

## Networks in Biology, June 2008

Pensum:

Chapter 1: page 1-6, Chapter 7a: page 1-49, Chapter 7b: page 1-19 (-dead end), 20-21, 25-36, 42-47. Chapter 8a: 1-43 end. Chapter 8b: 16-37

- 1) Phage lambda, The genetic switch: Describe the lambda system, the basic network motif for the genetic switch (CI vs. Cro), stability considerations, initial decision process (CII versus Cro, briefly). (focuss: Chapter 7, page 10-25, 42-48).
- 2) The partition function method for calculating promoter activities. Formalism and examples, from lambda and designed combinatorial regulation. In what way does non-specific binding influence results? (focuss: Chapter 7a, page 25-41, chapter 8a: 30-32).
- 3) Non-specific binding, timescales for protein binding to operator and promoter activity: On-rate considerations, off rates, how they are modified by non-specific bindings. (focuss chapter 7a: 33-35, chapter 7b: 1-10)
- 4) Transcriptional interference. Basic model for promoter activity, and how promoters could give bunched activity (slow transcription factors, or supercoil mediated recruitment) (focuss chapter 7b: 10-16middle, fano factor 17-19, 20-21 until eq. 48).
- 5) Nucleosome mediated Epigenetics: What is essential ingredients in model, basic equations for 2-state model, relation to Kramers escape problem (prediction of stability with system size). (focuss on Chapter 7b, 25-35, fig 22, 43-47)
- 6) Networks, basic concepts and models that give scale free networks: Random network, cliques, relationship to simple matrix manipulation, outline the 3 models that give scale free networks, argue for power laws in at least one of them. (focuss chapter 8a: page 1-26)
- 7) Heat shock, how it works, relationship to unfolded proteins, basic network motif and where the motif is also seen. Relationship to p53 motif and LexA-recA motif. (focuss chapter 8a: page 32-43)
- 8) Metabolic regulation: Fe regulation as combined motif. Motifs with examples, Logic of feedback, Socialist, Consumer, Fashion and Collector motifs. (focuss Chapter 8b: 17-24, 24-31)
- 9) Regulation with sRNA: Fe regulation, what is advantages/disadvantage with sRNA regulation of iron using proteins. sRNA and sharp responses, sRNA speed, sRNA and sorting. (focuss chapter 8b: 24-31, 32-34)