The Engineering of Growth Control

Arthur D. Lander

Departments of Developmental & Cell Biology and Biomedical Engineering, Center for Complex Biological Systems, University of California, Irvine, CA 92697-2280 USA

Biological growth—whether of cells or tissues—is naturally autocatalytic (ribosomes make more ribosomes, cells make more cells), implying kinetics that are fundamentally exponential. Exponential processes are both difficult to stabilize (think of nuclear power plants) and highly sensitive to perturbations (because errors compound). Seen from this perspective, it is quite remarkable that most organs grow to pre-determined sizes with great precision, and then stably maintain those sizes. Even more remarkable is the fact that, for many organs, size is specified in a manner independent of body size, independent of cellular growth rate, and independent of cell size. Many lines of evidence point to a critical role for feedback in achieving growth control, but although some molecules and mechanisms have been implicated, the strategies that achieve both stability and robustness are still poorly understood. I will discuss some of the things that modeling and experiments have recently revealed about design principles underlying biological growth control, focusing in particular on the roles played by regulated cell lineage progression. *Supported by NIH P50-GM076516*.