Anion Channels and Transporters All Mixed Up

Christopher Miller
Howard Hughes Medical Institute, Department of Biochemistry, Brandeis University, Waltham, MA

We and the textbooks that we use have traditionally described biological membrane transport as arising from two distinct classes of proteins: transporters (or "pumps") and channels. The former build up gradients of solutes across membranes by using *conformational cycles* powered by sources of free energy, such as a chemical reaction (e.g., decarboxylation of oxalate) or the pre-established gradient of a coordinately transported solute (e.g., Cl^--HCO_3^- exchange). Channels, in contrast, use a totally different transport mechanism—simple *downhill diffusion* through a water-filled pore. Because of these thermodynamically distinct mechanisms, it is natural to imagine that channels and transporters are completely separate at the level of molecular architecture—that they must be built on entirely different plans. But evolution, which just wants to get the job done, is sloppier than textbook authors, who must simplify things, and it is now becoming clear that certain classes of membrane transport proteins have both channel-like and pump-like features built into their mechanisms. This growing collection of mechanistically androgynous membrane proteins will be surveyed, and timely pontifications will be disgorged.