Düsseldorf – Cologne 2017

In *Plasmid Factory* you are a young scientist, seeking for the goal to achieve the degree of plasmid designing. To do so, you and your fellow students are facing 5 semesters of increasing levels of difficulty.

But before discussing your adventure in detail, I would like to introduce you to the field of synthetic biology.
"Synthetic biology is the design and construction of new biological parts, devices and systems but also the re-design of existing natural biological systems for useful purposes" (http://syntheticbiology.org). By using either natural existing genes, features and characteristics of organisms or trying to recreate these with unnatural molecules synthetic biology offers us a wide range of genetical engineering. To begin in a small way, the goal of synthetic biology is to solve world problems, by giving organisms special features or furthermore using microbial cells as mini factories for pharmaceutics, medicines or fuels.
In this game you are creating a plasmid (circular DNA) that should work in the microorganism (Baker's yeast) *Saccharomyces cerevisiae*, using the *E. coli* bacteria as a reproducer of it.

Have you ever imagined that one of the smallest organisms in the world could be capable of tackling the biggest challenges humanity faces, such as global warming, pollution or the extinction of coral reefs? Bacteria are literally everywhere we live and beyond. Some of them are extremophile, which means that some species survive in geochemically or physically condition we wouldn't even think of. We even have bacteria in our gut which provides us with a barrier against pathogenic organisms. Indeed there are some who thrive in hot geysers of the deepest oceans or even on the moon. Bacteria reproduce very fast (they divide their genome every 20 min) and are therefore used as a cloning factory. Once the wanted plasmid is available in a sufficient amount, it can be transformed into the yeast cells. The yeast *Saccharomyces cerevisiae* is well known for its industrial use in breweries and bakeries. It is also a common model organism for research purposes due to its well analyzed characteristics.
Unlike human DNA, some of the genome from bacteria and yeast is circular and is called a plasmid. It is a lot shorter and less complex which makes it easier to change specific genes in order to change to whole organism and its functions.
Once a plasmid is successfully transformed into yeast it is treated like a natural yeast plasmid and the enzymes for transcription and translation do also work here. This results in the translation of proteins from the previously designed and transformed Plasmid.

You are now responsible for the content of the transformed DNA. Each Plasmid has to contain eight parts in a specific order, each of them with a needed function, like a certain resistance or the gene you would like to express. Only if you combine the right parts in the right order, the transformation into yeast will work out. So be careful!
To achieve your degree in synthetic Biology you have to follow the instructions written on your card and complete the challenges.

<u>This box contains</u>

4 phase cards
68 normal game cards in 4 different colors
4 ATP game cards
4 special game cards explained on the next page

fungal infestation! All players without described resistance have to drop their coding sequences.

fire alarm! You have to leave the building and are not able to continue with your work. (Hand this card to a player and he has to pause)

no supervisors! All your supervisors are not in the lab today and you are not allowed to work. (Hand this card to a player and he has to pause)

Rules of the game

At the beginning, every player gets an individual phase card.
After this all game cards are mixed up and every player gets 8 of these. The rest of the cards are placed in the middle of the table.
The players now try to complete the phases on their list. Every plasmid should be made of eight parts (one card is one part) which have to be in a given order and, depending on which phase you are working at, fulfill different standards.
One player starts by drawing either one card from the draw pile, or the top card of the discard pile in the middle of the table, and adding it to his hand. Then he ends his turn by discarding any one of his cards to the discard pile. The next player now has the opportunity to either take one card from the draw pile or, if it helps him completing his phase, taking the top card from the discard pile, which the player before him just dropped off. You play this scheme, collecting the cards you need for you phase and making sure you always have 8 cards on your hand. If one player collected all required cards, he can hand in his final project by laying all of them in the right order in front of him. For fairness, the game round will be completed until the starting player, then it ends. Now all the cards are collected and a new round begins. All players who managed to complete the first phase are now starting with the second, if you did not complete the first phase, you have to work on the same phase again until you finish it. There are 5 phases and the first player to complete phase 5 is the winner.

Order of the different parts

The right order of the different parts is necessary to build a functionable plasmid:

Part 1: Assembly Connector (L)
Part 2: Promotor
Part 3: Coding Sequence
Part 4: Terminator / PTS
Part 5: Assembly Connector (R)
Part 6: Yeast Marker
Part 7: Yeast Origin
Part 8: Bacterial Marker and Origin

Special cards

There are several special cards within the game. You can drop them off at your turn instead of a normal card and hand it to the person you want to suffer a mistreatment.
ATP allows you to not only take the top card, but choose any card of the discard pile. After using it, the ATP card is placed outside of the game and not discarded on the pile. In the next game round you mix it up again with the other game cards.

Background information about building plasmids, the 2017 iGEM team DUS_CGN ‘artico’ and our project

The parts we used to create ‘plasmid factory’ are taken from “A Highly Characterized Yeast Toolkit for Modular, Multipart Assembly” (Michael E. Lee, William C. DeLoache, Bernardo Cervantes and John E. Dueber; 2015). We are not only using this paper for creating this game, but mainly for our this year’s project. As we want to create an artificial compartment, we need to have the opportunity to modulate the yeast’s characteristics.