concerns and reverse senescence-associated phenotypes, we designed a novel and efficient system for removal of these senescent fibroblasts with the help of assembled DPP4-targeting CAR-T immunotherapy. Due to the side effects of CAR-T system, cytokine release syndrome (CRS), we have also designed a negative feedback circuit with detecting the concentration of IL-6, markers of CRS. With the constant function of our project, anti-aging CAR-T, the harmful senescent fibroblasts are eradicated without severe side effects and the grand vision of rejuvenating with one shot will be realized.

<https://2022.igem.wiki/zjuintl-china>

ZJUT-China

Project Title: Healthy teeth legion：Oral guardians for targeted detection and elimination of Streptococcus mutans

 Remote Team Village

 Judging Session: October 26, 12:30-13:00 CEST, Room J5

Oral problems are widespread among people of different ages. Most oral problems can be preventable and treated in their early stages, especially for the universal tooth decay deduced by Streptococcus mutans. This project is seeking a low-cost and convenient way to prevent oral diseases by developing oral probiotics based on GRAS strain-Bacillus subtilis. With introduction of quorum sensing system from S. mutans, the switch of our designed genetic circuits would be triggered by sensing competence-stimulating peptide (CSP, quorum sensing signaling molecule with concentration positively correlated with the number of S. mutans).Our Healthy Teeth Legion project designed multiple genetic circuits to achieve the purpose of detecting oral hygiene and preventing dental caries, as well as achieving convenient feedback of test results. For safety reasons, termination switch has been added accordingly. With combination of scientific research, computer modeling and extensive experimental data,more reliable and convenient Healthy Teeth Legion would be developed.

<https://2022.igem.wiki/zjut-china>