

The background of the slide features a vibrant, abstract pattern of colored ink (blue, red, orange) swirling and diffusing in water against a dark, solid background.

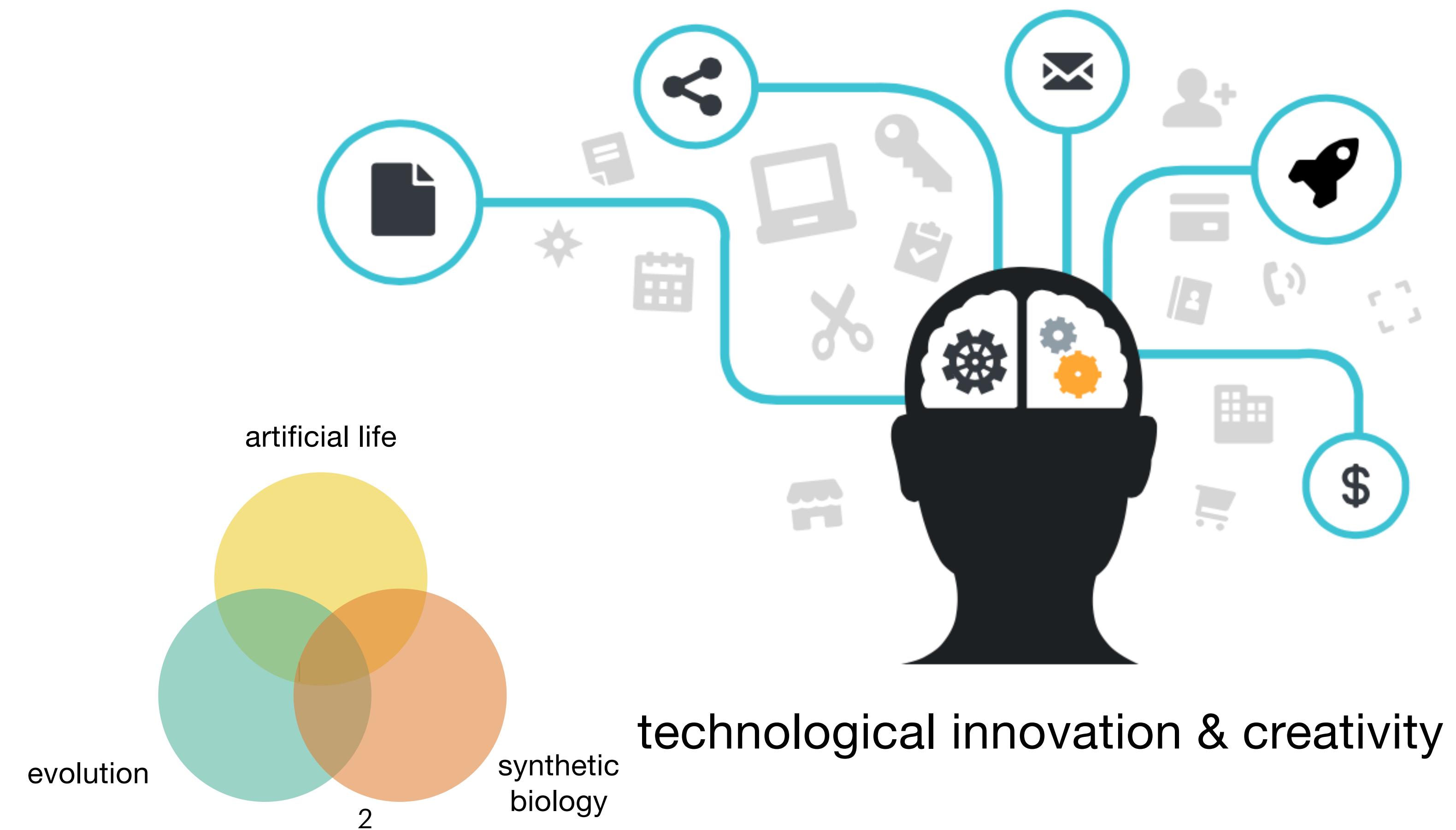
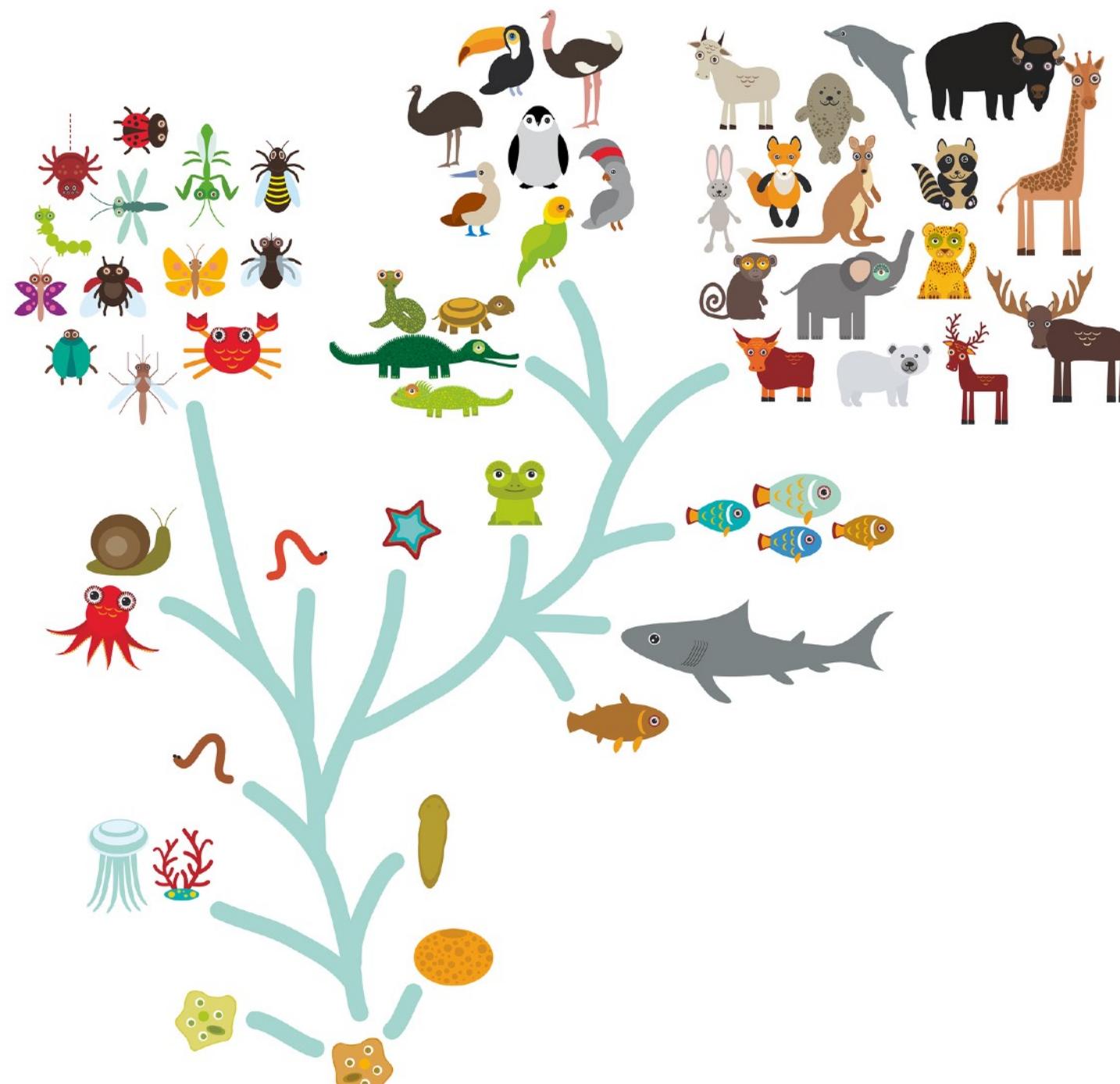
How to make everything: open-endedness in synthetic biology

Michiel Stock & Thomas E. Gorochowski

WIVACE 2023
XVII International Workshop on Artificial Life and Evolutionary Computation
Venice, Italy, 6-8 September 2023

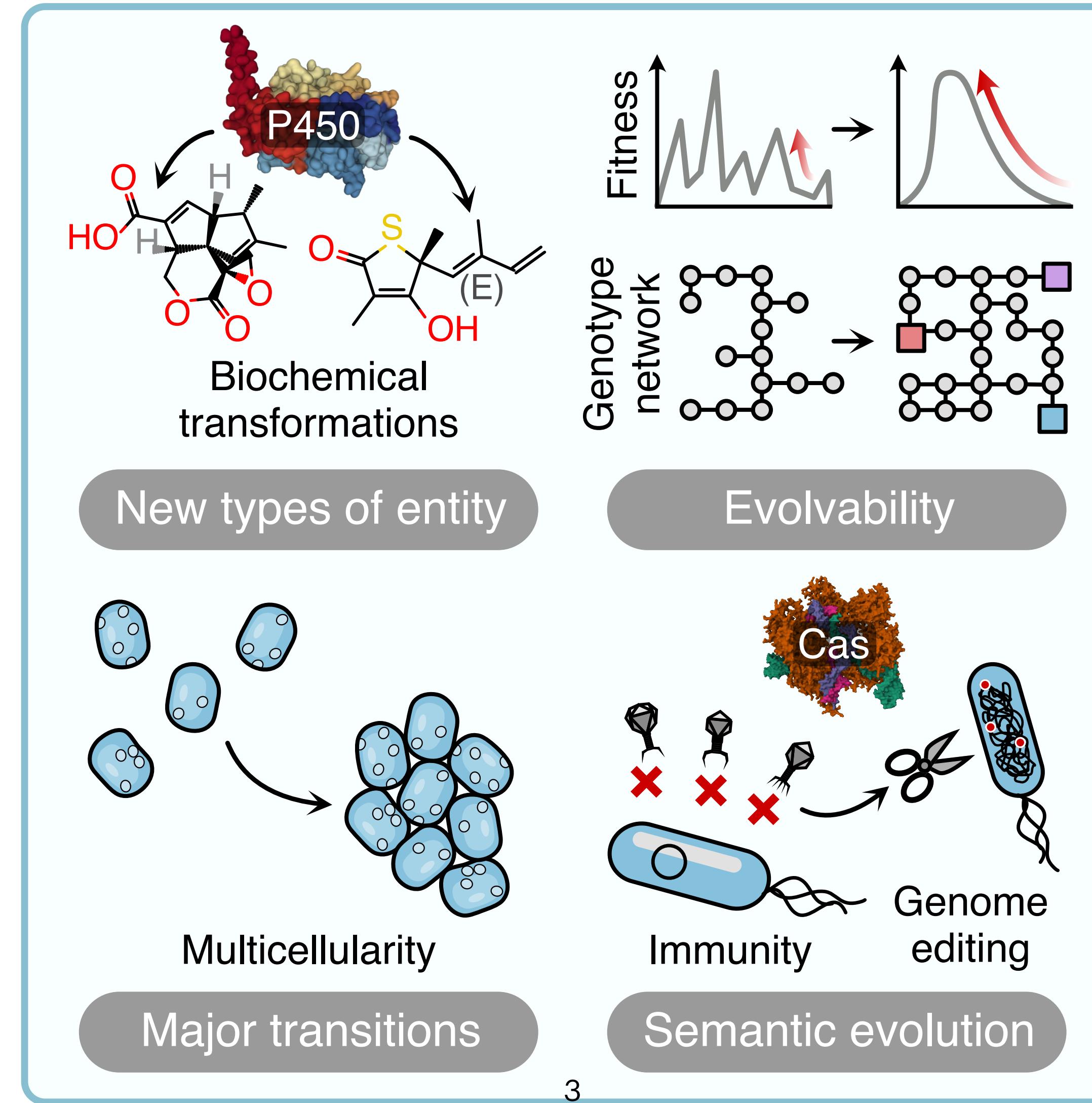
Open-ended systems

An open-ended process keeps generating novel entities or entities that can improve their functionality without bound

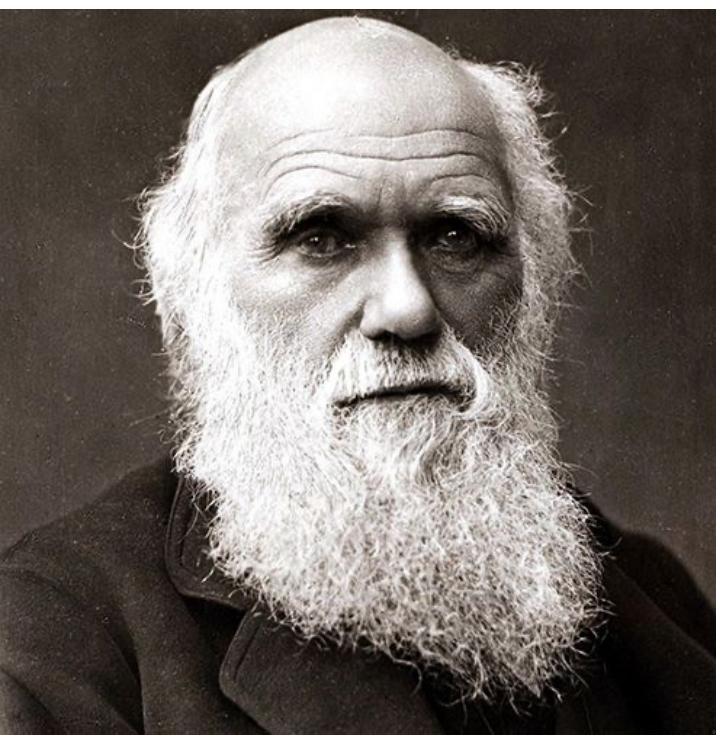
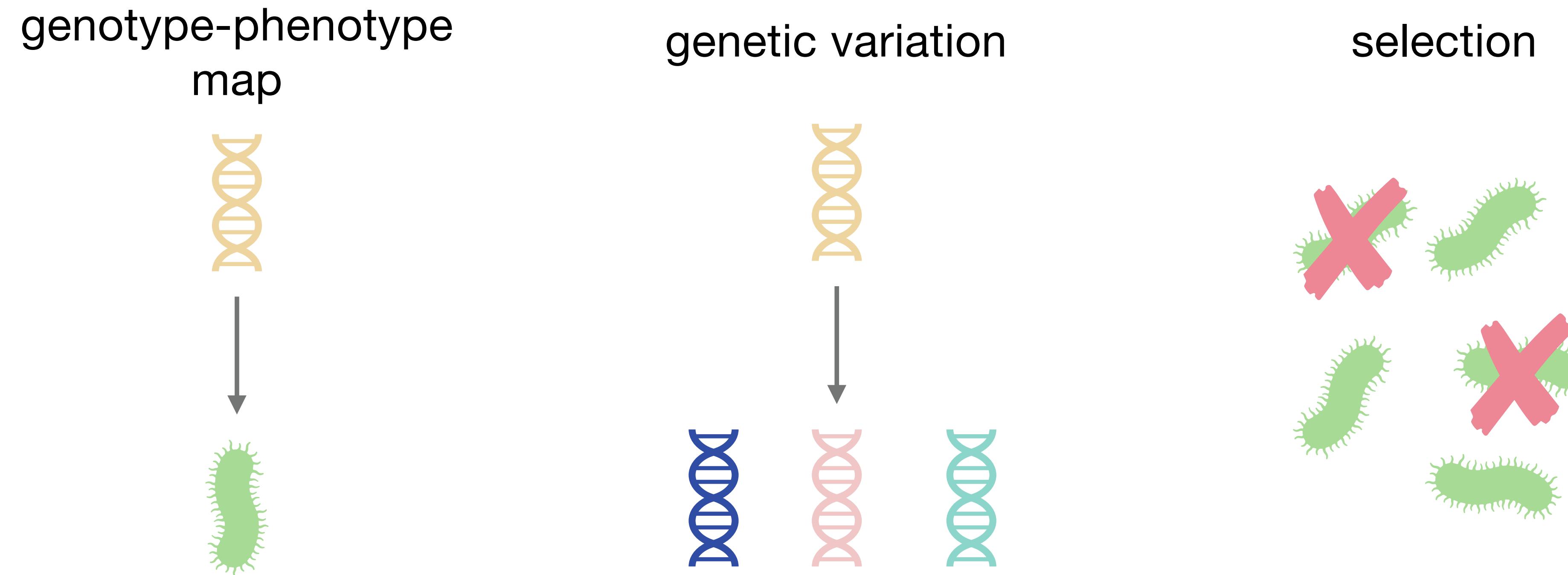


Hallmarks of open-endedness

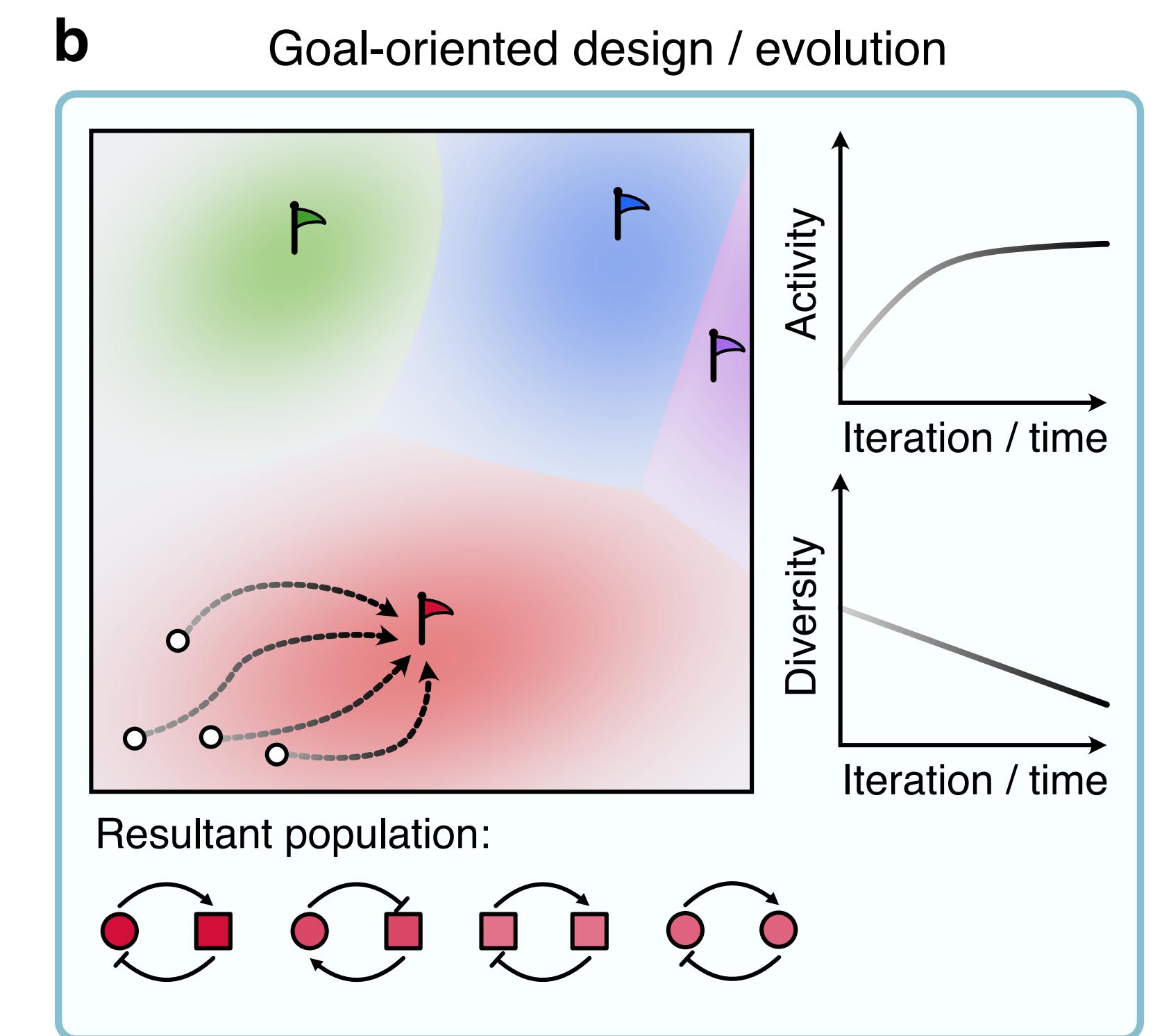
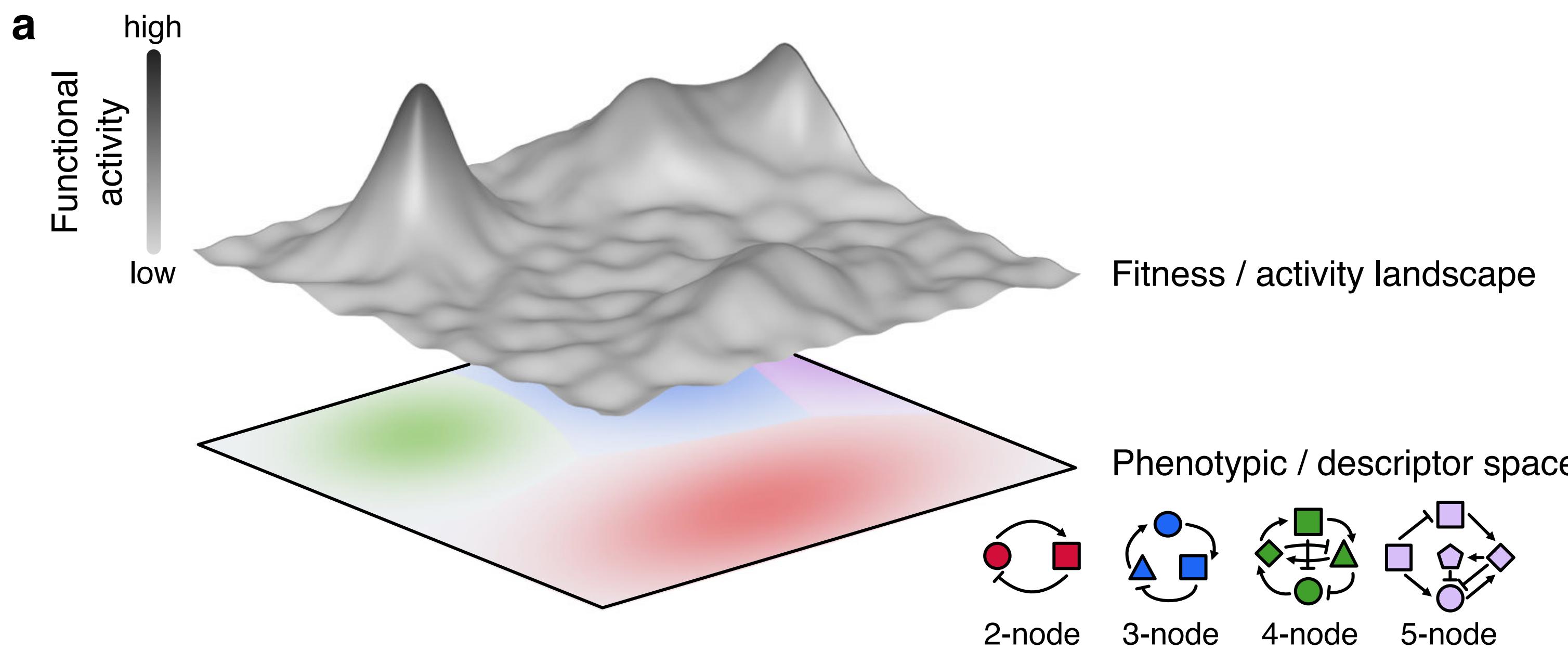
ongoing generation of:



Evolution as the master algorithm

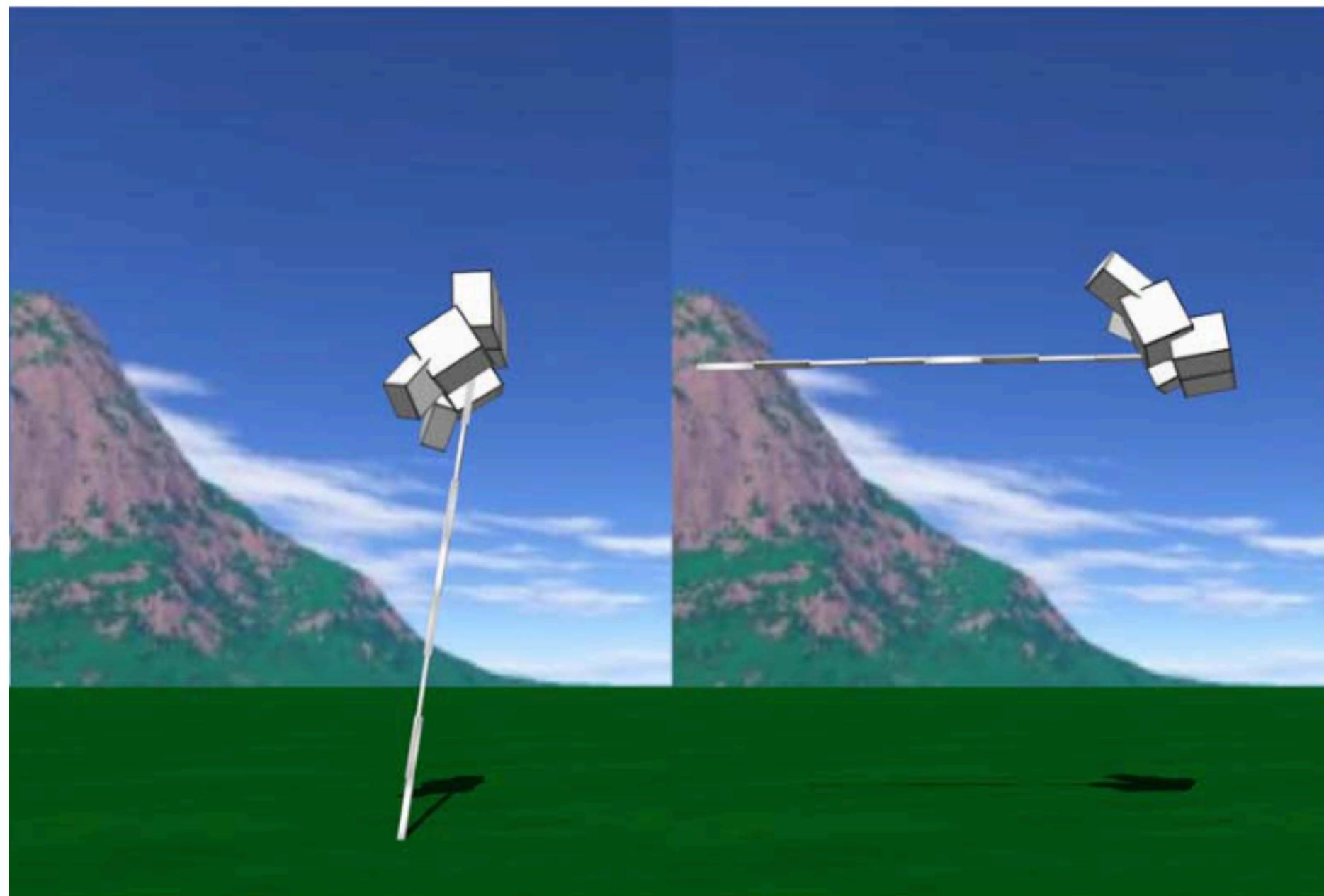


Objective-based evolution and design



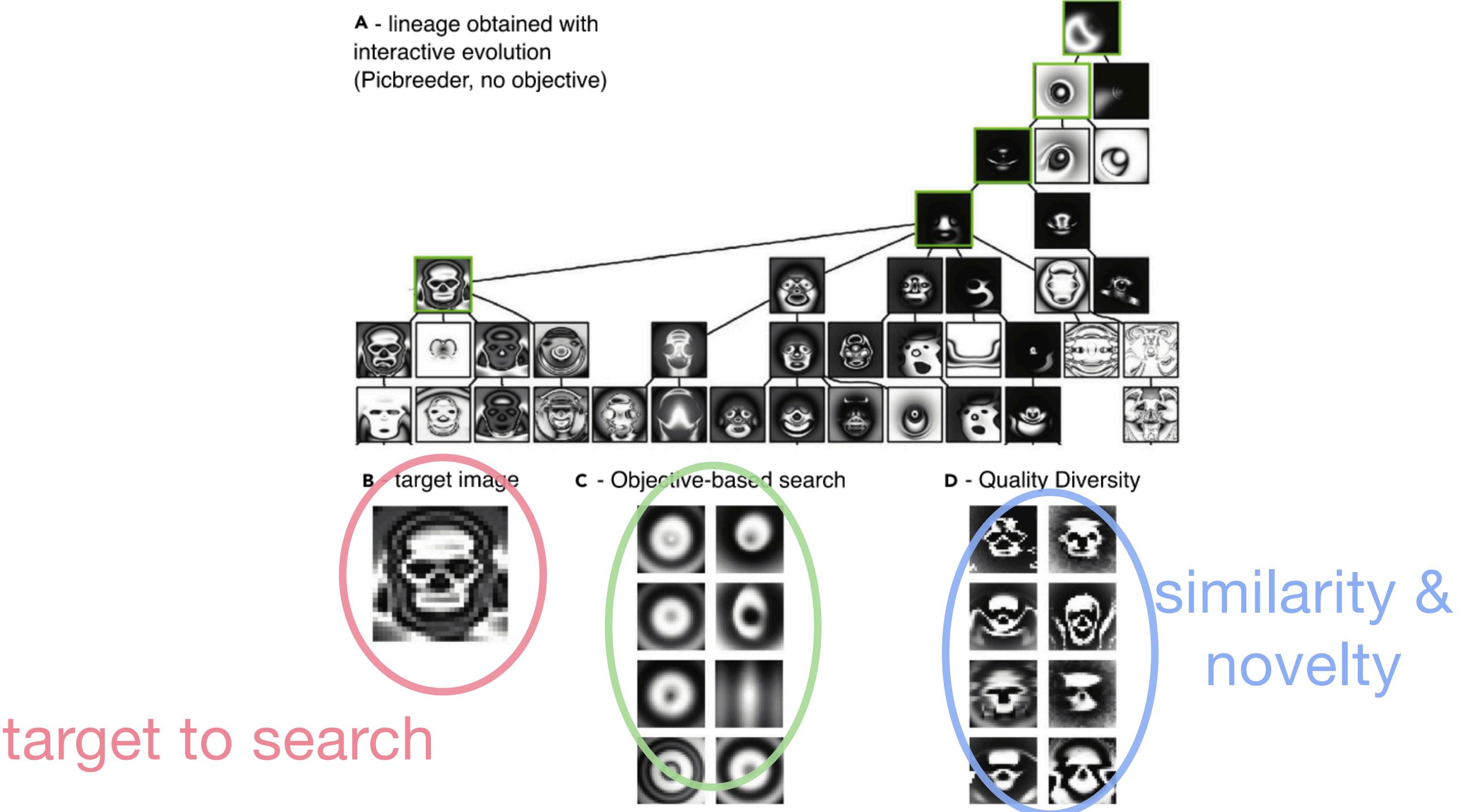
Bottlenecks in artificial evolution

reality gap problem

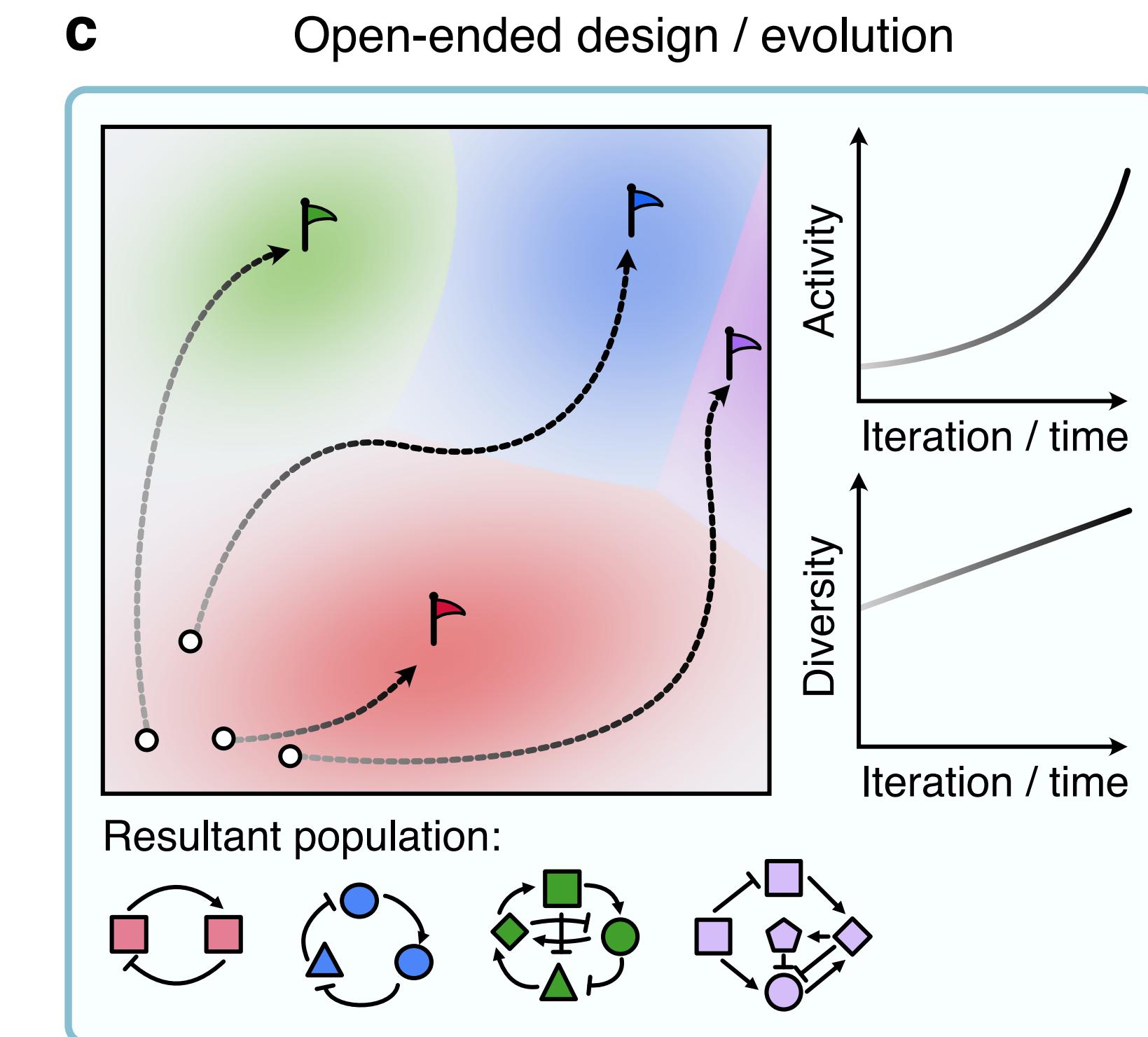
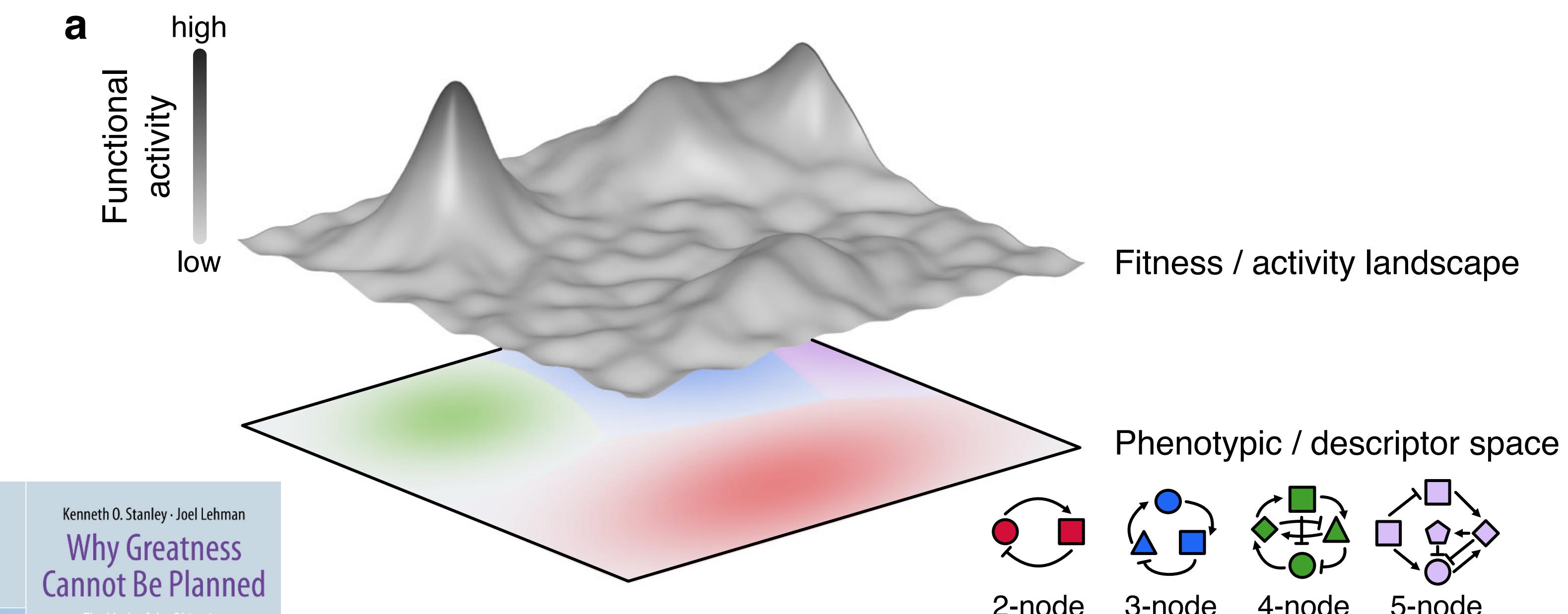


simulator \neq real world

stepping stone problem



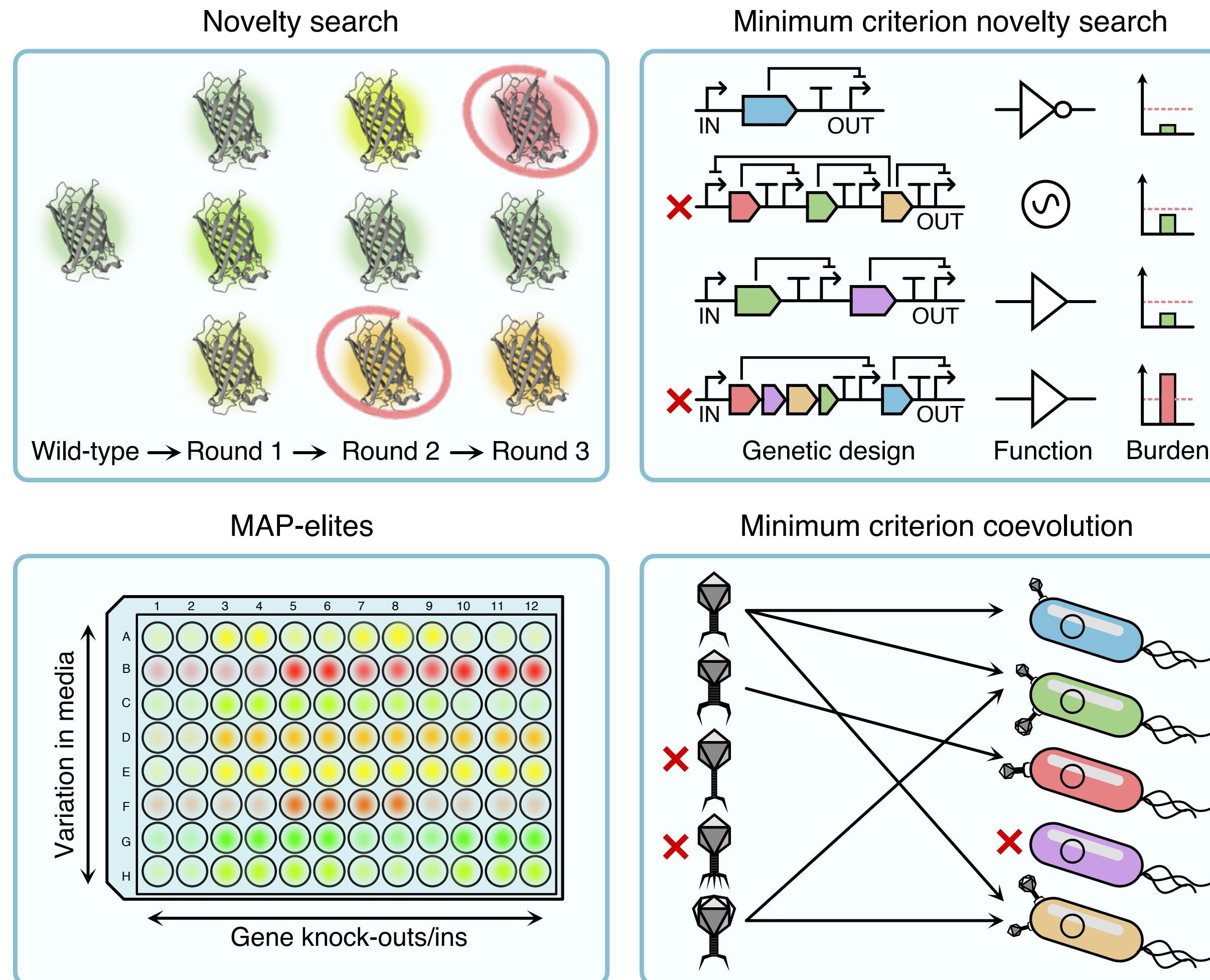
Novelty-based evolution and design

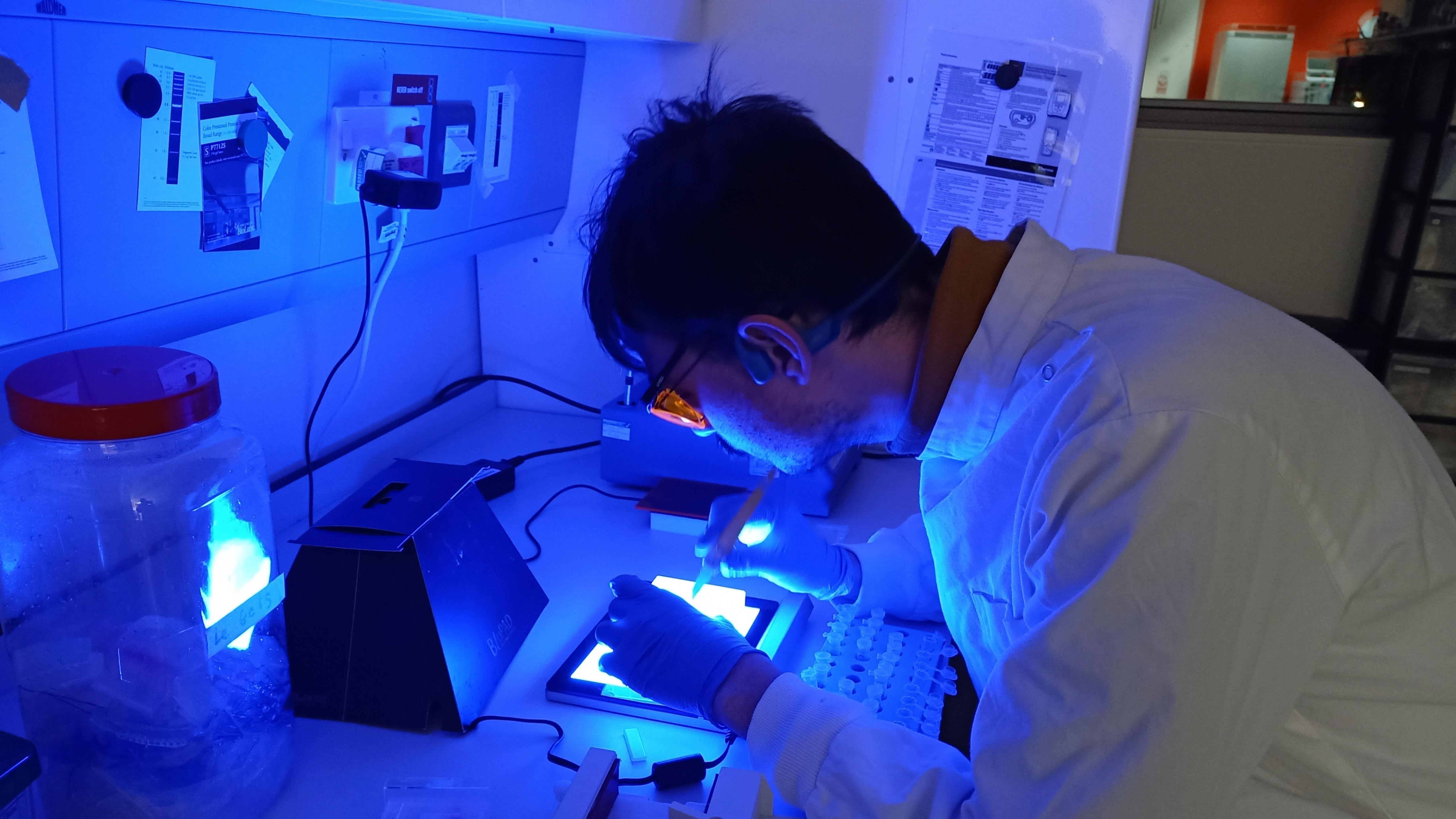


Kenneth O. Stanley · Joel Lehman
Why Greatness
Cannot Be Planned
The Myth of the Objective

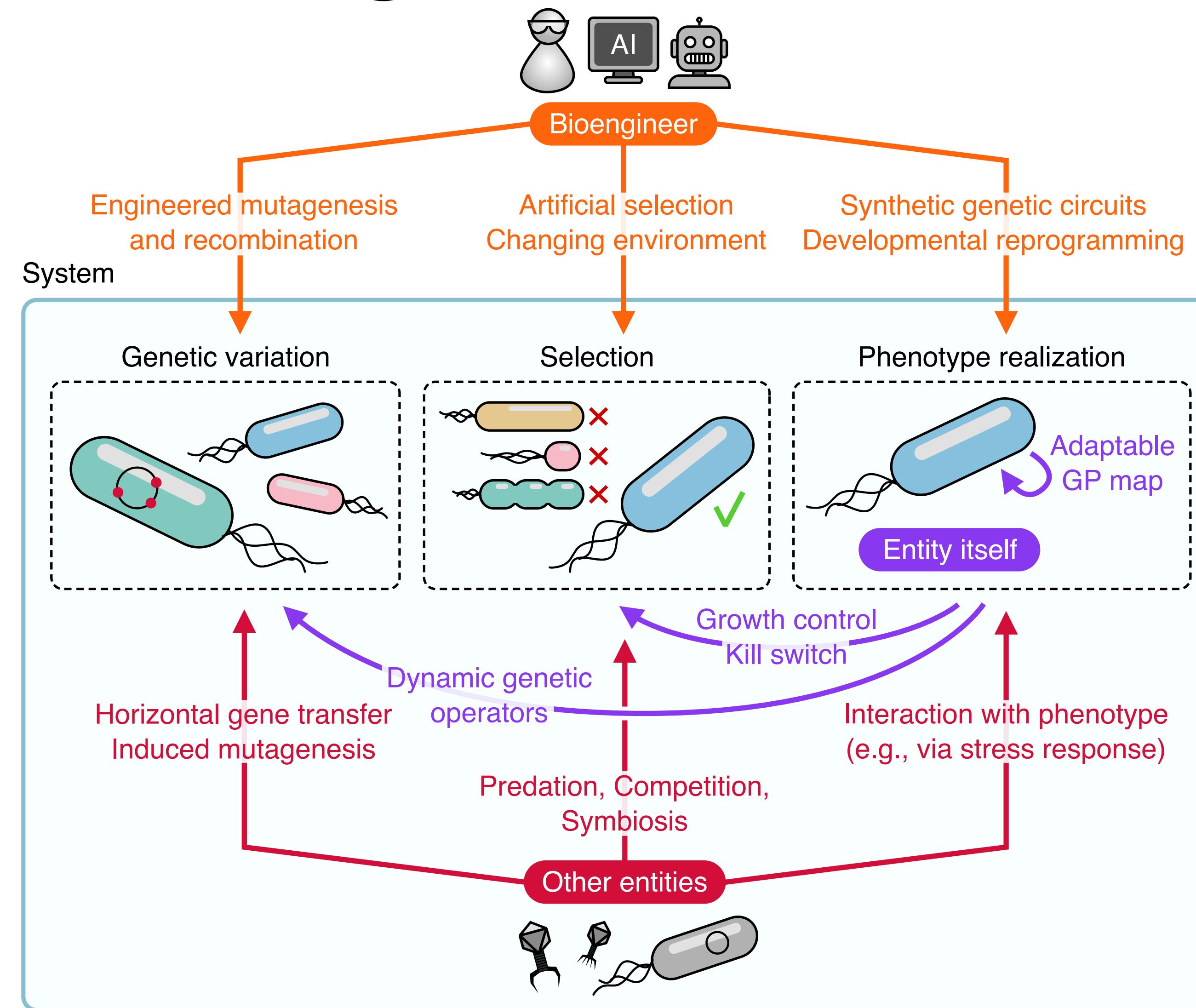


New algorithms for biodesign



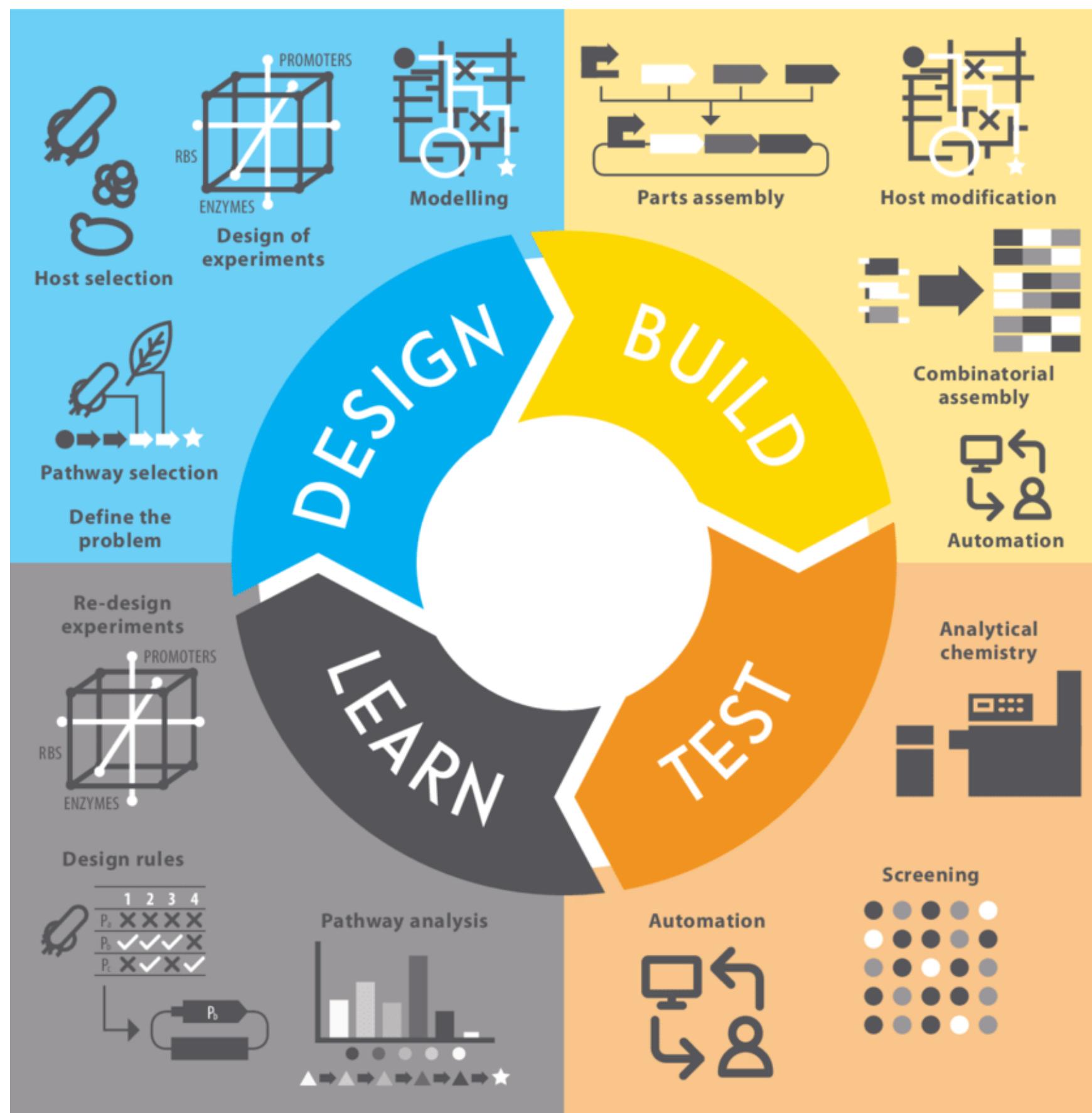


Evolving open-endedness

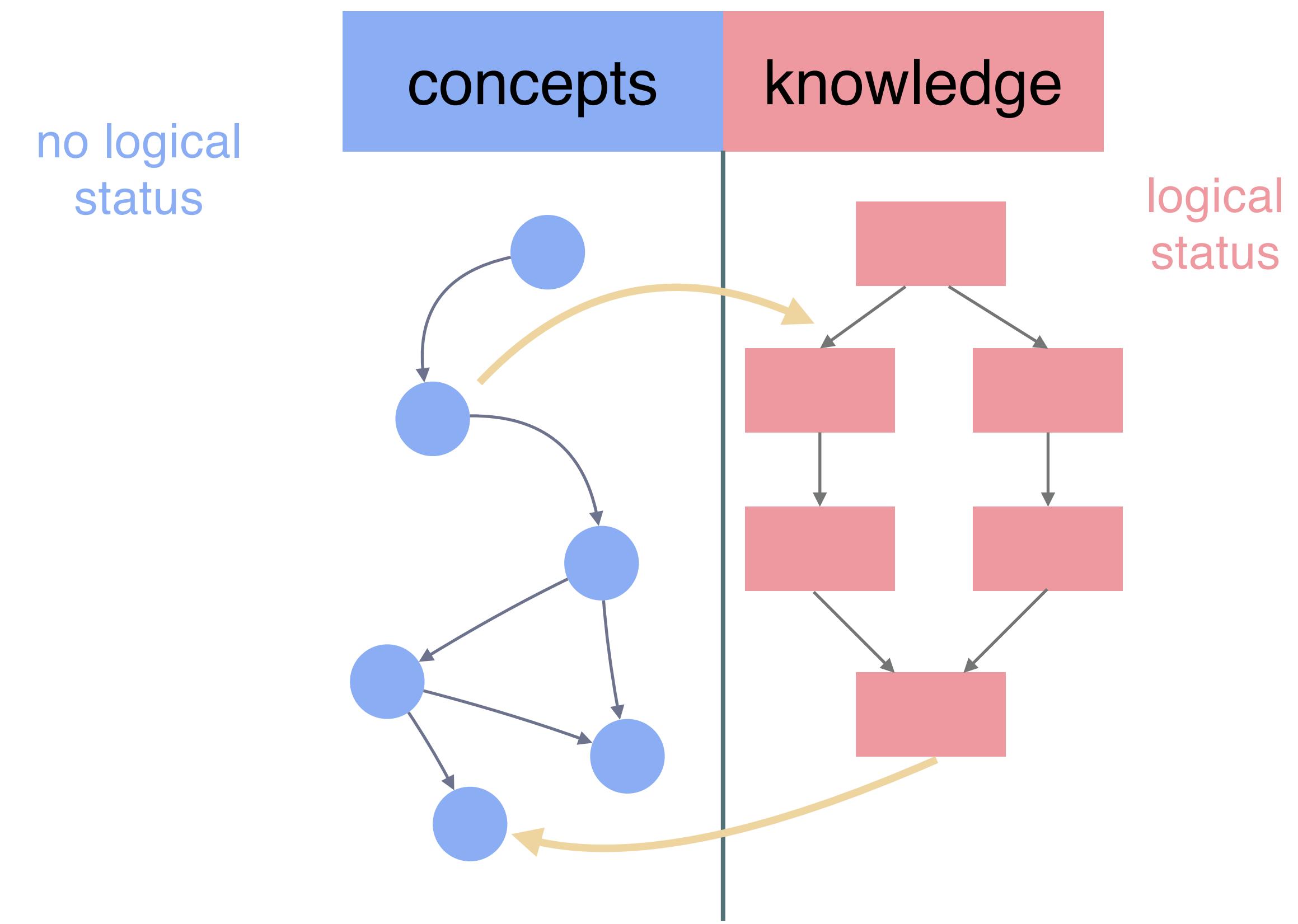


Embedding creativity in synthetic biology

the DBTL cycle as a powerful tool to improve designs



CK-theory as a possible alternative to inject creativity in the design process



S. D. Castle and T. E. Gorochowski, “Engineering is evolution: a perspective on the biological design process.” OSF Preprints, Aug. 31, 2023. doi: [10.31219/osf.io/urq9w](https://doi.org/10.31219/osf.io/urq9w).

Conclusions & prospects

Unlimited novelty and improvement (“open-endedness”) can be facilitated for synthetic biology. Algorithmic procedures, such as novelty search, are key here!



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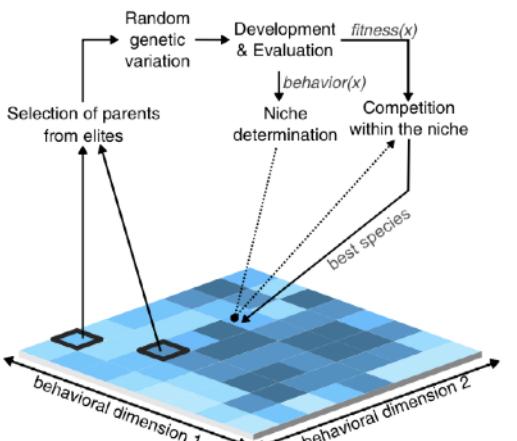
Open-endedness in synthetic biology: a route to continual innovation for biological design

Michiel Stock^{1,*} & Thomas E. Gorochowski²

Review

Evolving the Behavior of Machines: From Micro to Macroevolution

Jean-Baptiste Mouret^{1,*}



Thomas E. Gorochowski
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Towards an engineering theory of evolution

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