BE 159: Signal Transduction and Mechanics in Morphogenesis

Justin Bois

Caltech

Questions to consider: Ben-Zvi, et al., "Scaling of the BMP activation gradient in *Xenopus* embryos"

Following are some questions that it will be helpful to understand when reading the paper. They are definitely not exhaustive, but useful to help you understand the motivation of the work and the experimental protocols.

1. Most importantly: What is meant by scaling in the context of this paper?
2. What are the opposing challenges to developmental processes that the authors mention? Do you think these are opposing?
3. Why have some researchers argued that morphogens cannot be involved in scaled patterning?
4. Be sure you can define what "shuttling" is and explain the difference between a shuttling mechanism and an inhibition-based mechanism.
5. How do the authors quantify whether a mechanism is shuttling-based?
6. How could it be that a ligand-Chordin complex, which is physically bigger, can diffuse *faster* than the free ligand?
7. The activation profiles are approximately given by a scaling law. All of the plots have BMP signaling levels on a log scale. Do you see any potential issues with this? Do you think that scale is appropriate?
8. The authors talk about thresholds, such as T_{Admp}, the threshold BMP concentration for repression of *admp*. In what molecular circumstances does it make sense to talk about thresholds? How do the authors incorporate this in the dynamical equations (it is in the supplement).
9. What is a morpholino?
10. Make sure you know what a flux is. Why do they set the flux at the dorsal-most region as $\eta_{\mathrm{Chd}} = D_{\mathrm{Chd}}\, \mathrm{d}[\mathrm{Chd}]/\mathrm{d}t|_{x=L}$?

11. At the end of the paper and supplement I posted on the course website, I included two short commentaries about the paper. Francois et al. wrote a criticism to which Ben-Zvi et al. responded. Read these commentaries. They certainly provide things to think about!