Overcoming challenges in anion transport: a story on phosphate, bicarbonate, and fluoride transport

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Synthetic anion receptors are increasingly explored for the transport of anions across lipid membranes.[1] This research is warranted by the potential biological applications of anion transporters, which range from the replacement of defective proteins in diseases linked to anion transport (such as cystic fibrosis) to the disruption of homeostasis, leading to toxicity (anticancer and antimicrobial applications).[2]

The vast majority of the research on anion transport focusses on the transmembrane transport of chloride. While chloride is the most abundant anion in organisms, bicarbonate and phosphates play crucial roles in biology as well.[3] However, it is more difficult to design receptors for these non-spherical anions. Furthermore, $H_2PO_4^-$, F^-, and HCO_3^- are more strongly hydrated than Cl^- and different (de)protonation equilibria have to be considered in the transmembrane transport process.

While many simple structures with urea/thiourea/squaramide groups show activity as chloride transporters, the efficient transport of bicarbonate and phosphate requires more sophisticated anion receptors, with 8-12 H-bond donors in macrocyclic structures. Here, I will present our recent breakthroughs in the transport of these more challenging anions,[4,5] including the first example of a phosphate transporter.

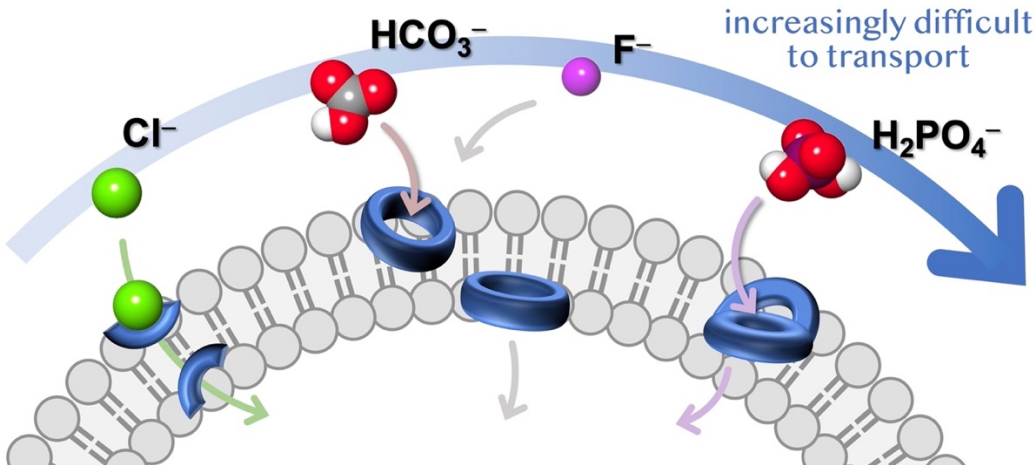

Figure 1. Compared to Cl^-, the anions HCO_3^-, F^-, and $H_2PO_4^-$ are increasingly difficult to transport across lipid membranes, requiring more advanced anion receptor designs.

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