

CELL-MATRIX MECHANICS

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**Homework #3  
Answers**

**Effects of mechanical forces on cells in culture.**

A bioengineer has been investigating the effects of mechanical strain on cells grown on a flexible polymeric membrane *in vitro*. The apparatus stretches the polymeric membrane, to which the cells are attached. The bioengineer has run a series of experiments in which she has changed the maximum strain in the flexible membrane in the center of the circular culture dish. After 2 hours, the bioengineer recovered all of the medium in the culture dish and measured the amount of a particular protein synthesized by the cells, which is reflective of the cell response. She plotted the graph in Fig. 1. You are to assist the bioengineer in interpreting her results.

**a. If the experiment was performed using the apparatus shown in Fig. 2a, which transduction mechanisms might explain the direct effects of mechanical strain on the cells in the regions (1) between points A and B, (2) between B and C, and (3) between C and D?**

(1) between points A and B the initial cell response to the increasing strain might be the activation of membrane-bound enzymes. Alternatively the opening of increasing numbers of stretch-activated ion channels with increasing strain.

(2) between B and C, the sudden increase in the response may be due to the opening of stretch-activated ion channels. Alternatively, breach in the cell membrane due to “cell wounding.”

(3) between C and D irreversible rupture of the cell membrane and cell death.

**b. If the experiment was performed using the apparatus shown in Fig. 2b, would your interpretation of the data change? If so, why and how?**

It would be more difficult to assess the effects of the strain in the membrane on which the cells are grown in Fig. 2b, because of the non-uniform strain at various locations on the membrane. Cells at locations of high strain would respond before other cells and release regulatory molecules that could have a paracrine effect.

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