Lattice-Based Multi-Cellular Virtual-Tissue Computer Simulations of Infection, Development and Disease Using CompuCell3D

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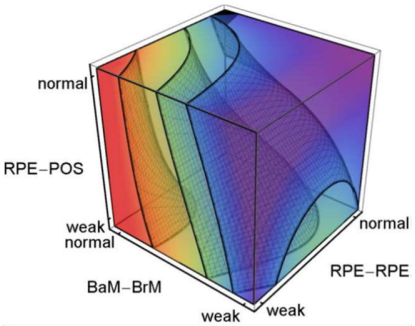
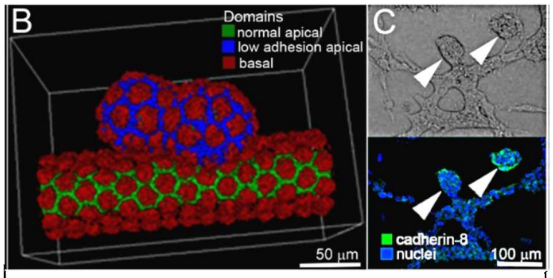
The difficulty of predicting the emergent development, homeostasis and disfunction of tissues from cells' molecular signatures limits our ability to integrate molecular and genetic information to make meaningful predictions at the organ or organism level or to design living engineered systems. Virtual Tissues are an approach to constructing quantitative, predictive mechanistic models starting from cell behaviors and combining subcellular molecular kinetics models, the physical and mechanical behaviors of cells and the longer range effects of the extracellular environment. For the past 15 years, we have been developing Virtual-Tissue tools (CompuCell3D, www.compucell3d.org) to bridge the gap between molecule and physiological outcome. I will illustrate these approaches in: 1) the pattern of viral replication, spread and cellular immune response in epithelial tissue, 2) the development of blood vessels and its effect on Choroidal Neovascularization (CNV) in Age-Related Macular Degeneration (the most common cause of blindness among the elderly) and in Diabetic Retinopathy, 3) the disorganization of normal tubular structure which occurs in Polycystic Kidney Disease, which leads to overgrowth and eventual kidney failure, and 4) toxin-induced damage in the liver.



CNV Risk Dependence on Adhesion in the Retina



(B) Simulated and (C) *in vitro* study of the induction of cystogenesis by ectopic Cadherin-8.

Dr. Glazier received his B.A. in Physics and Mathematics from Harvard University and his M.S. and Ph.D. in Physics from the University of Chicago. His research focuses on experimental and computational approaches to pattern formation in embryology. He has held faculty appointments at the University of Notre Dame and Indiana University, Bloomington, where he is founding director of the

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