

ANALYSIS AND MODELING OF CELL MECHANICS

Homework #5 (due 5/15/09)

The learning objective of this homework is to better understand the foam mechanics model, how it relates to the architecture of the cytoskeletal and how changing the assumptions of the model can better match the experimentally measured cell mechanics data.

Dewey & Satcher modeled the actin cytoskeleton as a three-dimensional foam. In many cells, however, actin forms a thin layer underneath the membrane that supports the structure. With this consideration, it may be more appropriate to model the actin network as essentially a two-dimensional "sheet" that is only one fiber layer thick but with a repeated foam unit structure that spans the plane of the sheet.

- 1) Draw the two-dimensional version of the foam unit cell in a similar fashion to the illustration in Fig. 4 of Dewey & Satcher's paper.
- 2) Derive the equation relating the relative elastic modulus to the relative actin network density.
- 3) Given that $\rho_s = 800$ mg/ml, $\rho^* = 10$ mg/ml, $E_s = 1$ GPa for F-actin, how well does this new equation predict cell stiffness as compared to the experimental results? Please cite examples.