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Modeling population dynamics of mitochondria in mammalian cells[1] KELLIANNE KORNICK, MOUMITA DAS, Rochester Institute of Technology — Mitochondria are organelles located inside eukaryotic cells and are essential for several key cellular processes such as energy (ATP) production, cell signaling, differentiation, and apoptosis. All organisms are believed to have low levels of variation in mitochondrial DNA (mtDNA), and alterations in mtDNA are connected to a range of human health conditions, including epilepsy, heart failure, Parkinsons disease, diabetes, and multiple sclerosis. Therefore, understanding how changes in mtDNA accumulate over time and are correlated to changes in mitochondrial function and cell properties can have a profound impact on our understanding of cell physiology and the origins of some diseases. Motivated by this, we develop and study a mathematical model to determine which cellular parameters have the largest impact on mtDNA population dynamics. The model consists of coupled ODEs to describe subpopulations of healthy and dysfunctional mitochondria subject to mitochondrial fission, fusion, autophagy, and mutation. We study the time evolution and stability of each sub-population under specific selection biases and pressures by tuning specific terms in our model. Our results may provide insights into how subpopulations of mitochondria survive and evolve under different selection pressures.

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