2009 Report: Systems Biology

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Systems biology approaches in Arabidopsis research continued to flourish during the past year. Systems biology can be defined as the exercise of integrating the existing knowledge about biological components, building a formal model of the system as a whole and extracting the unifying organizational principles that explain the form and function of living organisms. More practically speaking, a systems approach to understand biology can be described as an iterative process that includes (1) experimentation at a global level, (2) data collection and integration, (3) system modeling and (4) generation of new hypotheses to initiate a new cycle of experimentation at a global level. The promise of systems biology is that by using this global integrative and iterative approach we will greatly increase our understanding of biological systems as wholes.

A primary goal of the Systems Biology Subcommittee is to further the use of Systems Biology among Arabidopsis researchers to elucidate the structure, dynamics, and organizational principles of the regulatory and metabolic networks that support living cells. The MASC Systems Biology and Bioinformatics Subcommittees held a joint workshop on "Frontiers in Plant Systems Biology" at the Arabidopsis conference in Montreal, 2008. The goal was to bring together groups that produce, integrate and model data from a systems perspective. There were talks from biologists performing cutting-edge systems research that highlighted the new frontiers in genomic data collection for systems biology and the challenges in data storage, analysis and integration. Contributors also discussed the state-of-the art and vision for systems research in plants. There was also a presentation from the NSF-funded iPlant Collaborative initiative. The goals of the iPlant and the contribution of the iPlant initiative to advance systems biology research in Arabidopsis were communicated at the workshop.

The Systems Biology Subcommittee has a Wiki at http://arabidopsis.info/wiki/index.php/Plant_Systems_Biology. We encourage researchers to post questions, comments, suggestions, news or any other material that may stimulate discussion related to Systems Biology approaches in Arabidopsis. Several excellent publications last year illustrated the growing breadth and sophistication of Systems Biology approaches to gene network, signaling and developmental research in Arabidopsis; only a few can be highlighted here:

1. A systems approach reveals regulatory circuitry for Arabidopsis trichome initiation by the GL3 and GL1 selectors. Morohashi K, Grotewold E. PLoS Genet. 2009. 5:e1000396.
2. MAPK target networks in Arabidopsis thaliana revealed using functional protein microarrays. Popescu SC, Popescu GV, Bachan S, Zhang Z, Gerstein M, Snyder M, Dinesh-Kumar SP. Genes Dev. 2009. 23:80-92.
3. Root system architecture from coupling cell shape to auxin transport. Laskowski M, Grieneisen VA, Hofhuis H, Hove CA, Hogeweg P, Marée AF, Scheres B. PLoS Biol. 2008 Dec 16;6(12):e307.
4. Systems approach identifies an organic nitrogen-responsive gene network that is regulated by the master clock control gene CCA1. Gutiérrez RA, Stokes TL, Thum K, Xu X, Obertello M, Katari MS, Tanurdzic M, Dean A, Nero DC, McClung CR, Coruzzi GM. Proc Natl Acad Sci U S A. 2008. 105:4939-44.