Introduction
For creating an RPS game between humans and bacteria, we tackled three problems. Firstly, we used two sets of three signaling molecules which correspond each to rock, paper, or scissors. Secondly, to know who wins the game, we needed a set of E. coli that act as judges. We constructed the Judge E. coli by using AND gate promoters. Finally, we made our randomizers which enable E. coli to choose any of its three signaling molecules with the same probability in order to be able to play the RPS game fairly and properly. To do so, we designed two randomizers: Conditional Knockout by Recombination and Survival of One Strain.
Because it was very hot in summer vacation, as a prize for winner in RPS game, we also designed an E. coli that can make rain and other E. coli that will allow us to make urea coolers. All this, to make the hot summer more fun and refreshing!

Judge
Using AND gate promoter for Judging
The AND gate promoter can detect two different signaling molecules as inputs and produce fluorescence protein as an output to indicate the winner of the game.
We need a set of nine judges because each of the players has a set of three different signaling molecules.
Each of the 9 Judges contain one AND gate promoter
We constructed one of the Judges
This judge detects human’s paper and E. coli’s rock, and shows human’s winning by green fluorescence.
+lux-lac-GFP (BBa_K649100)[1]
We confirmed the expression of gfp gene is dually regulated by IPTG and JO3C-HSL.

Choosing one hand randomizers which enable E. coli to choose any of three signaling molecules with the same probability

-Decision made by Recombination

To design the randomizer based on Cre-lox recombination, we needed two lox cassettes of different recombination frequency...

[BBa_K649021]

...and we successfully constructed these cassettes!

Survival of One strain
To create a randomizer, we used three rival strains each corresponding to rock, paper, and scissors. We make them compete for survival and take the surviving strain to represent the bacteria’s choice of the RPS game.

-Our New Model

Durrett & Levin (1996)
Tokyo Tech iGEM 2011

In the old model, the producer strain can’t survive, which is a critical limitation as a randomizer for the RPS game. To be able to create a true randomizer, we modified the differential equations of the model. We limited the resistance of the colicin-resistant bacteria. In this case, a type of bacteriocin, produced by colicin-resistant, is toxic to the colicin-sensitive strain as well as itself. With our new differential equations, any of the three types of bacteria can outcompete the other two strains and ultimately survive by very small differences between the initial population densities of the strains.

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Reference