Conductance selectivity of Na^+ across the K^+ channel via Na^+ trapped in a tortuous trajectory

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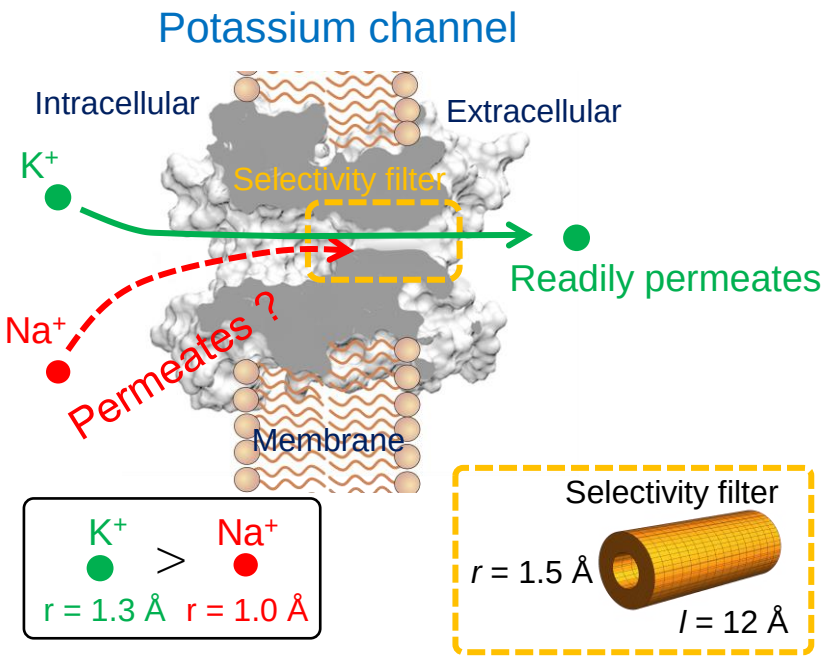
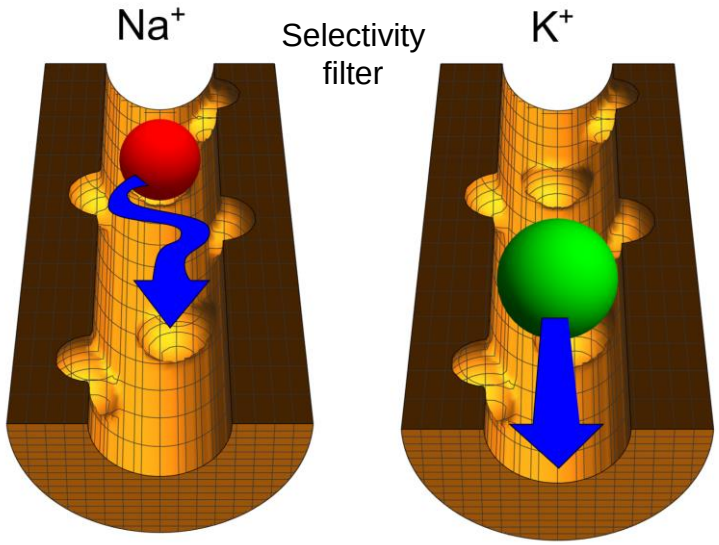
A channel protein operates in the nano-world: Mechanism of the selective passage of larger K^+ over smaller Na^+ across a potassium channel



The potassium channel is a nano-machine, permitting K^+ to pass rapidly and selectively across a narrow pore (the radius: 1.5 Å), named the selectivity filter. The mechanism underlying the ready passage of larger K^+ (ionic radius of 1.3 Å), while least permeable for smaller Na^+ (1.0 Å), has been described in standard textbooks. We demonstrated the substantial passage of Na^+ through a K^+ channel for the first time and refuted the previous hypothetical mechanism.



To get insights into the nano-world event, single-molecule measurements and computer simulation were applied. In contrast to the previous data, our experimental results showed that Na^+ exhibits small but substantial passage through the potassium channel. The computer simulation revealed that smaller Na^+ is trapped in small pits here and there in the selectivity filter, leading to slow passage. Contrarily, larger K^+ rapidly passes without bothered by the pits.

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