

## Change of single-position fitness landscapes and its causes

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The dimensionality of complete genome-level fitness landscapes is huge, and studying their shape is hard. Arguably, the most basic level of understanding of a fitness landscape concerns distribution of fitnesses of alleles at a small locus, such as the amino acid propensities at a protein site. In the course of evolution, such single-position landscapes can change due to epistasis (changes elsewhere in the genome) or to environmental fluctuations. Several approaches have been proposed to study the rates and properties of such changes. They can be inferred from a range of patterns, such as changes in direction of selection, patterns of divergence, and phylogenetic distributions of homoplasies. These patterns are informative of the changes of amino acid propensities and, indirectly, of the shape of the fitness landscape. Furthermore, they can be used to distinguish between two major possible causes of changes of site-specific fitness landscapes: epistasis or environmental fluctuations, as these mechanisms predict very different dynamics of site-specific fitness landscapes.