Ph.D. projects in progress

1.

Mentor: Tamás Fehér

Doctoral school: University of Szeged, Faculty of Science and Informatics, Doctoral School of Biology

Ph.D. student: Ranti Dev

Title of the research topic: Uncovering the evolutionary- and biotechnological potential of bacterial mobile genetic elements

Description of the research topic: Transposable elements (TEs) are DNA segments that can move from one locus to the other within a genome. They are usually considered molecular parasites, but can, in certain cases provide benefits to their hosts. We have recently demonstrated that the advantage of a single copy of TE conferred to the host Escherichia coli cell is measurable under certain conditions. The projected work will probe the upper limits of TE copy numbers within bacteria, and its dependence on environmental factors and the genetic content of TEs. The forces of positive and negative selection, as well as the effect of regulation will be investigated. The obtained results will be immediately used for biotechnological purposes: the activity and the copy number of TEs will be controlled to modulate genomic stability of bacterial cell factories. Furthermore, novel genetic tools will be developed that rely on the controlled mobilization of TEs.

2.

Mentor: Tamás Fehér

Doctoral school: University of Szeged, Faculty of Science and Informatics, Doctoral School of Biology

Ph.D. student: Walliyulahi Ajibola

Title of the research topic: Investigating microbial interactions: antimicrobial compounds found in the environment, and bacterial strategies for their evasion

Description of the research topic: One of the most acute problems challenging human health is the worldwide increase seen in the incidence of infections caused by antibiotic resistant bacteria. The uncontrolled use of antibiotics in agriculture, along with their overexploitation in medicine has led to the emergence of multi-resistant bacterial strains. Furthermore, the development of novel antibiotics has slowed down in the past decades, further narrowing the available antimicrobial armada. It is noteworthy however, that our natural environment still harbors numerous unexploited antimicrobial agents, produced by yet uncultured microorganisms. These compounds are assumed not only to function as weapons against other bacteria, but also as channels of communication within a

bacterial community. This current research has set a double goal: screening for genes involved in the production novel antibiotics, as well as investigating the role of antimicrobial compounds in the interactions seen within bacterial communities. Functional metagenomics, i.e. the screening of environmental DNA for functions of interest is a promising solution to identify new antimicrobials without the need for culturing the producer organisms. The successful applicant will learn methods involving the sampling and analysis of microbial communities, including DNA isolation and preparation for next generation sequencing. State of the art molecular biology techniques concerning DNA amplification, plasmid cloning, library genesis and high-throughput phenotypic screening will also be applied. Collaboration with analytical and preparative chemistry laboratories is also planned. The prospective outcome of the project is an improved insight concerning the role of antimicrobial agents in the interstrain communication of microbial communities, as well as the potential identification and characterization of novel antibiotic compounds.

3.

Mentor: Tamás Fehér

Doctoral school: SZTE TTIK Biológia Doktori Iskola

Ph.D. student: Ákos Avramucz

Title of the research topic: Metabolic engineering of cultured bacteria: novel techniques and targets

Description of the research topic: Metabolic engineering is often defined as the reprogramming of cells to produce, break down or transform compounds of interest. The goal of our young team is to develop and test novel genetic methods to expand the toolbox of metabolic engineering. We are interested in multiple divisions of the engineering workflow: modification of endogenous genes, cloning and establishment of exogenous pathways, gene expression control, diversity generation, screening and selection or modulation of genetic plasticity. The candidate will use established and experimental methods for metabolic pathway design and enzyme selection, for design and engineering of transgenic circuits, and for optimization of pathway fluxes. The ultimate addition of novelty will be warranted by the choice of the target compounds, preferably ones that have never been produced in bacteria before.