University of Delaware

Center for Bioinformatics & Computational Biology

BIOINFORMATICS SEMINAR

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UTILIZING FLUCTUATIONS IN A TRANSCRIPTION FACTOR TO CREATE CELL SIZE PATTERNS

Development is remarkably reproducible, producing organs with the same size, shape, and function repeatedly from individual to individual. Yet, these reproducible organs are composed of highly variable cells. My laboratory focuses on the mechanisms that produce diversity in cell size in the Arabiodpsis sepal (outermost green leaf-like floral organ) and the mechanisms that ensure the same size sepals are produced from these variably sized cells. Today I will tell you a story about cell size diversity. Plant cells often undergo endoreduplication, a specialized cell cycle in which the cell replicates its DNA and grows bypassing division to become an enlarged and polyploid. Arabidopsis leaves and sepals have highly endoreduplicated giant cells scattered between smaller cells that have undergone fewer or no endocycles. This pattern of endoreduplication affects the curvature of the organ. Using live imaging, quantitative image analysis, and computational modeling, we found that apparently stochastic fluctuations in the concentration of the transcription factor ATML1 create the pattern of highly endoreduplicated giant cells scattered among smaller cells in the Arabidopsis sepal epidermis. If the ATML1 concentration surpasses a threshold during the G2 phase of the cell cycle, the cell is likely endoreduplicate and become a giant cell. In contrast, if the ATML1 remains below the threshold during G2, the cell is likely to divide, thus remaining small. Our results demonstrate that apparently random fluctuations can generate a pattern of endoreduplication.

BIOGRAPHY

Dr. Adrienne Roeder has had a longstanding interest in combining biology with computation since she was an undergraduate student at Stanford where she majored in Biology with a minor in Mathematical and Computational Science. She received her PhD from UC San Diego in 2005, studying fruit development and seedpod dehiscence in Arabidopsis. Then she was a postdoctoral scholar at Caltech where she was involved in establishing the computational morphodynamics approach to understanding morphogenesis by combining live imaging, image processing, and computational modeling. Now she is the Nancy M. and Samuel C. Fleming Term Associate Professor in the Weill Institute for Cell and Molecular Biology and the School of Integrative Plant Science, Section of Plant Biology at Cornell University. Her lab uses a computational morphodynamics approach to study how cell sizes and organ sizes are controlled in Arabidopsis. Through this research, the themes emerging are the importance of stochasticity and heterogeneity at the cellular level which the plant utilizes to develop robust organs with the correct size, shape, and functions.

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