

Vanilla-flavoured Synthetic Biology

Aim of the activity: to communicate to non-experts in the field the principles and applications of synthetic biology, an expanding field of biotech research which is becoming part of our everyday lives.

Length: 40 minutes approx.

Background:

Synthetic biology is an expanding field of biotech research. Recently, various industries have been investing in applications regarding new production processes based on synthetic biology. In the food industry an interesting example is vanillin, the molecule which gives vanilla its typical perfume. With synthetic biology, this molecule can be produced by inducing yeasts to express genes from various organisms (human, fungi and bacteria).

During the activity offered in this workshop, the production of vanillin with synthetic biology will be simulated involving a theoretical introduction to the topic and a practical demonstration. A crucial phase will be the participants' evaluation of the activity and the understanding of the key messages which the workshop aims to deliver.



Activity phases	Objectives	Methodology	Operator actions	Participants' actions	Materials
Preparatory phase	- to set up the activity stations	<p>- Preparation Prepare the stations for the activity. The operator will set up the objects required for carrying out:</p> <ul style="list-style-type: none"> (i) the introductory explanation on the use of vanilla; (ii) the practical workshop activity (simulation of yeast engineering which enables it to produce vanillin by synthetic biology); (iii) the explanation of where synthetic biology is used nowadays (iv) the financing choice test for sectors with potential synthetic biology applications; (v) the post-activity evaluation. 	- Preparation of the activity.	-----	-----
<p>Introductory phase</p> <p>Length ≈ 5 min</p>	- to explain the topic of the activity	<p>- Meet and Greet The operator will meet and greet the participants and put sheets on the desk to be used for taking notes on any doubts, questions or perplexities which come up during the activity. The sheets will be collected at the end of the activity as useful material which may be used in the project (e.g., for surveying the participants' perceptions of the topic being dealt with).</p> <p>- Introduction to the topic (question/objects) The operator will ask, "Can you guess the perfume in here?" while holding up a Petri dish which contains vanilla aroma. After having collected the observations, the operator will confirm that it is vanilla aroma. The operator will illustrate the use of vanillin, how it is produced and why it is important, by using the objects from the preparatory stage. The various vanillin production methods will be demonstrated using the following objects: a vanilla pod for the natural process; cosmetic cream for the chemical process; a Petri dish for the biosynthetic process.</p> <p>- Watching the manufacturer's video A video will be shown (max. length 2 min) which illustrates the use of synthetic biology in producing vanillin (technical and commercial advantages/disadvantages).</p>	<p>- Meet and greet the participants;</p> <p>- put the sheets for the questions on the desk;</p> <p>- ask the question: "Can you guess the perfume in this?" - Show the video.</p> <p>- Interact with the objects during the explanation.</p>	<p>- Replying to the operator's question;</p> <p>- watching the video;</p> <p>- Interacting with the objects that the operator has made available.</p>	<p>(i) Sheets of paper and pens, Petri dishes containing vanilla aroma, cosmetic products containing vanillin (cream, etc.), pods or sticks from vanilla plants.</p>

		<p>- Watching the NGO's video A video will be shown (max. length 2 min) which analyses the bio-economic impact of synbio vanillin production, in particular on local farmers.</p> <p>- Basic concepts for the production of vanillin using synthetic biology At the end of the video, in order to focus on the key concepts and to introduce the link with synthetic biology, the operator will explain that at present vanillin is mostly produced using chemistry, but since 2012 it has also been produced using another technology: synthetic biology. The latter uses a common micro-organism, baker's yeast. A genetic reconfiguration takes place which gives the yeast a new function which previously it didn't have: i.e. the ability to produce vanillin.</p>	- introduce the basic concepts for the production of vanillin using synthetic biology.		
<p>Central Phase</p> <p>Length ≈ 10 min</p>	<p>- to Explain the fundamentals of what synthetic biology is and why it is important (by using a video interview with an expert);</p> <p>- to make the participants aware of the potential of synthetic biology in many fields (by using practical examples of current projects);</p> <p>- to interact with the participants: discussing questions and doubts about the topics presented in the</p>	<p>- Practical activity to understand the main concepts of synthetic biology To perform a small group activity to improve participants' understanding of the theoretical notions presented in the session. Objective: to manipulate yeast by inserting the 4 genes from 4 different organisms required to produce vanillin. The operator will use the specially-created "Vanilla-flavoured Synthetic Biology game board" as a tool to explain the practical activity correctly and in detail. This game will be used as follows: the operator will place 4 puzzles (each representing one of the 4 organisms involved) on the desk. The various parts of these puzzles, when assembled, represent their genomes. A fifth puzzle will represent the yeast which we want to manipulate and a sixth puzzle will represent the molecule of vanillin (i.e. the final product).</p> <p>- Watching the video where a scientist explains the fundamental principles of synthetic biology The operator will show the participants a second, short video. A scientist who's an expert in synthetic biology will explain what synthetic biology is, its research fields, why it is important nowadays and the risks and benefits of this new branch in a video interview using carefully prepared questions.</p>	<p>- Explain what synthetic biology is using a short, practical activity;</p> <p>- deliver concluding remarks on the potential of synthetic biology not only in the food industry but in various field (by using images, objects or project examples);</p> <p>- collect the sheets with the questions;</p> <p>- give short</p>	<p>- Watching the video interview;</p> <p>- the operator will explain the significance of</p>	<p>(ii) Material for the practical activity: 6 puzzles, a list with the genes involved;</p> <p>(iii) objects, images or projects regarding the use of synthetic biology in various fields: environmental (rubber production for tyres and</p>

	session.	<p>- Where is synthetic biology used these days? The operator will take up the conversation again bringing the participants' attention to the present-day fields of use for synthetic biology, noting how it is not only used in the food industry but also in medical and environmental fields. Here a few questions could be answered.</p>	answers to the questions.	synthetic biology with the help of this activity.	biofuels), medical (artemisinin synthesis against malaria) and food industry (this workshop).
End Phase Length ≈ 5 min	- To investigate participants' willingness to invest public money for research on synthetic biology in general and in 3 main fields in particular, by using an <i>ad hoc</i> survey.	<p>- Explaining the financing activity To conclude the activity, and prior to distributing the evaluation questionnaire, an <i>ad hoc</i> survey will be carried out, as follows. Participants will be provided with a cheque facsimile. They will be asked to insert the cheque in one of the containers provided, which are respectively marked with 3 different research fields where synthetic biology can be applied (food, environment, medical industry) and 'none'.</p> <p>- Handing out and filling in the evaluation questionnaire During the final part of the workshop, the operator will distribute an evaluation questionnaire to be filled in. This will enable an evaluation of whether the objectives of this workshop have been reached or not.</p> <p>- Financing activity This survey-game will conclude the workshop and after inserting their cheques in the chosen box, the participants will leave the laboratory. A gadget will be available as small gift for their kind participation.</p>	- Explain the survey-game on the willingness to invest public money (or not) in a selected research field. -Distribute the evaluation questionnaire on the activity.	- Filling in the evaluation questionnaire, at the end of the activity. - Choosing whether (or not) and where to invest public money simulated by a cheque.	(iv) Facsimile cheques, 4 boxes labelled with 'food industry', 'medical industry', 'environmental industry', and 'none', respectively. (v) Evaluation questionnaires.