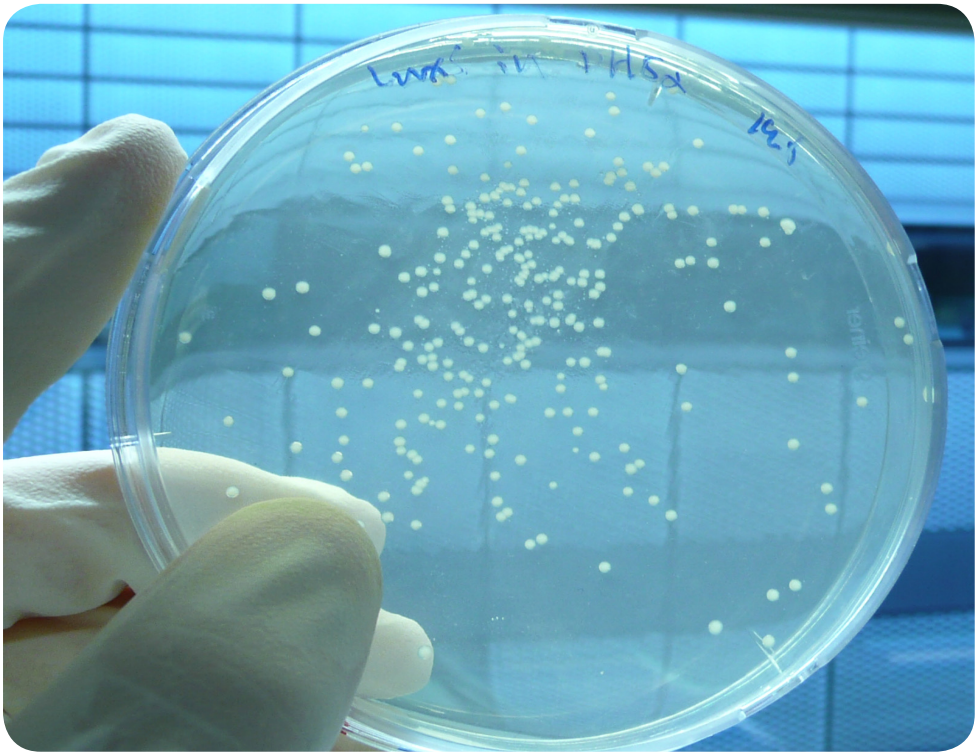

iGEM TEAM HEIDELBERG 08 ECOLICENCE TO KILL

“Can simple biological systems be built from standard, interchangeable parts and operated in living cells? Or is biology just too complicated to be engineered in this way?”

- Randy Rettberg, director of the iGEM competition -

iGEM

iGEM (international Genetically Engineered Machines Competition) is a competition organized by MIT (Massachusetts Institute of Technology) in Boston, USA, since 2005 and has become one of the largest international competitions in the field of science. This year 84 teams of undergraduate students compete against each other, and for the first time three teams from Germany join the competition. The competition was originally initiated to use the laboratories of the universities that normally are empty during the summer months.

The project of the Heidelberg team is directed by Prof. Dr. Roland Eils from University of Heidelberg and the German Cancer Research Center (DKFZ).

This summer all teams work on self-developed projects which will then be presented in the beginning of November at the “Jamboree” in Boston. Several prizes in different categories will be awarded.

Synthetic Biology is a young field in science, which combines classic gene technology with an engineering approach. Similar to the construction of an airplane, Synthetic Biology uses simple gene building blocks for the construction of new complex systems with distinct functions. These gene building blocks are collected in a database by iGEM and can be used by all participants of the competition. So far, the collection contains more than 1000 gene building blocks, due to the continuous development of new parts over the last years.

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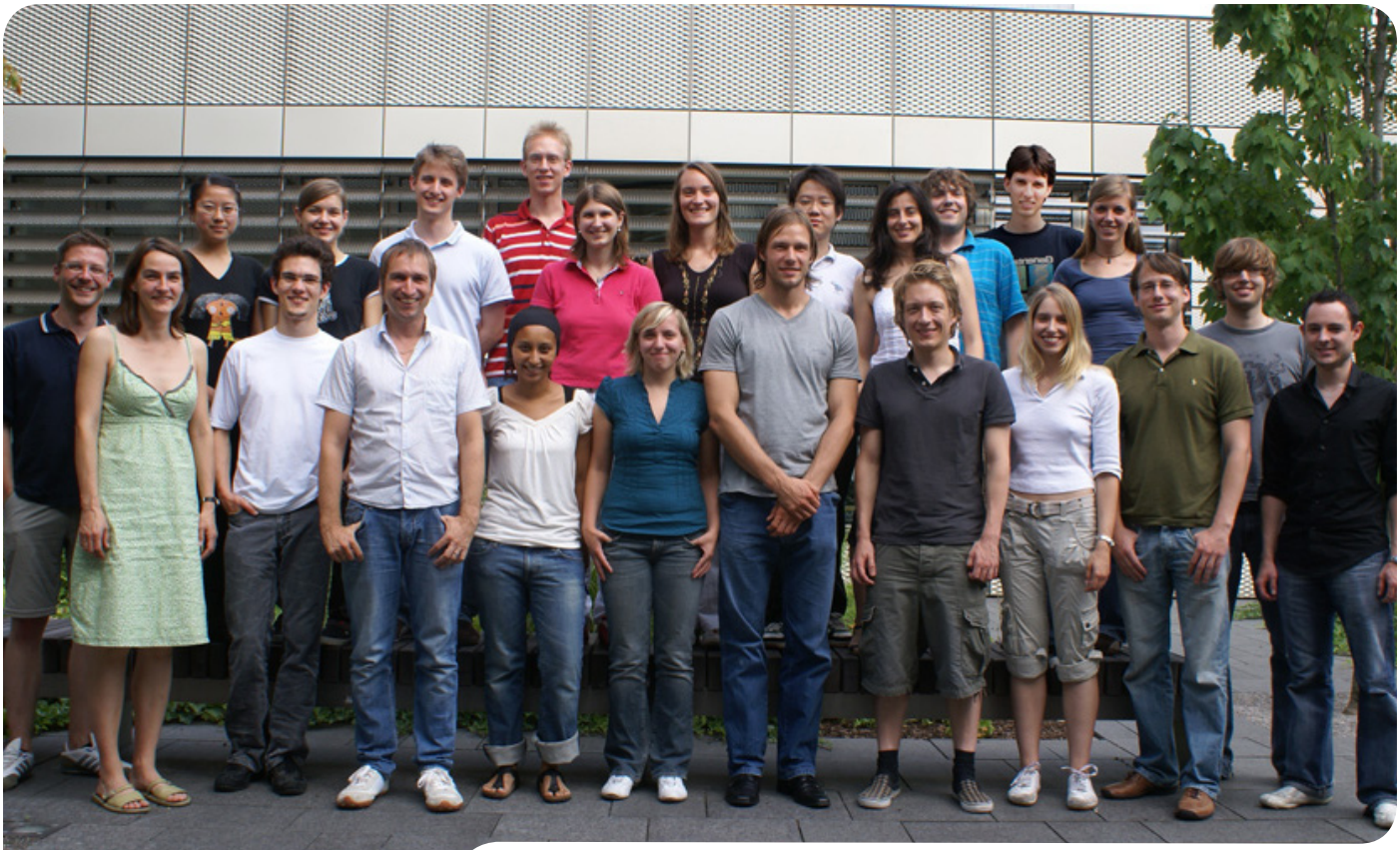


Team

Roland Eils

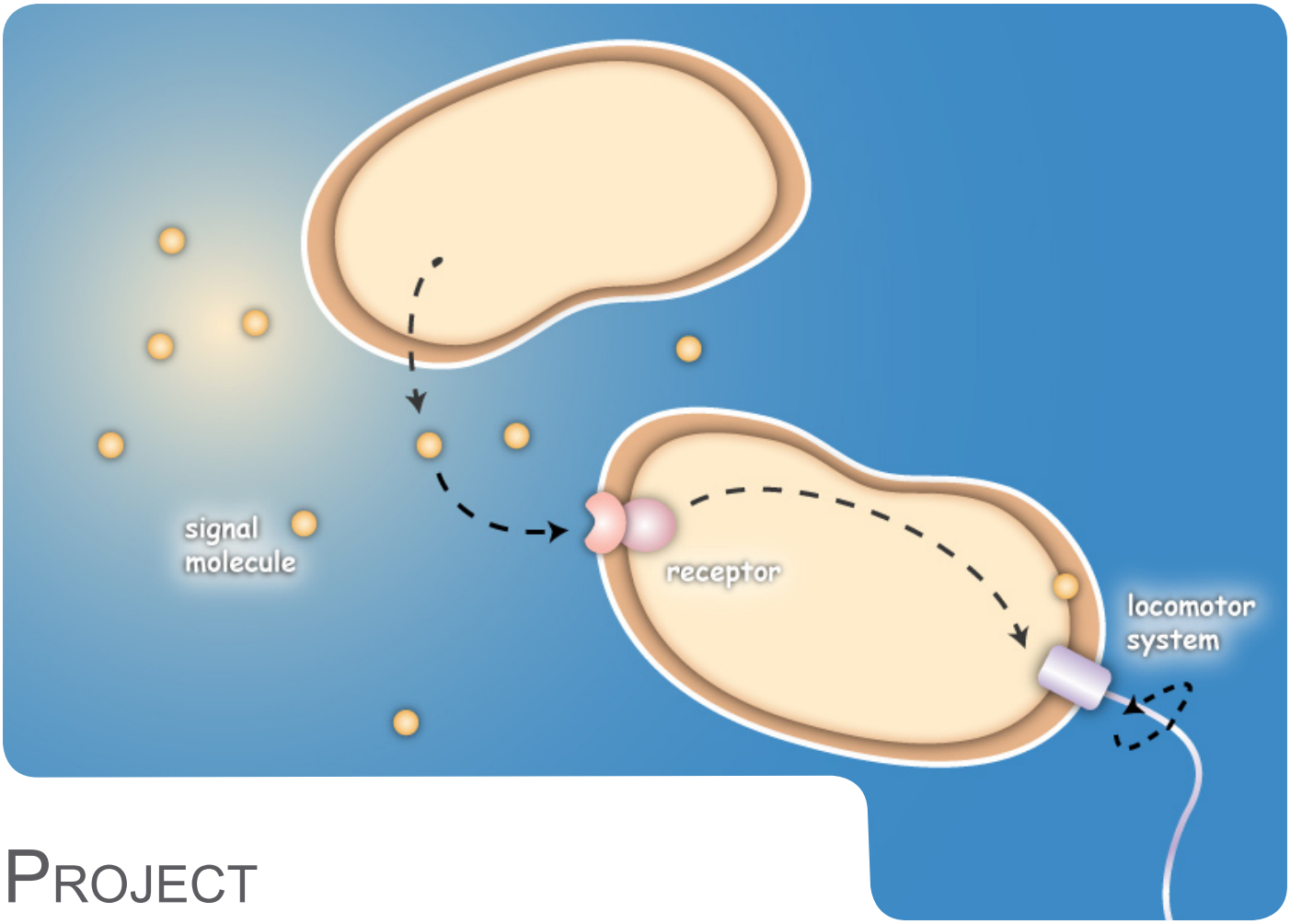
Professor Eils studied Mathematics and Physics and is head of the Departments of Theoretical Bioinformatics in the University institutes Bioquant and IPMB as well as in the DKFZ. Moreover, he is founding director of Bioquant and directs the two largest national Systems Biology in Germany. Together with Professor Wolfrum he directs the Viroquant initiative on modeling and simulation of virus entry. He has won several awards in the field of systems biology, among this the Microsoft research award and the BioFuture prize endowed with 1.2 million euros. In 2004, he was the organizer of the International Conference on Systems Biology and will host it again 2011 in Heidelberg.

Victor Sourjik

Dr. Sourjik has studied Molecular Biology and Physics. Starting from his PhD, he works in the field of signal processing in microorganisms. Since 2003 he leads an independent group at the Center for Molecular Biology at the University of Heidelberg (ZMBH). His research focuses on quantitative analyses and computer modelling of bacterial chemotaxis as an example of the cellular perception and transduction of environmental signals. His research has been recognized with the EMBO Young Investigator Award in 2006 and with the Chica and Heinz Schaller Award in 2007. He currently coordinates the Bioquant Graduate School “Molecular machines: mechanisms and functional interconnections”.

The Heidelberg team consists of 15 students of the University of Heidelberg and one student of the TU Darmstadt, all with a different scientific background including Molecular Biotechnology, Biology and Mathematics. The students are highly motivated to work within this interdisciplinary team, especially because they have the chance to carry out projects of their own in a very early state of their education. The students are supported by advisors from the group of **Victor Sourjik** (ZMBH; University of Heidelberg) and from the division of **Roland Eils** (University of Heidelberg and DKFZ).

The project itself is carried out in the newly founded Bioquant building, a center for qualitative analysis of molecular and cellular biological systems.



Project

The Heidelberg team is developing a biological machine that is able to detect and specifically kill pathogens or even cancer cells. In a proof of principle study the team has genetically reengineered two *E. coli* strains into a prey and a killer strain.The system consists of two modules: one for the recognition of the pathogen-presenting prey cell by the killer strain, and a module for directed movement of the killer cells towards their prey.

Sensing

The team utilizes the natural sensing and movement system of *E. coli* bacteria, **chemotaxis**, by redesigning the receptors of the killer strain to sense a molecular cocktail secreted by the prey strain.

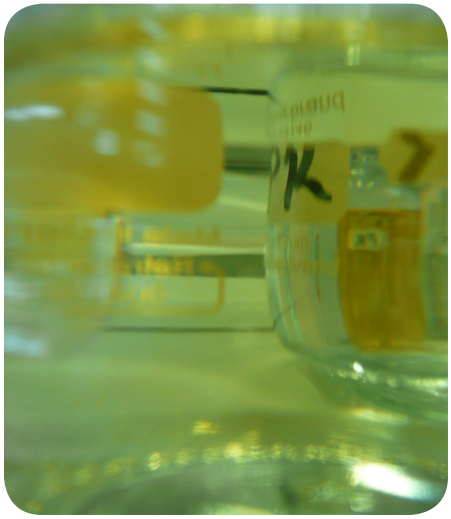
Killing

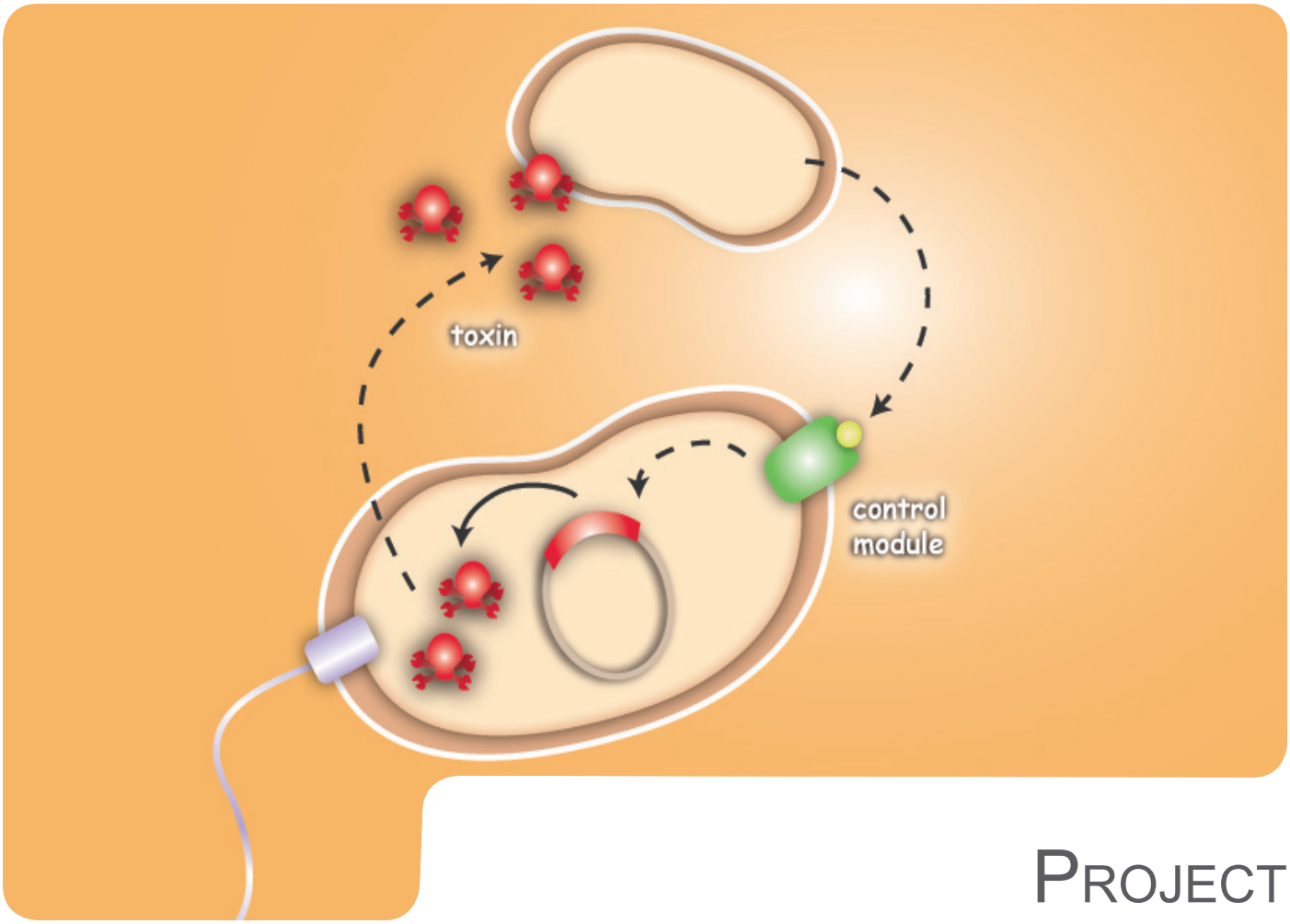
After arriving at the prey, an additional gene module is activated which then leads to the death of the pathogen or the cancer cell. The Heidelberg team follows two different strategies to achieve the killing.

The first strategy focuses on bacterial toxins, which are normally produced by certain bacterial strains to kill other bacteria. For the test system the team uses genetic information of bacterial toxin production. This information will be introduced into the killer-cells and modified to only become active once the killer strain reaches the prey strain. Activation then leads to toxin production and release, finally resulting in killing of the prey-cell.

Chemotaxis

The ability of bacteria to sense gradients of certain molecules and move alongside of these is called chemotaxis. Thereby they swim towards nutrients and away from toxins. The molecules are bound by receptors on the cell surface of the bacteria, which leads to a signal transduction within the cell. This activates the locomotor module, generating tumbling or directed swimming.





Project

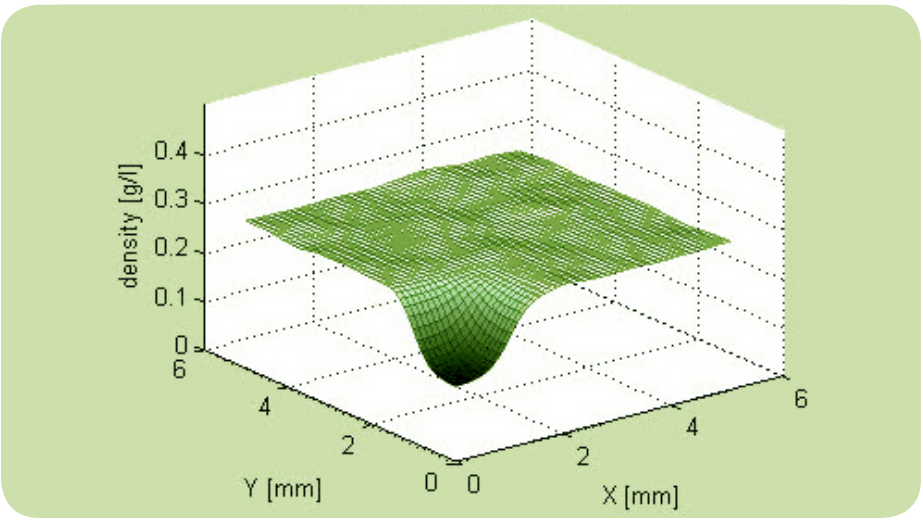
Bacteriophages

Bacteriophages are bacteria specific viruses. Their extracellular state consists of a protein coat, which surrounds the genetic information in the form of nucleic acids. If the phage infects a host cell, it injects its genome into it. This is transcribed by host derived enzymes. Thereby new phages are produced and released upon lysis. They can then infect other host bacteria.

The second approach for killing uses **bacteriophages**, which naturally infect *E. coli* cells. Like many other viruses they kill their prey and replicate into their host. Free phages are then again able to attack other bacteria. In this approach the team specifically takes advantage of this domino effect.

Modeling

In addition to the experimental work in the laboratory, an important part of the work involves computational modeling of both the sensing and killing module. The model simulations allow the prediction of system behavior under various conditions and help to better plan the experimental work.

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