

De novo organism design from membraneless orthogonal central dogma organelles

Initiative: "Leben?" - Ein neuer Blick der Naturwissenschaften auf die grundlegenden Prinzipien des Lebens

(beendet)

Bewilligung: 06.07.2020

Laufzeit: 5 Jahre

A major driver for the emergence of complex life was the evolution of organelles, which disable cross-talk between cellular processes. In eukaryotes replication and transcription have been confined to the nucleus while the third central dogma process - translation - occurs in the cytoplasm. This step was accompanied by the biogenesis of a complex transport machinery that regulates all molecular traffic across the nuclear envelope. Analogously, the design of artificial organelles harboring complex functionality is challenging due to the necessity of a suitable membrane transport machinery (e.g. translation requires hundreds of factors). We recently constructed a completely new membraneless organelle dedicated to orthogonal protein translation and engineering that effectively equipped a living eukaryotic cell with two genetic codes. This was achieved by phase-separating proteins to generate an orthogonally translating organelle that processed selected mRNAs efficiently. This puts us now in the position to de novo design new functionalities within eukaryotes. The membraneless architecture enables a step by step increase of the complexity of such systems while cross-talk with the host itself can be minimized. Further engineering to bud the newly created organelles off will provide insights into the principles and mechanisms that are needed to create new, independent and custom-designed entities. This will help us to understand how self-sustaining cellular structures can be created.

Projektbeteiligte

Prof. Dr. Edward Lemke

Universität Mainz

Biocentre

Biology and Chemistry

IMP and Institute for Molecular Biology gGmbH

Mainz