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Excitable signal relay in Dictyostelium discoideum TROY MESTLER, DAVID SCHWAB, PANKAJ MEHTA, THOMAS GREGOR, Department of Physics, Princeton University — The social amoeba D. discoideum transitions when starved from a collection of individual cells into a multicellular spore-complex. During this process, amoebae display several interesting phenomena including intercellular signaling, pattern formation, and cell differentiation. At the heart of these phenomena is the exchange of the signaling molecule cyclic-AMP, which has previously been extensively studied using a variety of indirect methods. Here we employ a sensor that uses a compound fluorescent protein whose emission spectrum changes in the presence of bound cyclic AMP to directly monitor, in real time and in vivo, intracellular cAMP concentrations. We use cells expressing this sensor in microchemostats to study intracellular cAMP concentrations at the single-cell level in response to precise, dynamically-controlled external cAMP stimulation. Specifically, we show that these cells display excitability much like that found in neurons and agree experimentally quite well with a modified FitzHugh-Nagumo dynamical systems model. This single-cell model sets groundwork for a comprehensive multicellular model that promises to explain emergent behavior in D. discoideum.

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