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A Gateway between Omics Data and Systems Biology

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Abstract

Metabolomics captures the cellular chemistry and thereby the ultimate realization of numerous genetic, transcriptional, and enzymatic events. The mechanistic interpretation of small molecules as substrates, intermediates, or products of biochemical action is necessary to place metabolites into the correct physiological context of a system. Therefore, the tight connection between omics technologies and systems biology is vital.

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Systems biology approaches such as large-scale omics platforms, or computational models generate mechanistic insights about metabolism. There has been a lag of more than a decade between genome assembly [1] and functional interpretation [2]. Savvy, integrative systems biology approaches [3] will be instrumental to avoid a similar lag in the field of metabolomics. In particular, multi-omics network models of metabolism are valuable and bridge between high-throughput omics acquisition and systems interpretation [4].

Once a model is formulated, systems biology cycles between testable hypotheses and experimental validation [5]. As profiling platforms fuel this cycle with metabolomics and other high resolution data, systems biology becomes a playful exercise. It is possible to spin the cycle of systems biology in two directions. The first direction primarily supports identification of static network components and their interactions, the latter direction dynamically integrates large-scale omics data. While genes in combination with levels of transcripts and proteins provide information on possibilities of a cell, the levels of metabolic intermediates are direct indicators of current cellular activity and environment. Taken together it is possible to move beyond a plain inventory of working parts and to develop a systems understanding is generated that eventually pinpoints master regulators [6].

The combination of metabolomics and systems biology will bring about a revolution in biomedicine. Today's routine use of metabolic multiplexing in the clinic will be enhanced by patient specific sequence information and network models. The integration of systems biology networks [7] into diagnostic interpretation of metabolomics readouts [8] will naturally generate regimes for personalized medicine practice [9]. In this sense, metabolomics and systems biology will fundamentally transform our approach to patient care, disease prevention, diagnostics, and therapy.

The inaugural issue of the *Journal of Metabolomics and Systems Biology* nicely illustrates contributions to a long list of accomplishments in the merging fields of metabolomics and systems biology. It is its goal to integrate functional genomics, proteomics, metabolomics platforms with network modeling of living systems. In such emerging fields technological innovations are frequent drivers of new biological discoveries. The *Journal of Metabolomics and Systems Biology* covers novelties in analytical methods, profiling platforms, and fingerprinting technologies. Special attention is dedicated to combined experimental and computational approaches, where different disciplines stimulate one another and fundamentally enhance our understanding of cellular systems.

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