

Purification of putative *de novo* proteins from inclusion bodies

Background: Different species have different proteins encoded in their genome. Today we know that proteins do not only evolve by duplication and divergence of existing proteins but also arise from previously non-coding DNA. These proteins are called *de novo* proteins. Their properties are still poorly understood and their experimental analysis faces major obstacles. A starting point for soluble expression of *de novo* proteins is by using chaperones, however some *de novo* proteins still remains in an not solubly expressed manner, meaning the proteins are packed into inclusion bodies, to protect the cell from harmful proteins.

Objectives: In this project we want to purify prior unsolubly expressed *de novo* proteins from inclusion bodies. We will us two different ancestral proteins from the WT Atlas protein. The proteins will be expressed in *E. coli* cells with the help of chaperons. After expression the cells will be cracked and all solubly expressed proteins will be removed. Then the inclusion bodies will be opened and re-folding of the two target proteins will be performed.

Requirements:

- Interest in evolution at the level of individual proteins
- Interest in lab work on DNA and protein level and basic knowledge of PCR, DNA-cloning, protein expression & purification

Methods:

- Expression and purification of proteins
- Biochemical characterization of the proteins via SDS-gels, maybe CD and TSA

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Selected Literature:

1 Eicholt LA, Aubel M, Berk K, Bornberg-Bauer E, Lange A.

Heterologous expression of naturally evolved putative *de novo* proteins with chaperones.

Protein Science. 2022 <https://doi.org/10.1002/pro.4371>

2 Lange A, Patel, PH, Heames B, Damry, A, Saenger, T, Jackson, CJ, Findlay GD, Bornberg-Bauer E

Structural and functional characterization of a putative *de novo* evolved gene essential for male fertility in *Drosophila*

Nat Comm, 2021 <https://doi.org/10.1038/s41467-021-21667-6> 3 Bornberg-Bauer, E, Hlouchova, K, Lange A

Structure and Function of Naturally Evolved *de novo* Proteins

COSB, 2021 <https://doi.org/10.1016/j.sbi.2020.11.01>

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***De novo* gene birth**

PLoS Genet. 2019 doi: 10.1371/journal.pgen.1008160 5 Keeling, DM., Garza, P., Nartey, CM., Carvunis, AR.

Philosophy of Biology: The meanings of 'function' in biology and the problematic case of *de novo* gene emergence
elife, 2019

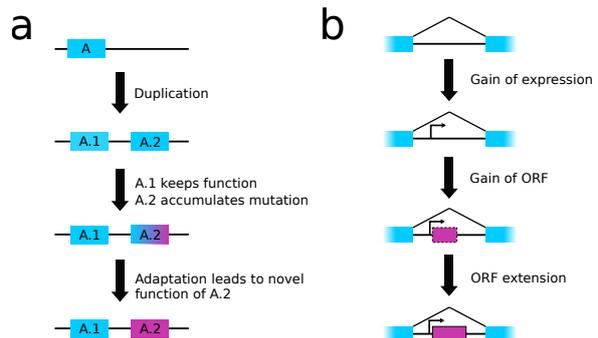


Figure 1: a) Gene emergence via duplication followed by divergence; b) *De novo* gene emergence from non-coding DNA starting from a weakly transcribed proto-gene can eventually result in a functional gene