Abstract

Epithelial tissues line the cavities and surfaces of blood vessels and organs throughout the body. In monolayer epithelia the cells are single-layered without overlapping.
Mathematically one can treat monolayer epithelial cells as polygons defined by the number of neighbors of a cell. Empirical studies found that monolayer epithelial cells of many evolutionarily very distant species like Fruit Fly, African Clawed Frog, Hydra, *Anagallis* (a flower) and Cucumber exhibit nearly identical proportions of k-sided cells. In [1], it is theoretically demonstrated that these distributions may arise as a direct mathematical consequence of cell proliferation. The mechanism for choosing the cell division cleavage plane is still unknown. Focusing on comparing the fit with the data for various hypotheses, the simulation studies reported in [2] support this conjecture.
Following their idea, we independently wrote an algorithm to simulate the process of epithelial cell proliferation, allowing us to implement new options of choosing the cleavage plane. Some of the latter options are giving better fit than all the ones in [1, 2]. It therefore seems plausible that actual mechanisms for choosing the cleavage plane are similar to one of these options.

References

[1] M. C. Gibson, A. B. Patel, R. Nagpal, N. Perrimon (2006) Emergence of geometric order in proliferating epithelia. *Nature* 442: 1038–1041.

[2] A. B. Patel, W. T. Gibson, M. C. Gibson, and R. Nagpaul (2009); Modeling and Inferring Cleavage Patterns in Proliferating Epithelia. *PLos Computational Biology* 5(6), e1000412