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Simulating and Modeling E. Coli's Inorganic Phosphate Two-Component System Response[1] STEPHANIE LAKE, Wright State University — Stress on cells, such as nutrient deprivation, can induce signaling processes that amplify further and create necessary proteins simultaneously. Many signaling processes involve low numbers of reactants and thus have stochastic nature. The inorganic phosphate signaling response within E. coli is thought to be one example. Such inherent noise in the system hints to fundamental information behind life processes and survival. The main proteins involved in the phosphate deprivation response in E. coli are the membrane-bound phosphate transporter, Pst, the membrane-bound histidine kinase, PhoR, and the cytoplasmic response regulator, PhoB. When the exterior phosphate concentration falls low, PhoR activates PhoB. Activated PhoB creates a positive feedback loop for the expression of Pst, PhoR, PhoB, and other proteins. Experimental data from changing the exterior phosphate signal suggests there is noise and bistability in expression rate. It is predicted a simple model with seven parameters can be used to represent the system's general behavior. Its structure is based on a birth-death reaction with a hill function acting as the birth rate. The hill function in the experiment relates to the activated state only. An ODE solver and Gillespie's stochastic simulation algorithm were used to simulate the model. The phase space of X and dX/dt were varied and analyzed. The simulations' results were found to be comparable with experimental data.

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