BMT-72106 Cellular Biophysics
Exercise 1, 22.3.2019

Contact assistant: Aapo Tervonen, aapo.tervonen@tuni.fi
Remember to submit the exercises via Moodle before the exercise session!

Exercise 1.
Shortly explain the following terms

a) Protein quartenary structure

b) Young's modulus

c) Mechanotransduction

Exercise 2.
Extracellular matrix (ECM) forms the extracellular part of tissues. ECM consists of many kinds of molecular components. Which are the main molecular components in ECM? Describe their structure and main functions.

Exercise 3.
Explain the working principle of atomic force microscope (AFM). How it can be used to study the protein folding and interactions between proteins? Further, explain what is happening in the result plot from AFM below, including what the axes describe.

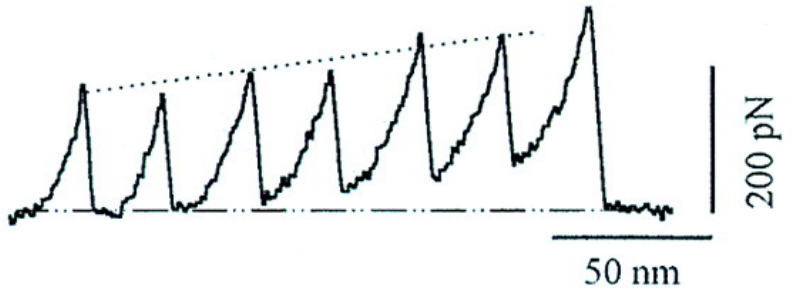

Figure 1: Result plot from AFM measurements.

Exercise 4.
Molecular dissociation constant can be calculated as

$$K_d = \frac{k_r}{k_f} = exp\left(-\frac{\Delta E + F\Delta x}{k_B T}\right), \tag{1}$$

where k_r is the unbinding reaction rate and k_f is the binding reaction rate. Avidin protein binds biotin extremely efficiently, K_d[biotin-avidin] $= 10^{-14}$. Antibodies bind to their epitopes also really well with K_d[Ab-epitope] $= 10^{-10}$. However, when the force needed for unbinding was measured by using AFM, the force needed for biotin-avidin unbinding was observed to be about 50 pN, but for antibody-antigen pair it was measured to be about 200 pN. Explain why this sounds strange and what the possible cause is for this by using the above equation and schematic figures below.

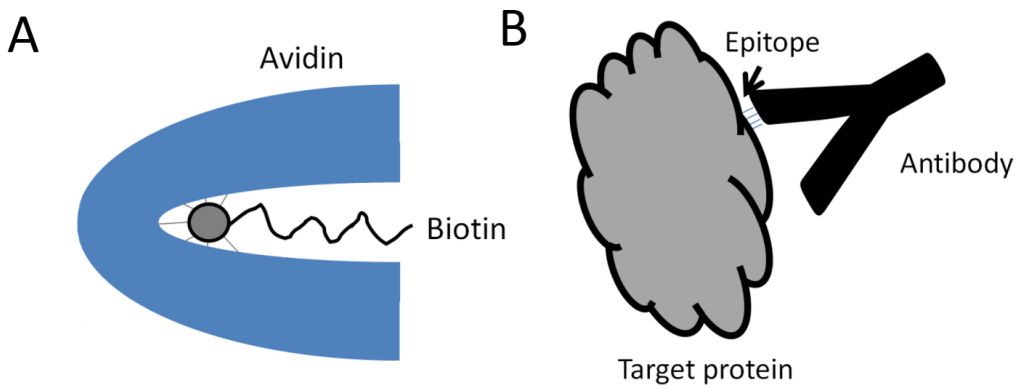

Figure 2: Schematic presentation of A) biotin-avidin binding and B) antibody-epitope binding.