

Function, robustness and optimization: transport on ciliated epithelium, blood microcirculation

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Some physiological functions rely on very specific physical processes and structural and dynamic organizations of living matter. Examples include the protection of airways by the circulation of a protective layer of mucus on their surface, the protection of the skin of fragile organisms by vigorous washing, the filtration of rigid aging red blood cells from the bloodstream, the vigilance against respiratory infections by a specific circulation of leukocytes in the pulmonary bed.

In these examples, we may ask whether the physical processes and organization of living matter are optimized to best fulfill the physiological function, or whether the important thing is the robustness of the function, which must be maintained even when systems are degraded by the many life hazards, old age or disease. Using these examples, I'll show and discuss the power of simple physics concepts, but how we must sometimes be wary of physicists' intuitive approaches, generally based on optimization.