EscapeTheLab!

A Pedagogical Escape Game about Synthetic Biology

The guide to recreating EscapeTheLab!

A game designed for the 2017 iGEM Competition, by the Paris Bettencourt Team.
Check more about our project here:

This pedagogical game was designed during summer 2017 by the Paris Bettencourt iGEM Team, for the iGEM competition. The complete design was the result of a collaboration with the iGEM team and external people and friends: We deeply thank Mourdjen Bari and Anton François from the bottom of our hearts, for their full involvement in the creation and the management of this Escape Game.

The different riddles were created during a jam session with several students and friends from within the CRi or externally, including Ismael Ait-Aouit, Nina Brache, Pauline Chevallin, Tristan Isaac, Jade Joannot, Emilie Nastet, Adrien Tsoungui, Nikola Zarevski: we deeply thank all of them for their creativity, their volunteering and their support. This project evolved in the CRI, an ecosystem suitable for collaboration and ingenuity, and we also thank the members of the CRI, including Maria Azi , Alvaro Banderas, Youcef Benarekzi, Antoinette Bouziane, Victoria Maria Diez, Benedicte Gallon, Jean-François Gianni, Prateek Garg, Sophie Gonthier, Haotian Guo, Ariel Lindner and Edgar Ornelas.

We also deeply thank our friends and first test-players, including (but not only) the iGEM 2017 UPMC team and the iGEM 2017 Pasteur team. Ultimately, we thank the whole iGEM competition for this fabulous experience and opportunity it gave to all students around the world.

iGEM-illy yours,
The 2017 iGEM Paris Bettencourt Team.

INTRODUCTION

The Goal

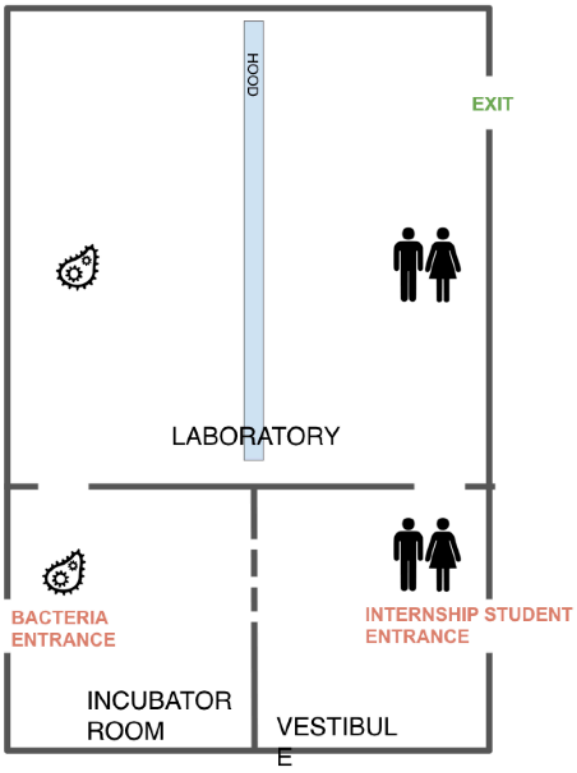
Synthetic biology is a field of science that mixes natural biology and engineering, to create alternative biological systems. It can lead to new industrial application in medicine and therapies, agro-industry, environmental pollution, materials and etc. This field of science is a new domain, thus, the general audience is not aware of the progress that has or is being made. It also leads to a bunch of questions on different topics, such as the application, ethics, biosafety and religion. In order to make the general public more aware of how synthetic biology works, and why it is important, we created this game.

This game is part of our iGEM 2017 project's Human Practice section, in the Education and public engagement part. We assume that the aim of this game is not to necessarily teach the benefits of synthetic biology but instead to debate the pros and cons of new kinds of techniques.
This folder also contains a form to submit to players before and after the game: it will permit us to understand if the game is calibrated to our aim and if the pedagogical goal has been reached.

During the game, at least one person will follow the team: known as the Game Master (GM). It is obviously better if there are two GM's during the game, one with the bacteria group, one with the internship students group. GM's are there to explain but also repeat the rules, manage if there is a mistake in a riddle or if a clue is destroyed and to provide supplementary oral clues if necessary.

After each session, 10 to 15 minutes should be taken to check with players about each of the riddles, the corresponding pedagogical goal and scientific notion behind it. This time will also be used for the players to submit questions and give their opinion.

ROOM SETUP



An Escape Game takes place in one or several rooms. For the Escape Lab, we decided to play inside an approximately 12m2 room. This room is divided into 3 parts:

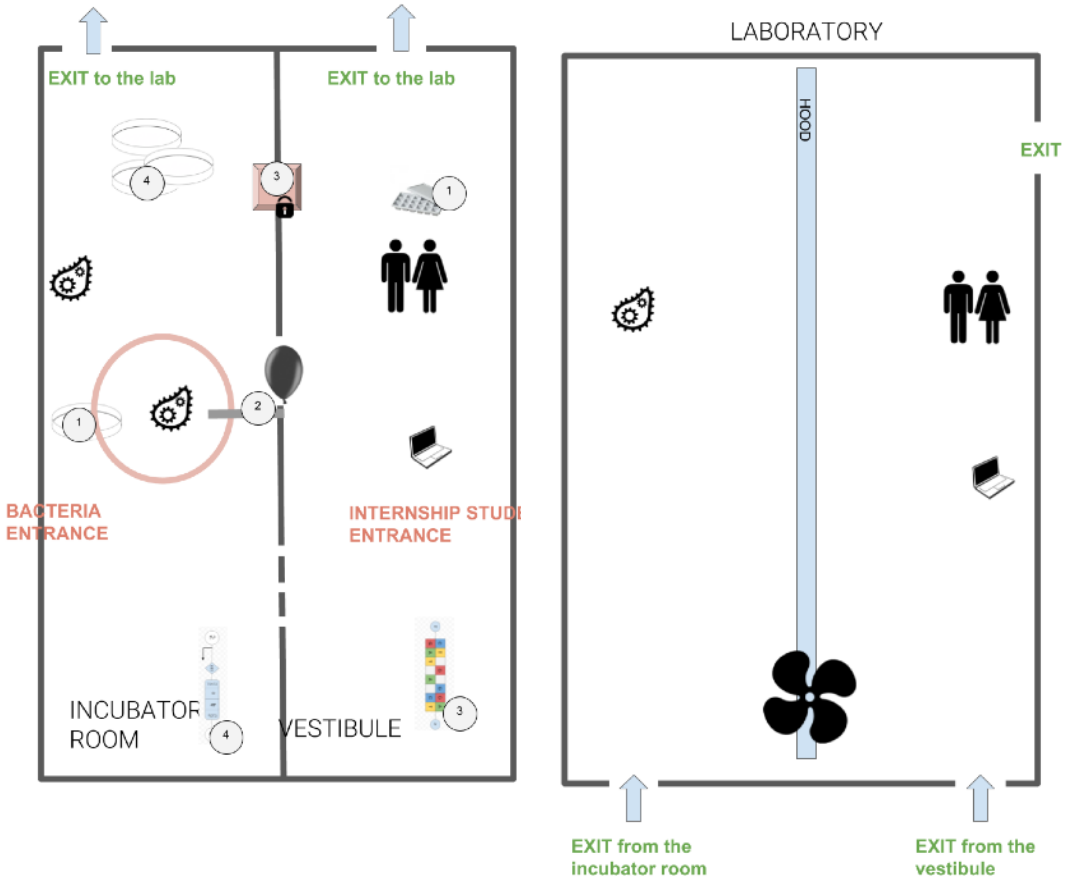
- the incubator room,
- the vestibule
- the laboratory

Of course, this space can be changed depending on your demands. You should take the initiative to calibrate the spread of objects across the room. "Rooms" have been defined with black curtains fixed with strings. We placed red chairs at places where we did not want the player to cross and added a new rule to the Escape Lab: players cannot cross through the red chairs. Chairs defined the "doors" between the incubator and the lab, and between the vestibule and the lab.

The Vestibule and the Incubator Room are separated by a curtain with holes, to permit to communication between the two sides. In each area, feel free to add more decoration, to enhance the immersive aspect of the game, like the two plastic tubes use to blow up and give the lamp to the other team. In each area, riddles can be solved using different tools: these tools should be hidden in the appropriate room, in a place that enhances the search part of the game. In the laboratory, there are a lot of riddles: if tools are hidden far from the complementary pieces, it is better to add a small symbol, colour indicators or any type of sign to link the complementary tools for the players.

In the laboratory, an alignment of the tables defines the area for the students and bacteria. The two groups can freely exchange objects on the table. The idea of the hood, where scientists can manipulate bacteria, is represented by a vertical plexiglass plate between the two sets of players. A fan is here, orientated to the direction of the plate: one bio-brick is hidden over the fan.

A more detailed map with the location of each enigma is proposed:



<u>Inside the Vestibule, we should find:</u>
-The computer with questions
-The DNA template
-The scrabble pieces
-A box closed with a 4 digit padlock
-The ice cube tray

<u>Inside the Incubator room, there are:</u>
-The delimited adhesive tape circle
-The petri dishes
-The gene template
-Falcon tubes

<u>Inside the bacteria's side of the laboratory, you should find:</u>
-The 3D molecule
-The organic ball
-The box attached to a pulley system
-A 96 plate with red cabbage juice
-2 gloves
-Falcon tubes
-Mirrors

<u>Inside the student side of the laboratory, you should find:</u>
-The tip boxes
-The pipettes
-The funnel part of the pulley system
-Petri dishes with corn starch
-Restriction enzymes (scissors)
-The biological wastes dustbin
-Petri dishes with corn starch (on the table,

GAME PLAY

Scenario

A group of players (between 4 to 8 people) is divided into two teams (by chance, or the game master can choose, they should be less affinity with people of the same team). The two teams are named: The Internships Students and The Bacteria. Internship Students wear lab coats, whereas bacteria wear green antenna (or any bacterial characteristic that you want). The whole session should last one hour. Bacteria start in the Incubator Room and Internship Students start in the vestibule. The first goal is to enter inside the Laboratory. Once they are inside, they have to fulfil the internship report with the different bio-bricks they find. The different parts of the bio-bricks will automatically be inserted into a plasmid that should be given to the bacteria to permit them to leave to the lab.

Chronological Progress

Bacteria are the first to enter. They are blindfolded and guided by one of the Game Masters to an adhesive tape circle, inside the incubator room. They will sit down, and the GM will tell them that there are not allowed to leave the circle until it is explicitly mentioned.

The internship students begin outside of the Vestibule. Once they enter, the chronometer must start. Students have to resolve riddles to give to the bacteria the ability to see (removal of blindfold) and have permission to move (outside of the circle). Then, in order to enter into the lab, the players have to find the username and passwords, both of which will be found by resolving other riddles. During all this time, student and bacteria are not in the same space: they are not allowed to touch each other or go into the other area, but they can talk to each other.

Once they arrive in the lab, they are again in two different and defined area. The lab specificity is designed so that they can exchange tools from the two sides of the hood. On the computer, the page of the internship report is present: players will enter here the succession of different bio-bricks that will permit them to leave the lab.

Explanations Before Entering The Room

The objective of the game: An escape Game is a game where you are inside a closed room, the goal is to leave the room. Riddles, puzzles, enigmas will give the solution to leave the room. Players have to search indices and key elements inside the room, and should not hesitate to comb the whole area. The other major point with Escape game is collaboration. Some riddles cannot be completed with only one person, so, players should communicate loudly about their discovery and try to assemble together the different parts of the puzzles. In the Escape Lab, bacteria and students are not in the same place but should collaborate as much as possible. There is nothing to find above 1m70 (small players are not disadvantaged) and if they try to open or pull something that seems handmade and fragile, be careful to not destroy it!

PART ONE: INCUBATOR AND VESTIBULE

Internship students will play in the vestibule room and bacteria play in the incubator room. Bacteria enter first, blindfolded, and be placed inside the adhesive tape circle. The chronometer starts once the internship students have entered inside the vestibule.
They have to answer the question on the computer in order to enter to the lab. The program to run is attached to this document, please download it and have a test session. The answers are:

BIO-SENSOR ; FLAGELLUM ; rosalindfrancklinjr@cri-paris.org and igem2017

The enigmas of the first part are:

BIOSENSOR | FLAGELLUM | DNA Scrabble | Petri dishes

Each enigma is detailed on its own information page, the problem and the solution, and the pedagogical goal is described. If a special template needs to be printed, it will be explicitly mentioned.

Once players have found the username and the password, they can enter into the laboratory, from their respective doors.

PART TWO: THE LABORATORY

When the players enter into the lab, the internship report will appear on the computer. They have to keep it and fulfil the set of questions with the bio-bricks they find in the lab. The internship report will need them to choose the correct bio-bricks from a catalogue. Once the bio-brick is correct, it will turn green and is virtually inserted into a plasmid.
There are 5 main riddles to solve and 5 bio-bricks to generate on the computer. The 6 enigmas of the second part are:

MIRROR | HOOD | 96 WELL PLATE | TIP BOX

RESTRICTION ENZYME

Once the plasmid on the screen is full with the five bio-bricks, it will give the code to leave the room, by using either a digit padlock or a key, depending on your choice.

ENIGMAS

1 – BIOSENSOR

Subject:
Find the two parts of the word: BIO-SENSOR

Problem:
First question: They have to find a word in two parts. Two parts of the word have to be given by the two teams. The word is asked by the computer.

Solution:
The Bacteria team has to find the letters B – I – O inside petri dishes with agar gel. They cannot see, they have to touch and destroy the gel to understand which letter it is.
Letters S-E-N-S-O-R-S are trapped inside ice cubes. Some cubes present false letters, forms with no sense. They have to melt ice cube with hot water.

Tools:
Ice cube tray – small letters in plexiglass – agar powder – water (frozen and hot) – petri dishes

Pedgagogy:
The asked question relates biosensors with environmental uses. The material used is the one from the laboratory.

2 – FLAGELLUM

Subject:
Inflate the balloon to see the word.

Problem:
A ballon is placed under the table, and it has a word written on it. There is a tube that is

Solution:
They have to blow into the ballon through the tube. A clue is given by the computer.

Tools:
Inflatable balloon – plastic tube (Ø 1 cm) – permanent marker

Pedgagogy:
Bacteria can be mobile and some have metabolic activities that produce gas.

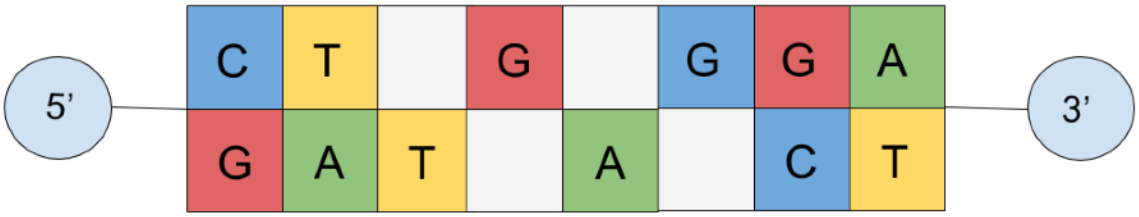
3 -DNA SCRABBLE

Subject
Add the corresponding bases and get the code

Problem
A strange DNA template is present in the vestibule. A set of scrabbles pieces are also in the room. A box closed by a 4 digit padlock.

Solution
On the DNA Scrabble template, students have to place the corresponding A, C, T and G scrabble pieces on the template. The succession of numbers written on the pieces deliver a code that open the box. Inside the box, a lamp permits us to see an invisible ink in the dark. The paper with the ink is placed in the bacteria side. It is written over it « rosalindfranckinjr@cri-paris.org »

Tools
UV lamp and invisible ink – the DNA SCRABBLE TEMPLATE (see below) – paper – falcon tubes – scrabbles pieces – a 4 digits padlock where you can change the code – a plastic tube (Ø 5 cm)



Pedgagogy
The idea of synthetic biology is to give skills to bacteria, which can then be used by synthetic biology to produce things. This enigma also pays tribute to Rosalind Franklin, a great scientist that was crucial in the discovery of DNa structure.

4 - PETRI ANAMORPHOSIS

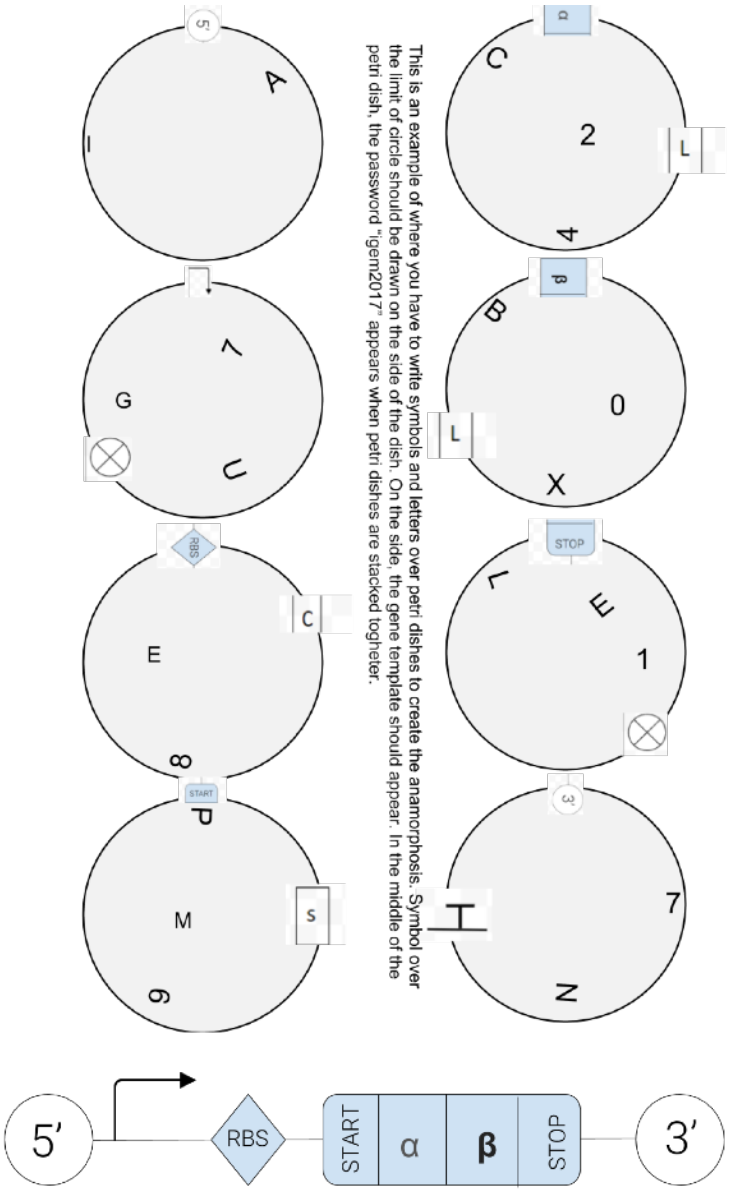
Subject
Stack the petri dishes and find the codes

Solution
By following the Gene template, dishes are stacked on the appropriate position and ordered. If we see through the box, we can see the code «igem2017»

Pedgagogy
How a gene is ordered– the use of petri dishes

Problem
Petri dishes are on the incubator. We need a password to go to the lab.

Tools
8 petri dishes with the appropriate code drawn on the cover and the ‘part of the gene’ order on the side (template below) - gene template (seen below, under petri dish template)



This is an example of where you have to write symbols and letters over petri dishes to create the anamorphosis. Symbol over the limit of circle should be drawn on the side of the dish. On the side, the gene template should appear. In the middle of the petri dish, the password “igem2017” appears when petri dishes are stacked together.

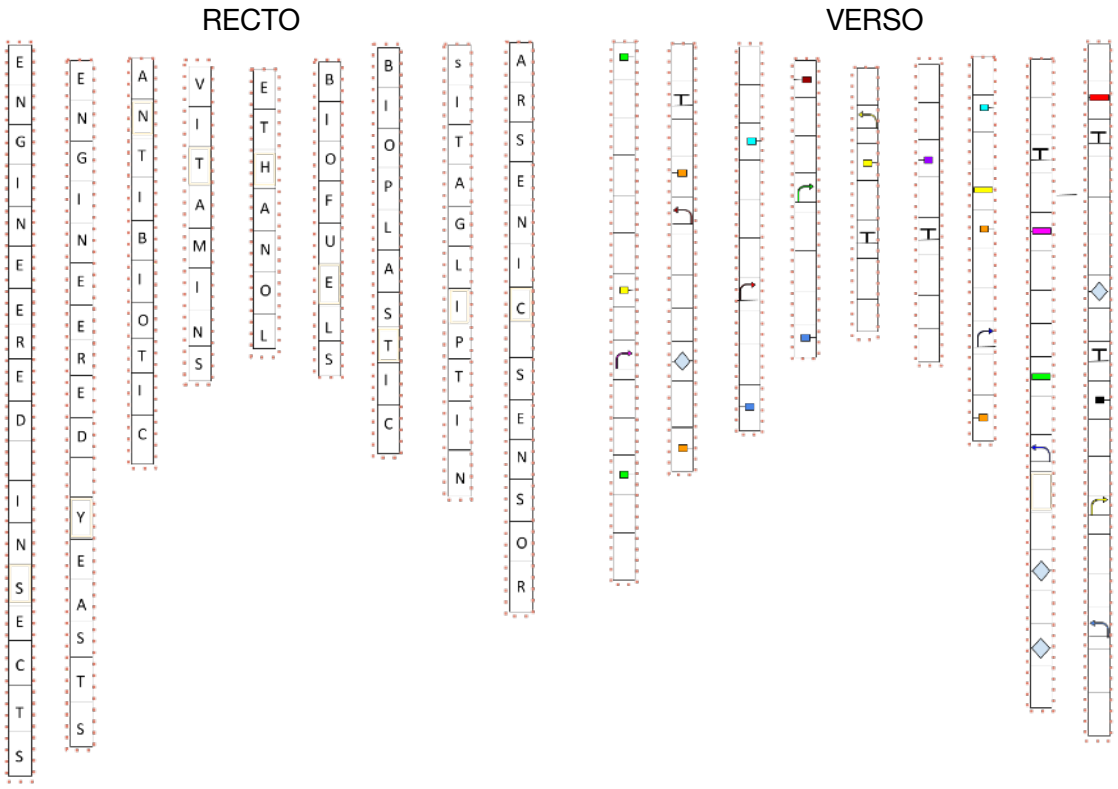
5 - HOOD

Subject:
Between students and bacteria, a hood is represented. On the plate, players have to fix found papers with vertical words. By aligning words in a correct position (depending of the horizontal word SYNTHETIC), players can find the full and correct bio-brick on the reverse of papers.

Problem:
Over the hood, an alignment of 9 checkboxes is drawn: on the right of it, the word “biology” is written. The pulley system is placed over the two side of the lab (see pulley system tutor). Over the funnel, is written to use gloves.

Solution
Players have to find the gloves. They put water in the funnel that goes into the bucket that becomes heavier and with the pulley will open the box. Inside the box, plastic paper band present words. When then aligned words to write the word “synthetic” on the recto, the aligned biobrick will appeared on the verso.

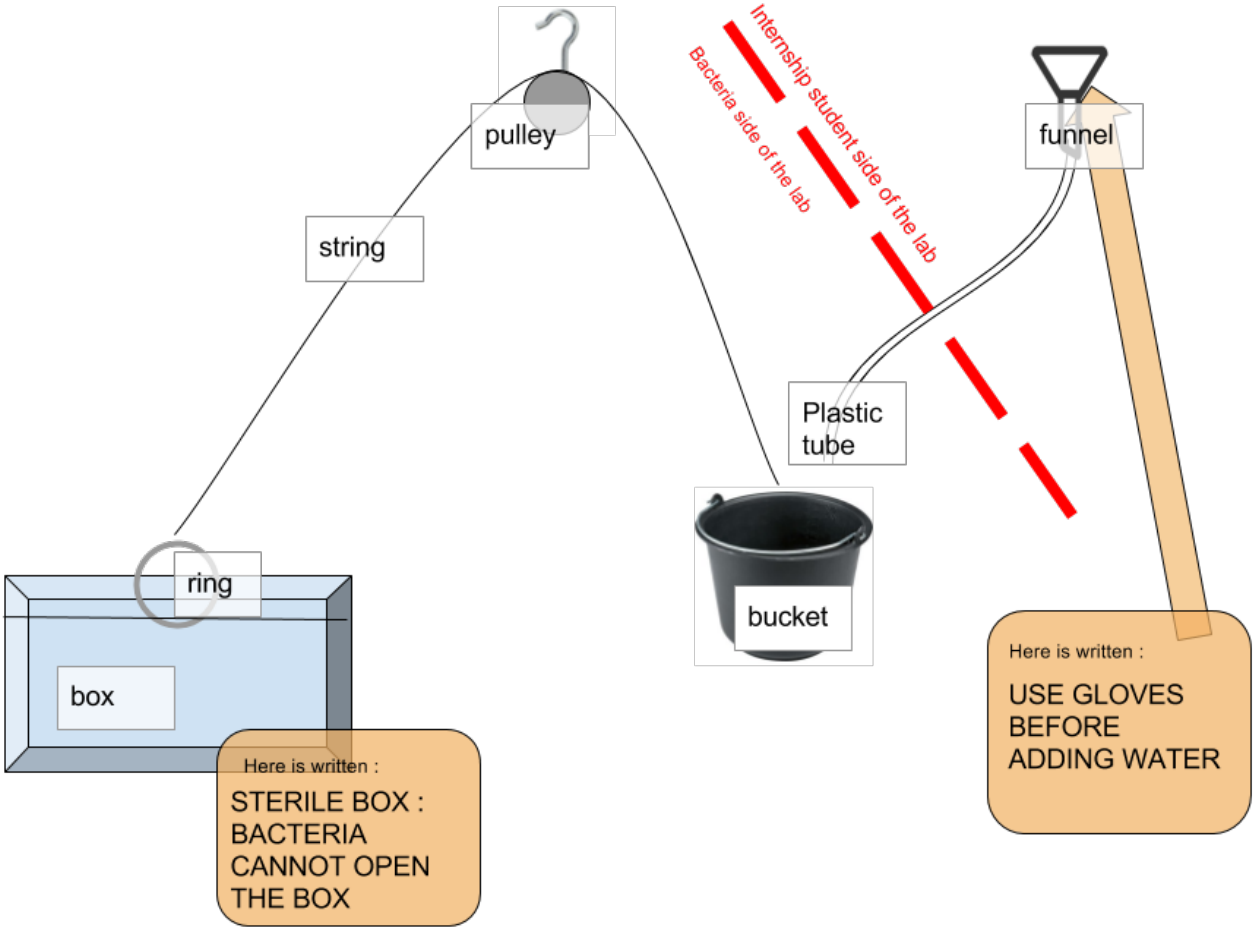
Tools
Plexiglas plate – feet (to maintain it vertically) - HOOD TEMPLATE (see below) - stick gum – permanent marker



Pulley system continues on next page.

5 - HOOD (continued)

Pulley system: (See image below) box – pulley – string – ring – gloves – water in bottle- flexible plastic tube – funnel – adhesive tape



Pedgagogy
Each word represent one thing that can be created by engineered organisms.

6– MIRROR

Subject:
To put a molecule in front of the mirror to obtain the code.

Problem:
A fan is turned on somewhere close to the hood. A molecule is placed on the bacteria side of the lab, and a mirror on the student side.

Solution:
By placing the molecule in front of the mirror, the code is revealed. It permits access to the button of the fan. By turning the fan off, the bio-brick appears, which is on the fan blade.

Tools
Mirror – molecule – fan – bio-brick – glue – digit padlock – carton box

Pedgagogy
About molecule having one order, and creating the opposite molecule «the molecule throughout the mirror» is part of the synthetic biology challenge.

7 – RESTRICTION ENZYMES

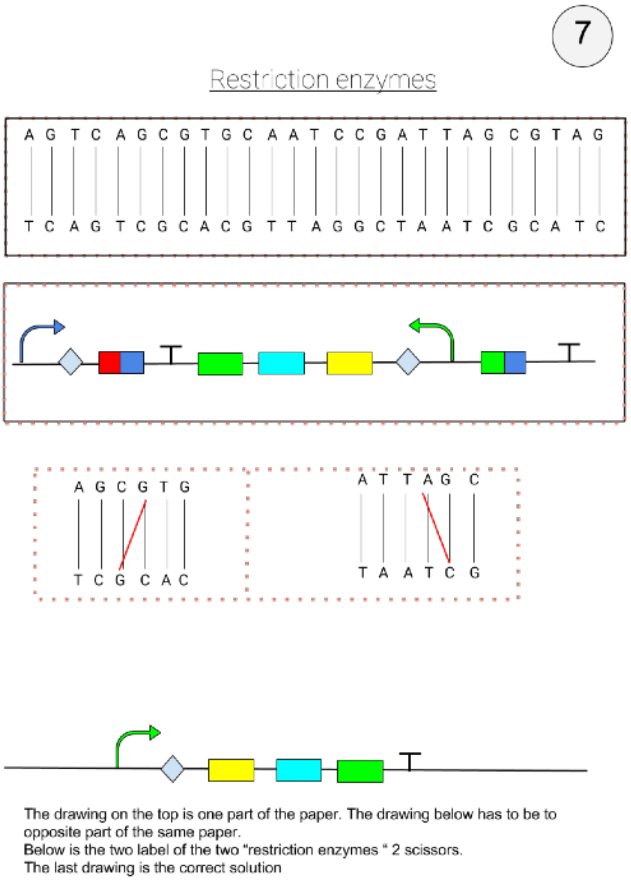
Subject
Restriction enzyme cut the DNA. let's open a cell, take the DNA and select our gene of interest

Problem
A cell, a key hidden, and scissors with a special label over …. where can we find our biobrick ?

Solution
Use the glove, take the key out of the liquid corn starch with the loop. Use the key to open the padlock that fix the oramic ball with an attached string that close the ball. Find the RESTRICTION ENZYME TEMPLATE (the long paper with a recto and a verso) and use the scissors to cut on the appropriate place. You will obtain the biobrick to synthesize with the resting paper.

Tools
RESTRICTION ENZYME TEMPLATE (document :recto, verso + scissors labels) – Oramic ball -- string – 2 scissors – Petri dishes – corn starch +water – loops – a carton box representing the oven

Pedgagogy
The oven induce the concept of a heat shock. Enzyme restriction are here scissors that cut the DNA from the cell, in order to select a gene of interest.



The drawing on the top is one part of the paper. The drawing below has to be to opposite part of the same paper.
Below is the two label of the two "restriction enzymes " 2 scissors.
The last drawing is the correct solution

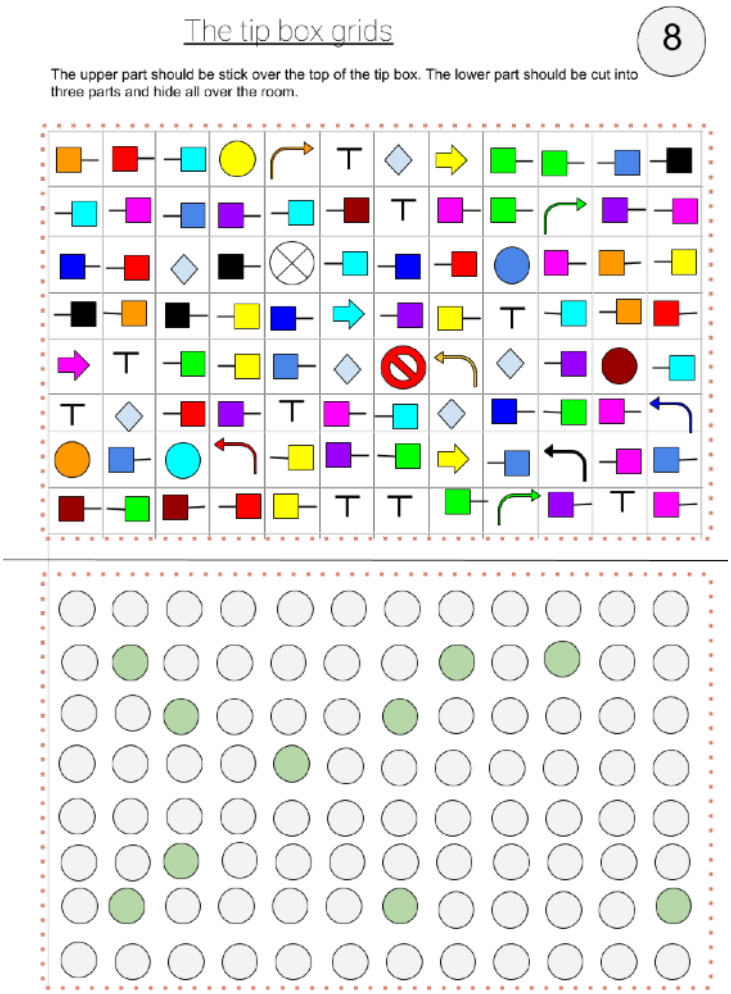
8 - TIP BOX

Subject
One tip box present z grid of biobrick. By finding puzzle pieces, players can create the correct biobrick succession.

Problem
On the top of the tip box, a grid of biobrick is fixed (it is on the TIP BOX TEMPLATE document) . People have to find the 3 parts of the white and green dots puzzle. (from the TIP BOX template.)

Solution
Find the 3 parts of the dots puzzle. It correspond to special hole location on the tip box and special biobrick location on the biobrick grid. The puzzle pieces have the shame shape of the delimited area drawn inside the tip box, on the holes part.

Tools
A tip box - TIP BOX TEMPLATE (on the right)– permanent marker



Pedgagogy
Creating a biobrick by choosing the correct succession of bricks. - getting familiar with tips, an essential tool of the biologist.

9 – 96 PLATES

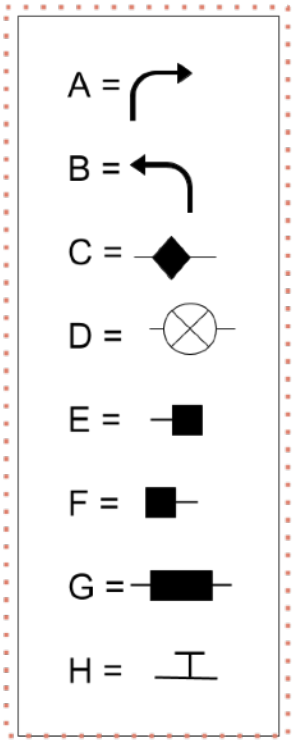
Subject
A 96 plate is full of a certain liquid. By adding red cabbage juice, each well will present a colour : yellow when the liquid is basic (from sodium hydroxide) violet if the liquid is acid (from white vinegar) only a few wells will be violet. Players have to find the 2 paper that deliver the code : the corresponding shape and colour.

Problem
Players have the find the 96 wells plate. It should be clearly indicated that wells are full of a liquid and should not be spilled : prepare several 96 wells plates in case of. The alphabet of letters to shape is attached to the 96 plate, but the alphabet from numbers to colours is hidden somewhere in the room.

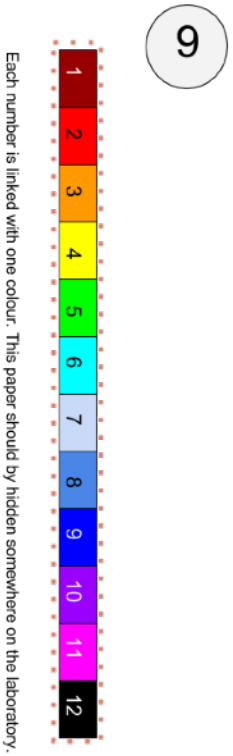
Solution
Each well is full of sodium hydroxide, EXCEPT the following ones : A8 – C7 – E3 – F11 – G6 – H12. Those wells are full of white vinegar, and will take a violet colour with the added juice. From each well correspond a shape and a colour, according to the 96 PLATE TEMPLATE document. Players have to fill the right biobrick on the computer.

Tools
The 96 PLATE TEMPLATE (pictured on the right) – a 96 plate – white vinegar – sodium hydroxide crystals and water – Pasteur pipette – red cabbage juice

Pedgagogy
Creating a biobrick by choosing the correct succession of bricks. - getting familiar with tips, an essential tool of the biologist.



Each letter of the alphabet corresponds to one shape. This paper should stay close to the 96 wells plate.



The 96 plate - coordinates template

The left part should be close the the 96 plate. The right part should be hidden in the room.

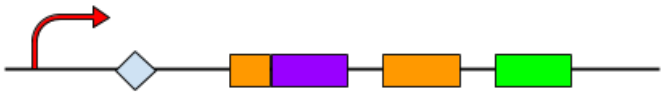
Solution :

A8 C7 E3 F11 G6 H12

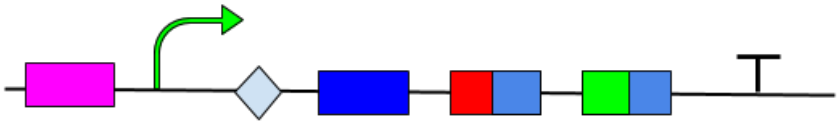
FINAL SOLUTION

Each of the enigmas in the laboratory lead to a biobrick part, which need to be entered into the computer, giving a code which will then allow the players to escape the room. This can be done using either a padlock or key, depending on materials when set up.

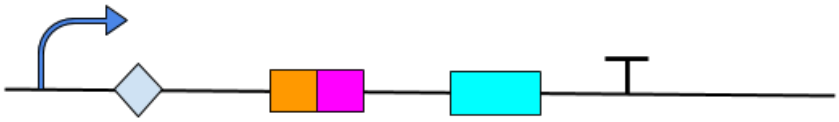
MIRROR (5)



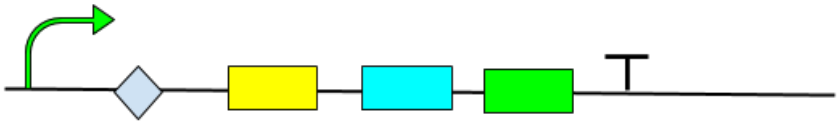
TIP BOX (8)



96 PLATE (9)



RESTRICTION Enzyme (7)



HOTTE (6)