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# Understanding Molecular Mechanisms of Biological Error Correction

One of the most fascinating features of biological systems is the ability to sustain an extraordinary high accuracy of all major cellular processes despite the stochastic nature of underlying chemical processes. It is widely believed that such low errors are the result of the error correcting mechanism known as a kinetic proofreading. However, there are contradicting views on the balance of speed and accuracy in biological processes. We developed a comprehensive theoretical framework that allowed us to quantitatively investigate the molecular mechanisms of the proofreading using the method of first-passage processes. Within this framework, we simultaneously analyzed speed and accuracy of the two fundamental biological processes, DNA replication and tRNA selection during the translation. The results indicate that speed-accuracy trade-off is not always observed, as usually assumed. However, when the trade-off is present, the biological systems tend to optimize the speed rather than the accuracy of the processes, as long as the error level is tolerable. Additional constraints due to the energetic cost of proofreading also might play a role in the error correcting process. We present theoretical arguments to explain these surprising observations. Our theoretical findings provide a new microscopic picture of how complex biological processes are able to function so fast with a high accuracy.