Right place, right time: Cellular transportation compartments

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Proteins are the machinery that accomplishes almost every task in every cell in every living organism. The instructions for how to build each protein are written into a cell's DNA. But once the proteins are constructed, they must be shipped off to the proper place to perform their jobs. New work from a team of scientists led by Carnegie's Munevver Aksoy and Arthur Grossman, describes a potentially new pathway for targeting newly manufactured proteins to the correct location. Their work is published in *The Plant Cell* journal.

The team's discovery concerns a cellular organelle that has been called an acidocalcisome. It is a compartment that isolates potential harmful or disruptive compounds from the rest of the cell and is also involved in the turnover of cellular components (similar to the so-called lysosome in animals). They are rich in phosphate-containing molecules and the team noted that they build up to high levels when cells of the single-celled, green alga *Chlamydomonas* are deprived of sulfur. They discovered that acidocalcisomes are also, surprisingly, involved in targeting proteins out into the cell space between the cell's membrane and the cell wall.

Working with *Chlamydomonas*, the team, which also included Carnegie's Wirulda Pootakham, was examining the organism's responses to nutrient deficiency. They found that mutant cells lacking the ability to form these acidocalcisomes also lacked the ability to cope with sulfur and nitrogen deprivation adequately.

What appears to happen with these mutants is that the proteins that

specialize in helping the cell survive a deficiency of sulfur or nitrogen don't get shipped out to the space between the membrane and cell wall where they are needed. Because of this, feedback is sent to stop construction of the proteins (and the messenger RNA that encodes those proteins) and the entire response to nutrient deficiency is derailed.

"Our findings point to a novel way to target proteins to where they're needed to function, and indicate that this targeting is also associated with checkpoints that might control gene transcription," Grossman said.

These findings tie in with new work from Sabeeha Merchant at UCLA, with whom Grossman's lab will be working to explore the interrelatedness of their discoveries.

Merchant's team used a combination of various spectroscopic methods to visualize a metal-storing compartment in *Chlamydomonas* that may be similar or related to that studied by Grossman. The compartment studied by Merchant specializes in storing copper and in making it available when it is necessary for the construction of certain proteins. Their work is published in Nature Chemical Biology.

"We wonder whether there are actually different types of acidocalcisomes or vacuoles in any one cell, each housing different amounts of individual metals," Merchant said. "We look forward to working together to explore the new possibilities in understanding mineral nutrient metabolism brought to light by our two papers, which underscore the interplay between multiple pathways for maintaining normal cellular function."

Provided by Carnegie Institution for Science

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