Using mutant bacteria to study how changes in membrane proteins affect cell functions

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Phospholipids are water insoluble "building blocks" that define the membrane barrier surrounding cells and provide the structural scaffold and environment where membrane proteins reside. During the 62nd Biophysical Society Annual Meeting, held Feb. 17-21, in San Francisco, California, William Dowhan from the University of Texas-Houston McGovern Medical School will present his group's work exploring how the membrane protein phospholipid environment determines its structure and function.

There are two types of membrane proteins inside the phospholipid environment. "Hydrophilic (water-loving) are exposed on the membrane surface where they stably interact with the aqueous environment surrounding membranes, and hydrophobic (water-repelling) are exposed to the interior of membranes," Dowhan said.

Because of this balance of hydrophilic and hydrophobic proteins on the inside and outside side of the cell membrane, the conditions remain stable. "For example, the hydrophilic (proteins) on one side of the membrane shouldn't flip through the hydrophobic core of the membrane to the other side," Dowhan said.

This made Dowhan wonder why "cells maintain thousands of unique phospholipid species." To find out, his group constructed mutants of the bacterium Escherichia coli and the yeast Saccharomyces cerevisiae in which the composition of these "building blocks" could be varied. "As we varied the membrane phospholipid composition, we adversely

affected cellular functions." Dowhan said.

These are significant findings, because "membrane proteins are initially made in the endoplasmic reticulum (inside cell), then transported to other membranes where they function," Dowhan said. "So, a change in phospholipid environment during this transport process ... within a membrane, can change a protein's structure and function. The importance of dynamic changes in membrane protein function related to phospholipid composition is an unrecognized way of controlling cellular processes."

How cells regulate various processes is central to maintaining cell viability, and it's a unique property of each cell type. "To fully understand life, we not only need to define each chemical reaction within a cell but also how each is regulated and integrated with each other," Dowhan said.

More information: 119-Plat - "Lipids as determinants of membrane protein structure" is authored by William Dowhan, Mikhail Bodanov and Heidi Vitrac. It will be presented at 10 a.m. PST, Sunday, Feb. 18, 2018, in the Esplanade, Room 156 of the Moscone Center, South. Abstract: plan.core-apps.com/bpsam2018/a … 1290aae09439cc2f9905

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