

iGEM as RRI laboratory

The annual international Genetically Engineered Machines student competition iGEM is a perfect match with SYNENERGENE. SYNENERGENE wants to include a number of iGEM teams in the program activities by offering small grants for scenario development in iGEM projects. For the 2014 iGEM edition 8 promising proposals have been selected. We asked Dirk Stemerding and Virgil Rerimassie, both from the Rathenau Institute and coordinators of this activity, how this approach fits in SYNENERGENE's goals.



What makes iGEM such a suitable candidate for cooperation?

"The focus of SYNENERGENE is on Responsible Research and Innovation (RRI) in synthetic biology. iGEM represents a growing community of dedicated young science students who already work in the spirit of RRI. At the beginning of the summer, student teams are given a kit of biological parts from the Registry of Standard Biological Parts. Working at their own universities over the summer, they use these parts and new parts of their own design to build biological systems and operate them in living cells. This project design and competition format is an exceptionally motivating and effective teaching method and it includes *policy and practices* work as an inherent part of each iGEM project. Indeed, team members should not only spend time in the laboratory, but also need to engage with society, as well as reflect on the broader implications of their design."

What is SYNENERGENE offering to iGEM teams?

"To further strengthen this policy and practices aspect of the iGEM competition a collaboration has been established between the iGEM community and partners in the SYNENERGENE network. The collaboration provides for an iGEM Fund offering small grants to iGEM teams for contributions to the program of activities undertaken by SYNENERGENE partners. iGEM teams can, for instance, do a series of real-time TA's by exploring possible futures for synthetic biology. These can be carried out by SYNENERGENE partners in collaboration with iGEM teams working on particular creative and significant ideas for innovation. Other examples include possible contributions from iGEM teams to anticipatory and adaptive forms of biosafety assessment in the field of synthetic biology, the development of a web-based educational platform introducing synthetic biology and its potential applications and implications in a playful way, and the development of design ideas for exhibitions aiming to expose the public in imaginative and artistic ways to different dimensions of synthetic biology." A first call for proposals has been published on the [iGEM main website](#) in which we invited iGEM teams to collaborate with partners from SYNENERGENE in real-time technology assessment.



Synthetic Biology
based on standard parts

What do you expect from iGEM teams in return?

“Teams will have to contribute in their policy and practices work to a process of real-time TA: an approach that integrates natural science and engineering investigations with social and policy research. This can be done by elaborating two different kinds of future scenarios relating to SynBio applications envisaged in their own projects. A first type of scenarios we call *application scenarios*. Application scenarios should offer detailed and realistic descriptions of how SynBio ideas can lead to actual applications in society. A second type we call *techno-moral scenarios* which should stimulate imagination, reflection and debate about ways in which SynBio applications may transform our society through wider impacts, including ethical, legal and social issues.



Can you tell us a bit more about the two types of scenarios and their relevance?

“An important step in the development of application scenarios is to identify and specify the practices and conditions in which particular SynBio applications envisaged by iGEM teams might be produced and used. How does these practices look like, who is involved in what role, and how will these practices be changed and affected by the new applications? Knowledge about the experiences and visions of actors involved in these practices is vital for the elaboration of future application scenarios. In fact, application scenarios can serve as a reality-check tool.

Some iGEM teams are already doing this kind of work, as for example the [finalist 2010 team from Bristol](#). The team focused on the design of modified E.coli bacteria, that should be able to detect and signal the presence of nitrates in soil and thus allow farmers to map soil nutrient content of their fields and optimize their fertilizer use. In considering this application, the team carefully specified the hypothetical properties that their product should



possess for a successful market introduction, using predictions based on their prototype and information about how arable farmers might wish to use it. The team defined smaller-scale farmers as the target market for their product and accordingly specified the engineering requirements that the product would have to satisfy, given established practices of farming and important conditions of cost and safety. The team also compared their approach to already available alternative methods to estimate nutrient needs of arable land, such as satellite imaging technology.

While application scenarios focus on the prospects and challenges for innovation and related regulatory concerns in regard to risks and ownership, techno-moral scenarios highlight the wider transformative potential of future applications of synthetic biology in society. Techno-moral scenarios explore the ways in which new technologies may challenge and shape what we want, how we relate to each other, and how we relate to the world. Thus they invite audiences to imagine and appraise ways in which particular SynBio applications might change our world, our ideas, values and ideals. Some thought-provoking examples of techno-moral scenarios can be found on the website of the Rathenau Instituut, inspired by

ideas from SynBio engineers thinking about a future world in which we might use plants as alternative sources of light or bring back species that have gone extinct. ”

How will SYNENERGENE incorporate the output of iGEM teams?

“SYNENERGENE (Platform 1) partners will take up the scenarios as a starting point for an interactive process of technology assessment, involving a variety of stakeholders and iGEM team members in workshop settings with the aim to develop socially robust agendas for SynBio innovation. Scenarios will also be used by SYNENERGENE partners as a tool in organizing public debates on SynBio futures.”

You're getting curious? Check out [Rathenau Institute's project website](#).



Photos by iGEM

The 8 selected proposals

Team / URL	Project	Framing	Approach
Bielefeld-CeBiTec (GER) http://2014.igem.org/Team:Bielefeld-CeBiTec	Electricity driven bioproduction from carbon dioxide in E.coli (Proof of concept)	Using surplus energy (energy storage) from sustainable energy production facilities.	Understand availability of renewable energy by discussing with electric power companies, engineers and users
Eindhoven-TU (NL) http://2014.igem.org/Team:TU Eindhoven	Engineering modified bacteria to perform tasks inside the human body	Potential risks, public sceptis, ethical implication of what is essentially an unnatural	Reflection on public fear, public access to information and trust, safety & regulation, perceptions

	without initiating an immune response	symbiosis.	of symbiosis
Groningen-RUG (NL) http://2014.igem.org/Team:Groningen	Antimicrobial bandage based on Lactococcus lactis producing nisin	The ethics of not using the potential of synbio to solve major problems.	Minimise risks, persuade society, change perspective on biological systems
Münich-LMU (GER) http://2014.igem.org/Team:LMU-Munich	New antibiotic systems – pathogen detection and destruction- in Bacillus subtilis	Frequent failure of classical antibiotics, availability of open source based medicine, cheap and easy to distribute.	Collaboration with experts to assess medical and legal aspects.
Darmstadt-TU (GER) http://2014.igem.org/Team:TU_Darmstadt	Integration of a biological production platform into an electronic solar cell	Providing a cheap, alternative to traditional solar cells without the use of rare earth elements (REE), suitable for poor countries	Explore how both current REE exporters and importers bare risk and could benefit from synbio solution.
Boston-TUFTS (USA) http://2014.igem.org/Team:Tufts	Blocking the signal for bacteria to form biofilms, thus prevent infections	The use of phage beyond the laboratory raises bioethical questions, the need for better public understanding and guidelines.	Organizing a workshop with experts while inviting people from the local community, surveys among students.
Valencia-Biocampus (SP) http://2014.igem.org/Team:Valencia_Biocampus	Intellectual Property: finding an intermediate between Open Access and Patenting	Making synbio useful for environmental conservation	
Wageningen-UR (NL) http://2014.igem.org/Team:Wageningen_UR	Protecting bananas by 'soil vaccination' with Pseudomonas, preventing Fusarium infection	Securing food production in a sustainable way	Seeking balance between food security and potential risk; free and unrestricted access to results.