Membrane proteins: Communicating with the world across the border

May 15 2014

All living cells are held together by membranes, which provide a barrier to the transport of nutrients. They are also the communication platform connecting the outside world to the cell's interior control centers. Thousands of proteins reside in these cell membranes and control the flow of select chemicals, which move across the barrier and mediate the flux of nutrients and information. Almost all of these pathways work by protein handshakes—one protein "talking" to another in order to, for example, encourage the import of a needed nutrient, to block a compound from accumulating to a toxic level, or to alert the cell's interior to changes in the outside environment.

Little was known about the relationships among membrane proteins and interior proteins. A team led by Carnegie's Wolf Frommer has revealed how membrane proteins were networked with each other and with the signaling proteins inside the cell. Their work is published in *Science*.

The messages conveyed to membrane proteins by signaling proteins, and vice versa, form the basis of communication between cells within an organism, as well as between the organism and the outside world. To gain insight into this protein-protein messaging across and within membranes, the Frommer team carried out a massive screen for protein-protein interactions between predicted membrane proteins and predicted signaling proteins. They focused on a mustard green called Arabidopsis, the reference organism used by plant biologists in their research.

Many millions of tests were performed and over 10,000 interactions

were discovered. The work is the first of its kind in any organism and will have implications for both plant and animal sciences.

Technical difficulties in studying membranes mean that only a few cross-membrane protein-to-protein signals are known. Both plant and human genomes contain thousands of membrane proteins whose functions remain mysterious. Similar techniques to identify membrane protein interactions have been used before to identify select membrane transporters. But Frommer's team developed a deeper process that was able to yield a greater diversity of results. The vast majority of the thousands of potential membrane protein-signaling protein interactions they found had never before been identified. The team's aim was to use their new protein interaction network to identify interactions important for protein-protein messaging and help assign possible functions to these "unknown" membrane proteins.

"Our findings can serve as an important resource for gene discovery and will be applicable to the animal kingdom, as well as to plants," Frommer said. "In plants, it could help lead to discoveries that will improve crop yields."

More information: "Border Control—A Membrane-Linked Interactome of Arabidopsis" *Science*, 2014.

Provided by Carnegie Institution for Science