Department of Biology
The College of Arts + Sciences | Indiana University Bloomington

Carlos O. Miller Lecture

Thu., Aug. 23, 2018 • 4–5:00 p.m. • Myers Hall 130

Dominique Bergmann, Ph.D.

Professor of Biology, Stanford University

Adjusting the valves: Optimizing stomatal development with systemic cues

Plants exhibit remarkable developmental plasticity in response to changes in nutritional status or the environment. We use the *Arabidopsis* stomatal lineage as our model to understand how information from a variety of local and distant sources is integrated into developmental decisions. The stomatal lineage creates stomata, microscopic cellular valves that are essential for gas-exchange between the plant and environment. The lineage also features a stem cell-like precursor stage that can be modulated to enable plants to make bigger or smaller leaves, and more or fewer stomata as appropriate for the environment. SPEECHLESS (SPCH) is a transcription factor required for the stem-cell divisions of the stomatal lineage. We have recently uncovered a regulatory circuit involving the hormone cytokinin (CK) and SPCH that modulates stomatal stem cell proliferation. This regulatory circuit dictates how often cells divide and, moreover, influences the type of asymmetric divisions made in the stomatal lineage. Live cell imaging of CK reporters revealed a spatially and temporally dynamic landscape of CK responses during stomatal lineage progression, and we can show that this landscape is sculpted by SPCH-dependent expression of CK-related signaling peptides and negative-acting regulatory elements. This hormone system works orthogonally to stomatal-specific peptide-receptor-MAPK signaling previously described to regulate cell fate, cell polarity and cell patterning, thereby allowing plants to conditionally modulate leaf anatomy, yet maintain appropriate tissue patterning. This SPCH-CK feedback loop, together with other signaling pathways, contributes to the extraordinary flexibility in growth and development we see in plants.

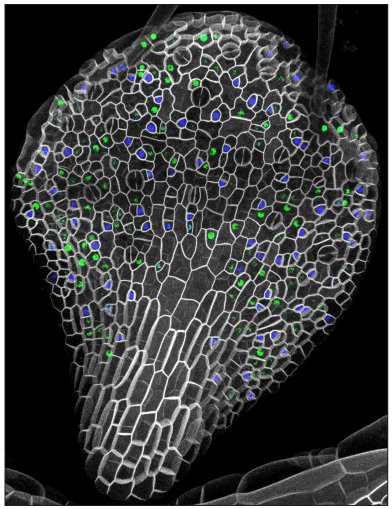


Image on left: *Arabidopsis* leaf surface showing outlines of all cells (gray) and two types of stomatal precursor cells: meristemoids (green nuclei) and guard mother cells (blue nuclei). Meristemoids will become guard mother cells, which will divide to create the paired guard cells surrounding the stomatal pore. Stomata are the breathing pores of plant leaves and they enable the plant to take in carbon dioxide from the atmosphere and to release oxygen and water vapor.

About Dr. Bergmann

Dominique Bergmann studies *Arabidopsis* stomatal development as a model for understanding how asymmetric cell division, cell-cell communication, and long distance communication work together to establish cell fates and tissue patterning.

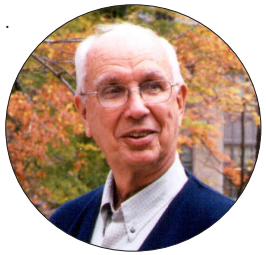
Bergmann received her Ph.D. in molecular biology from the University of Colorado, Boulder in 2000 and did her postdoctoral work in plant development at Carnegie Institution through 2004. She is currently a professor of biology at Stanford University.

Bergmann's honors include an NSF CAREER Award (2009-14) and a Presidential Early Career Award (2010-15), which is one of the highest distinctions for young science professionals. In 2010 the American Society for Plant Biology presented Bergmann with the Charles Albert Shull Award, recognizing her as an outstanding young plant biologist. She was selected as a Howard Hughes Medical Institute (HHMI)-Gordon and Betty Moore Foundation Plant Investigator in 2011 and her support was renewed as an HHMI Investigator in 2017. Bergmann gave the Carnegie Institution's "Capital Science" lecture "Making a difference: How to create stem cells and have their products change the world" in Washington, D.C., in 2016. Last year she was elected a member of the U.S. National Academy of Sciences.

Bergmann is involved in numerous outreach projects with local schools, has created materials for and advised area museums, and has designed projects for rural high school citizen science.

Image on left: Giant lily pads at the Missouri Botanical garden. Lily pads are unusual in that all their stomata are on the tops of the leaves (most plants have them on the bottoms).

The **Carlos O. Miller Lectures** honor Professor Carlos Miller (1923-2012), a legendary plant hormone pioneer and beloved member of the IU Biology faculty for 55 years. Miller had a longstanding interest in the mechanisms of plant growth and development. Established in 2004, the lecture series brings prominent scientists to Bloomington to discuss their research.



Lecture hosted by

Craig Pikaard, HHMI Investigator, Distinguished Professor, and Carlos O. Miller Chair in Plant Growth and Development

Refreshments served prior to lecture