Dr.
Hiroshi Koyama

Developmental Biology, National Institute for Basic Biology
38 Nishigonaka, Myodaiji, Okazaki,
Aichi 444-8585, Japan
Phone: +81-564-59-5862 , Fax: +81-564-59-5863
E-mail: hkoyama@nibb.ac.jp

How can we know mechanical states in living cells?
~Theoretical prediction of cellular stiffness during cell division ~

Cellular and developmental processes often include morphological changes of biological structures such as cell membrane, leading to cell division, tissue morphogenesis, etc. To unravel the underlying mechanisms of these processes, it is crucial to elucidate spatial and temporal changes in mechanical states/forces which drive these processes. It is challenging, however, to directly measure mechanical states/forces with high spatio-temporal resolution in living cells. Here I focus on the mechanics of cell division which is a fundamental process not only for unicellular organisms to proliferate but also for multicellular organisms to form their bodies. In the final step of cell division called cytokinesis, a mother cell is mechanically separated to two daughter cells by a cleavage furrow formed around the equator of the cell. I show a theoretical method to predict cell membrane stiffness by using experimentally measured cell shapes during cytokinesis. Cell membrane around the equator was predicted to be locally softened. Theoretical analyses revealed that the equatorial softening was sufficient for the cleavage furrow to ingress even without the constriction force generated by the contractile ring. From these results, I proposed a cell membrane stiffness-driven mechanism for cleavage furrow ingression. I also discuss the application of theoretical methods for prediction of mechanical states/forces during tissue morphogenesis.

CV

2001 – 2006	Department of Microbiology / Developmental Cell Biology, Institute of Pharmaceutical Science, The University of Tokyo, Japan
2005 – 2007	Pre- and Post-doctoral JSPS (Japan Society for Promotion of Science) Research Fellow for Young Scientist
2007 – 2011	Cell Architecture Laboratory, National Institute of Genetics, Japan
2011 – Present	Division of Embryology, National Institute for Basic Biology, Japan