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A possible role for chemotaxis in primitive streak formation SEBASTIAN A. SANDERSIUS, Department of Physics, Arizona State University, CORNELIS J. WEIJER, Division of Cell and Developmental Biology, College of Life Sciences, University of Dundee, TIMOTHY J. NEWMAN, Department of Physics, Arizona State University — One of the fundamental problems in modern biology is to understand the transformation of a fertilized egg to an adult organism. A key stage of this developmental process is gastrulation, in which cell germ layers are defined, and the basic three-dimensional body plan of the organism is established. Presented here is a model used to investigate the collective cell movement which is observed at the onset of gastrulation in the Chick embryo. In the avian embryo, gastrulation is initiated by a cadre of cells moving coherently, bisecting the embryo, thereby forming a structure known as the primitive streak. The mechanisms underlying primitive streak formation are the subject of recent experimental controversy. One hypothesis is that coherent cell motion is driven by chemotactic response to long-range signaling gradients. We will present results from large-scale computer simulations testing this hypothesis. In particular, we perform simulations using the Subcellular Element Model (SEM). Within the model framework, a single cell is represented by a collection of visco-elastically interacting elements. Dynamic interactions of elements are motivated, as coarse-grained representations, of the actively remodeling cell cytoskeleton. We have found that, in addition to chemotaxis, active cell migration is crucial for "fluidizing" the tissue thereby allowing large-scale coherent cell movement.

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