A mathematical basis for the *clock and wavefront* model for somitogenesis.

R. E. Baker, S. Schnell and P. K. Maini

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Abstract

Despite huge advances in biology, our understanding of how spatial patterns arise in development is still very crude. The post-genomic challenge in developmental biology is to elucidate the mechanisms underlying this phenomenon. To this end, somitogenesis, one of the most important and well-studied examples of pattern formation in the developing embryo, is becoming a leading candidate in developmental biology for a study that aims to couple findings at a molecular level with those at a cell and tissue level and lends itself openly to investigation from a more theoretical viewpoint.

Somites arise as the result of a complex process that takes places in the early vertebrate embryo: a seemingly uniform field of cells is organised into discrete blocks via a mechanism which is tightly regulated both in space and time. Further differentiation of the cells within these somitic segments leads to the formation of the vertebrae, ribs and other associated features of the vertebrate musculature.

Various experimental results have shown the existence of a wavefront of gene signalling along the vertebrate embryo, which, coupled with a segmentation clock, is able to gate the cells into blocks that will later go on to form somites. We use a signalling based approach, with cues from the wavefront and the segmentation clock, to mathematically model somite formation and show that our model can reproduce the results seen in vivo when progression of the wavefront is disturbed.