BE 159: Signal Transduction and Mechanics in Morphogenesis

Justin Bois

Caltech

Winter, 2017

Questions to consider: Mayer, et al., "Anisotropies in cortical tension reveal the physical basis of polarizing cortical flows"

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. In the main text, the authors use the word "tension," but in the supplement, the word "stress" is often used. What is the difference?
2. The authors state that viscous dissipation resists compression of the cortex. This seems a bit at odds with how we usually think of viscosity as resisting shearing motions. How do viscous stresses resist compression in the context of this paper?
3. How does particle image velocimetry (PIV) work? This technique is used in many studies of developmental processes and measurement of forces exerted by cells.
4. What is RNAi? How is it used in this paper?
5. What is Cytochalasin D? What does it do?
6. The authors claim to identify prerequisites for cortical flow. What are they? How were they deduced?
7. What is a kymograph? (You saw this in the Soroldoni, et al. paper, but the context is a bit different here.) How is it interpreted?
8. What is the "hydrodynamic length scale" the authors refer to? What is its significance? How does it relate to the ideas presented in our first paper by Howard, et al.?
9. Why should measured cortical tension be different in the direction of flow versus the orthogonal direction?
10. Why is it so important to know that the response of the cortex to ablation is proportional to the initial outward velocity? Can we get the constant of proportionality?

11. What is meant by the term "viscoelastic"? Why do the authors treat the cortex as an elastic solid during ablation, but as a viscous liquid when treating its flow?
12. What is meant by "active tension?"
13. What is the difference between anisotropy in cortical tension and a cortical tension gradient?
14. Why might the pseudocleavage furrow have high orthogonal tension?
15. Though not discussed in the paper, it is an intriguing problem to speculate on why myosin motor activity serves to contract the cortex, as opposed to expanding it.
16. What to the authors mean when they say that the "flows are subject to biochemical feedback"?
17. Why can the authors not obtain numerical values for stress (tension), viscosity, and friction?
18. The biological sciences are full of cute acronyms. Is COLA a cute acronym? Do you have another suggestion? I think SAMURAI would be cool, "Severing of Acto-Myosin UndeR An Intense light."