WS 14/15: Interactions of Proteins and Nucleic Acids
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Biophyscial Concepts and Theoretical Descriptions

Tuesday 14.15-15.45 Room 044 BioQuant

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Winter term 2014/15
Interactions of Proteins and Nucleic Acids
- Biophysical Concepts and Theoretical Descriptions
- Techniques and Applications

Summer term 2015
Physico-chemial methods in Systems biology
within the Major Systems Biology

Lecture web pages

Overview on learning Biophysics in Heidelberg
http://malone.bioquant.uni-heidelberg.de/teaching

Material for the lecture: Biophysical concepts and theoretical descriptions
http://malone.bioquant.uni-heidelberg.de/BPC_2014/BPC_1+2.html

Username: teaching
Password: nonukes

(currently not active)

Biophysical Concepts and Theoretical Descriptions

- Intro protein-DNA/RNA interaction and epigenetics
- The energy, length and time coordinate system
- Diffusion and hydrodynamics
- Equilibrium binding of proteins and nucleic acids
- Kinetics of protein-DNA interaction
- Dynamic interactions in the cell nucleus
- Chromatin - organization and genome access
- Interactions mediated by DNA/chromatin looping
- Mapping protein-DNA/RNA interactions by deep sequencing

Techniques and applications

- Quantitative molecular biological methods: electrophoretic mobility shift assay, filter binding etc.
- Spectroscopy: absorbance, circular dichroism, fluorescence
- Fluorescence microscopy based methods to study interactions of proteins and nucleic acids in living cells (imaging, FRAP, FC(C)S; FRET)
- Other biophysical methods (e.g. AUC, AFM, surface plasmon resonance, microscale thermophoresis)
- Chromatin analysis by genome-wide sequencing

Literature

K. E. van Holde, W. C. Johnson, & S. P. Ho, Principles of Physical Biochemistry, Prentice-Hall, 1998; 2nd edition 2005

C. Cantor und P. Schimmel, Biophysical Chemistry, Vol I, II und III, Freeman Press, 1980

M. Daune, Molecular Biophysics, Oxford University Press, 1999

P. Nelson, Biological Physics, Freeman, 2004.

V. A. Bloomfield, D. M. Crothers & I. Tinocco, Nucleic Acids Structures, Properties, and Functions, University Science Books, 2000.

Rippe, K., ed. Genome organization and function in the cell nucleus, 594 pages, Wiley-VCH, Weinheim, 2012

Research articles (see lecture web site)

Computer programs

Viewing 3D protein and DNA structures: VMD (Visual Molecular Dynamics)
http://www.ks.uiuc.edu/Research/vmd

Kinetic simulations: Copasi (is being developed by the group of Ursula Kummer in the BIOQUANT)
http://www.copasi.org

Calculations and plotting: e. g. Maple, Mathematica, Excel, Origin, Kaleidagraph

For “benotete Scheine” there are three options:

1. Problem sets (preferred option if not too many participants)

- Starting next week there will be problem sets (8-10 total)
- These have to be returned until the following week, beginning of lecture
- Answers to the problem set (and any problems) are discussed
- Corrected problem sets are returned the next week
- ≥ 50 % of the possible points have to be obtained
- There is one bonus problem set, i. e. one get 100% with one missing

2. Written examen

- about 20 questions at the end of the term, grading similar to problem set

3. Seminars (needs small number of participants)

- one original paper to be presented and 1-2 reviews for overview on topic
- 25 minutes presentation and 5 minutes discussion
- max 1-2 seminars per session

Problem sets (needed for “benotete Scheine”)

- Starting next week there will be problem sets every 1-2 weeks (8-10 total)
- These have to be returned until the following Tuesday, beginning of lecture
- Answers to the problem set (and any problems) are discussed
- Corrected problem sets are returned the next Tuesday
- ≥ 50 % of the possible points have to be obtained
- There is one bonus problem set, i. e. one can get 100% with one missing