Background and Motivation

The difficulty of cleaning nuclear leakage raises our motivation to design a special bio-robot to dispose of one of the main leakage substances, cesium-137. Cesium-137 not only has a 30-year half-life to cycle in ecosystems, but also leads to the injury of hematopoietic and nervous systems. To clean cesium-137 from sea where it is hard for humans to deal with, we utilize several necessary genes to control the movement of E.coli towards irradiation and implement the mission of cleaning cesium-137. At last, most E.coli will gather, making the cleaning more easily, and subside down to the seabed.

Movement

Ionizing radiation activates the SOS repair system, resulting in the expression of recA. The dephosphorylation level of CheZ controls the movement of bacteria. We placed gene cheZ in the downstream of recA to construct bacteria that move directionally towards ionizing radiation.

Ionizing radiation was replaced by UV light in our experiment. After exposing to UV, cheZ knockout E.coli showed an obviously movement and moved faster when the intensity of UV increases, indicating the E.coli moves towards a higher intensity of UV.

Measurement

The expression level of eGFP is positively correlated with the intensity of UV when placed in the downstream of cheZ. Additionally, a constitutively expressing mRFP can be used to eliminate the discrepancies among bacteria. So the ratio of green to red fluorescence intensity can indicate the intensity of ionizing radiation.

Cs Absorption

We armored our bacterial with TrkD, an ion channel with high affinity to cesium-137, to take in the radioactive cesium ion. Then we link recA with TrkD on a plasmid and transform it to our E.coli.

Gathering and Capture

After our E. coli absorbs enough amount of cesium ion, it will express protein Antigen-43, helping to gather with its brothers.

Then, we use GFP and RFP to show the accurate position of radiation.

With promoter recA, we could utilize cheZ to control E.coli to move towards radiation. After E.coli approaches the radioactive area, protein TrkD will absorb the cesium-137. Finally, all E.coli with radioactivity will be gathered and collected.

Achievement

Migration towards ionizing radiation
Absorption of radioactive cesium-137
7 basic parts sent to the Registry
Comprehensive human practice
Concise and beautiful wiki

Future Work

We need to complete the parts of measurement and aggregation at first. Then adding a device to protect the plasmids from gene flowing. In the end, all parameters and systems will be optimized to adapt the environment.

Human Practice

We designed an iOS app to introduce synthetic biology and our project to the public.
We developed a card board game, LabCraft, to make the learning more interesting.
We presented our project and publicized synthetic biology in our workshop.
We investigated students’ interest and comprehension of synthetic biology.