Carnegie donates landmark clones to biology

August 6 2009

With the information explosion, it's remarkable that so little is known about the interactions that proteins have with each other and the protective membrane that surrounds a cell. These interactive, so-called membrane proteins regulate nutrients and water fluxes, sense environmental threats, and are the communications interface with neighboring cells and within the cell.

Now with National Science Foundation funding, researchers at the Carnegie Institution's Department of Plant Biology have cloned genes to produce membrane proteins that may initiate the instructions for genes to turn on in the nucleus. They just donated 2010 of the clones for genes that function in the cell's interaction with its environment to the Arabidopsis Biological Resource Center (ABRC is at Ohio State University) for other scientists to use to help advance fields from medicine to farming. These genes are now used to unravel the interaction of the membrane proteins amongst each other.

Recent research at the Carnegie department has shown that cells across different species use the same mechanism at the cell membrane to regulate the uptake of the vital nutrient nitrogen. Previous Carnegie work indicated that plants have a novel regulatory mechanism that controls nutrient uptake—neighboring pore-like structures at a plant cell's surface physically interact to control the uptake. "Since plants, animals, bacteria, and fungi all share similar genes for this activity, we wanted to see in this study if same feature could occur across species," remarked Dominique Loqué lead author of a study published in the July 6, *Journal of Biological Chemistry*.

In the previous work, the scientists looked at the end of the protein *Arabidopsis* ammonium transporter (AMT1;1). This protein portion is called the C-terminus and it regulates the interactions of the pore-like structures at the membrane surface in plants. In this study they focused on the underlying mechanism of the pore activity by using mutant proteins that cannot shut the pores off with their C-terminus to see how they work in yeast and immature eggs of the frog *Xenopus* in the presence of ammonium.

The researchers were totally surprised that the mechanism in which three subunits regulate each other was found in the primitive archaebacteria. It means that it evolved billions of years ago. The fact that the C-terminus is found in all other bacteria, fungi, and plants demonstrates that it was necessary in the atmosphere where they developed—periods in which the toxic ammonium accumulated on the early Earth. This mechanism has been retained although a single mutation can make the transporters work independently. So why did this simpler mutation not succeed? The researchers believe that there must still be selective pressure on the system. The simplest explanation is that the mechanism is still necessary today, probably to control uptake and prevent toxicity.

"The newly donated 2010 clones will now be used to see how common such regulation by neighbors is. It also emphasizes the importance and the potential that the new clones have for understanding a spectrum of problems from kidney diseases to engineering better crops," remarked director of the department Wolf Frommer.

Source: Carnegie Institution