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A Molecular Model of Plant Cell Morphogenesis: The Case of Polar Growth in Pollen Tubes ENRIQUE ROJAS, SCOTT HOTTON, JACQUES DUMAIS, Harvard University — The growth of plant, fungal, and bacterial cells depends critically on two processes: the deposition of new wall material at the cell surface and the mechanical deformation of this material by forces developed within the cell. To understand how these two processes contribute to cell growth, we have undertaken an experimental and theoretical investigation of polar morphogenesis in pollen tubes. The pollen tube is an ideal model system for the study of polar growth because of its rich phenomenology and its ease of experimental manipulation. We formulated an experimentally-motivated model of pollen tube morphogenesis that incorporates 1) the microscopic architecture and rheology of the polymeric wall, 2) the dynamics of intracellular calcium, a key morphogen in pollen tubes, and 3) the exocytosis of wall material. These processes constitute a feedback loop that controls growth. Our model shows two regimes corresponding to observed steady and pulsatile growth in pollen tubes. The model accounts for the frequency, amplitude and waveform of pulsatile cells, and the scaling relationships between these variables. By solving the dynamical system on a three-dimensional thin-shell geometry we can also explain the surface expansion pattern and morphology of steady-growing cells.

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