BE 159 Winter 2017
Homework #6
Due at 5pm, March 15, 2016, either via email or JB's mailbox

Problem 1 (Adhesion and tension by looking)**.**
Several times in class we talked about how careful thinking ahead of experimentation can open doors for new inquiries. A key component of the Maître, et al. paper was the analysis of the force balances of doublet and triplet geometries of cells. In this problem, you will work through the theory to arrive at an equation that can be used to interpret the doublet experiments. Specifically, you will derive equation 1 of the Maître, et al. paper,

$$\cos\theta = \frac{2\gamma_{\mathrm{cc}} - \omega}{2\gamma_{\mathrm{cm}}}, \tag{1}$$

where the terms refer to Fig. 1A of the paper. To start with, explain why the total energy of the double can be written as

$$E = 2\gamma_{cm}A_{cm} + (2\gamma_{cc} - \omega)A_{cc}. \tag{2}$$

You can then use this expression to derive equation 1. *Hint*: It may be useful to recall the formulas for the surface area and volume of a spherical cap. Imagine was have a sphere of radius R. We then slice off a spherical cap. If we put the spherical cap on a table, its height is h. The surface area and volume of the cap are respectively

$$A_{\mathrm{cap}} = 2\pi Rh, \tag{3}$$

$$V_{\mathrm{cap}} = \frac{\pi h^2}{3}(3R - h). \tag{4}$$