GGSB PRELIM QUESTION # 7

Genetics of Model Systems/Human Genetics

The Bicoid gradient of the syncytial Drosophila embryo is an important model for morphogenetic gradients in development. How the nuclei of the syncytial blastoderm read the Bicoid gradient remains poorly understood. Recently, an optogenetic approach has been used by Huang et al (2017) to analyze the temporal interpretation of the gradient. The study revealed that short interruptions of Bicoid activity alter the most anterior cell fate decisions, while prolonged inactivation expands patterning defects from anterior to posterior. Such anterior susceptibility correlates with high reliance of anterior gap gene expression on Bicoid. Therefore, cell fates exposed to higher Bicoid concentration require input for longer duration remaining sensitive to Bicoid dosage for longer than posterior cell fates.

1. Summarize the method and key findings of Huang et al. (2017).
2. Discuss potential testable mechanisms of Bicoid action. Discuss hypotheses in the light of other recent findings (see for example additional references).

Main Reference

Huang et al. eLife 2017;6:e26258. DOI: 10.7554/eLife.26258
Decoding temporal interpretation of the morphogen Bicoid in the early Drosophila embryo.

Additional References

Ali-Murphy & Kornberg eLife 2016;5:e13222 doi: 10.7554/eLife.13222
Bicoid gradient formation and function in the Drosophila pre-syncytial blastoderm embryo.

Blythe & Wieschaus eLife 2016;5:e20148. DOI: 10.7554/eLife.20148
Establishment and maintenance of heritable chromatin structure during early Drosophila embryogenesis.

Datta et al (2018). Genes and Development 32: 1-14
A feed-forward relay integrates the regulatory activities of Bicoid and Orthodenticle via sequential binding to suboptimal sites.

Dubrulle et al. eLife 2015;4:e05042. DOI: 10.7554/eLife.05042
Response to Nodal morphogen gradient is determined by the kinetics of target gene induction