

Directed evolution is a cyclic process, which recreates the natural evolutionary process. It involves the generation of gene libraries based on one or more parent gene sequences. Through random mutagenesis and recombination, a large number of artificial mutations are created. High-throughput screening and selection can be used to select improved variants with desired properties, including genetic diversity, binding affinity, catalytic properties, thermal and environmental stability. Directed evolution is the most common approach to circumvent our limited understanding of protein structure-function-dynamics relationships.

The goal of synthetic biology is to design biological entities for a wide range of purposes. Directed evolution is a valuable tool for rapidly screening and selecting variant libraries with desired properties. It turns out to be crucial to the success of many synthetic biology efforts. Recent advances in intelligent library design have also helped mitigate the inherent limitations of directed evolution in the scale and rate of library preparation.