Calcium and reproduction go together

August 22 2014

Everyone's heard of the birds and the bees. But that old expression leaves out the flowers that are being fertilized. The fertilization process for flowering plants is particularly complex and requires extensive communication between the male and female reproductive cells. New research from an international team from Stanford, Regensburg, Heidelberg, and Munich, and including Carnegie's Wolf Frommer, David Ehrhardt, and Guido Grossmann reports discoveries in the chemical signaling process that guides flowering plant fertilization. It is published in *Nature Communications*.

Flowering plants have a double fertilization system. Grains of pollen carry the male reproductive cells. When pollen grains land on the flower's female reproductive organ, they germinate and grow towards the deeply embedded ovules via a pollen tube. After fertilization, ovules develop into seeds. What makes the process unique is that the pollen tube releases two sperm cells, one of which fuses with an egg in a process like that in animals. The other fuses with the so-called central cell to form a multi-nuclear entity that grows and provides nutrition for the developing embryo and seedling, respectively. This so-called endosperm is also the major source of nutrition for the animals and humans that eat these plants. Numerous cell-to-cell chemical interactions are necessary to guide this process as it takes place, many of which remain unidentified. In animals, calcium is key for communication between cells during fertilization. The research team, led by Thomas Dresselhaus from the University of Regensburg and Guido Grossmann, who recently moved from Carnegie to the University of Heidelberg, focused on finding calcium-facilitated communication in the double

fertilization of flowering plants.

It was already known that calcium is involved in the early stages of fertilization, including pollen tube growth control and the guidance that brings the sperm to the ovule. But more work was necessary to determine if it was as important in the later stages.

Using an advanced fluorescent calcium sensor the team was able to monitor calcium signatures in live cells throughout the whole double fertilization process. The work was performed using Arabidopsis, which is commonly used for research purposes. They found that calcium was involved in chemical signaling throughout the double fertilization process and is associated, for example, with sperm release and fusion with the egg cell. This type of real-time observation had previously been impossible due to the deeply imbedded location where double fertilization occurs.

"Thanks to technical advances we were able to observe the moment of plant fertilization at the cellular level and, at the same time, listen to the 'tête-à-tête' between male and female cells," Grossmann said. "Further work is necessary to decode the language and understand what is actually being said."

Provided by Carnegie Institution for Science