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How fundamental physics leads the way to a better understanding of life's complexity

Many biological systems rely on fundamental physical principles for their proper function. Here, mechanical processes such as force generation and adaptation of stiffness and viscosity have been very successfully used to explain complex biomedical questions with physical concepts. Such advances have been largely driven by new methods that allow to quantify biological processes and to construct theoretical models with high predictive power. I will present our recent approaches that allow to study active force generation and mobility in different biological systems over several length scales. Starting with active motion of membranes and intracellular particles in oocytes followed by cytosolic fluidification during cell division we will construct a surprisingly general description of active motion inside the cytoplasm. In a further direction, similar principles are used to study the flow of whole tissue. Here we analyze pressure driven outbursts of cancer cells from model tumors, but also the collective motion during zebrafish development that eventually shapes a whole new animal. The tools we use are largely based on continuum mechanics and statistical mechanics, and give deep insights into the physical principles that are exploited by cells and living objects to perform their intriguing function.