Viral DNA as a model for coil to globule transition

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LITA (Segrate)

DNA AS A MOLECULAR MODEL

DNA for modeling particles at finite valence
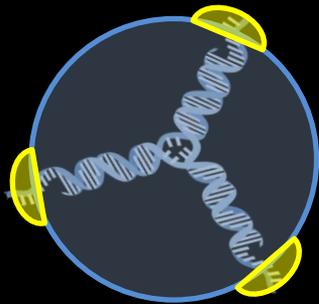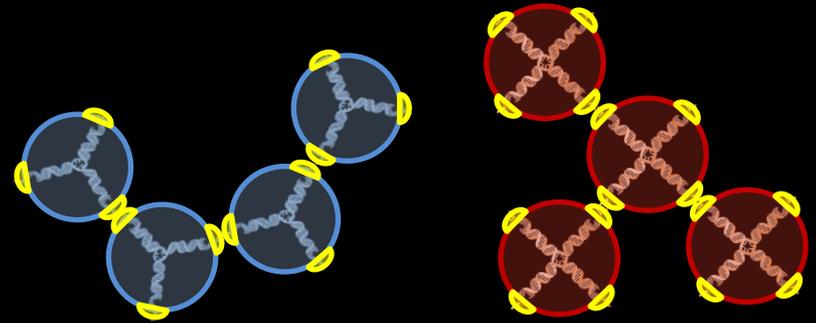
3-valence
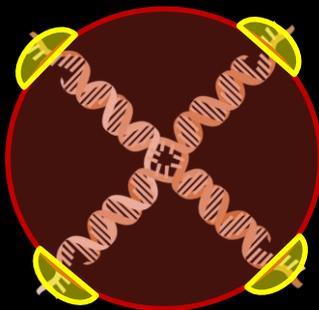
4-valence

(last year)

Liquid cristalline phases of DNA

Once upon a time (last year)
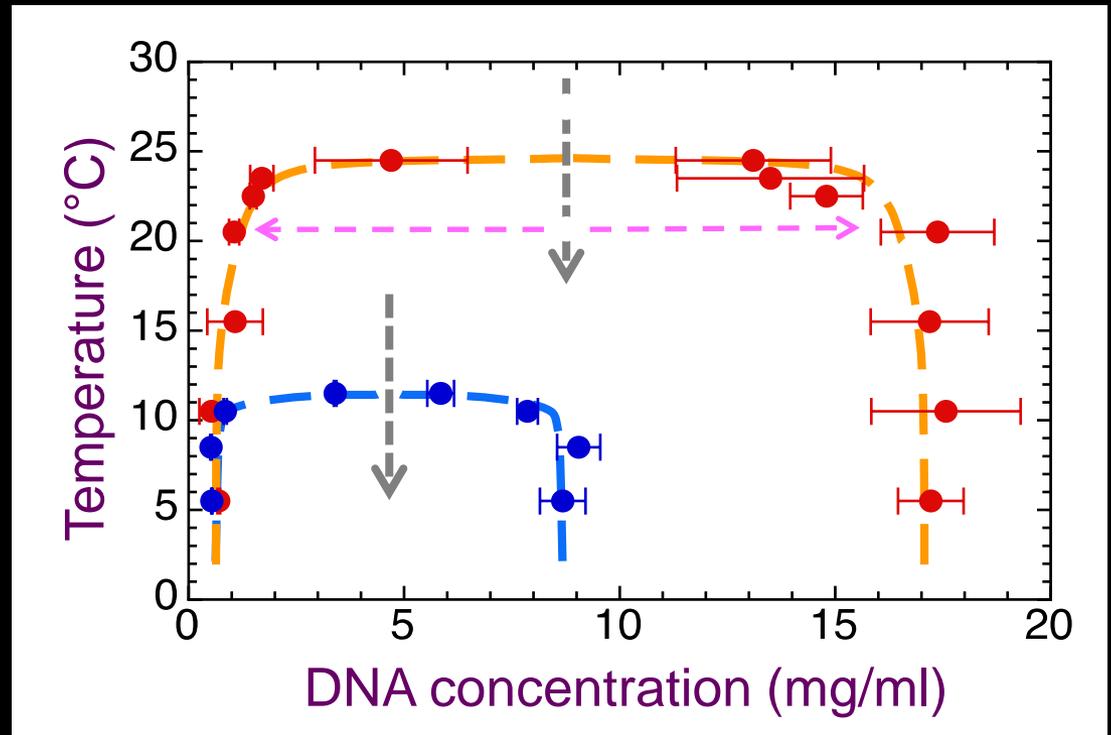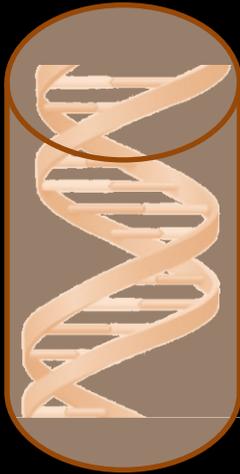
Liquid cristalline phases of DNA
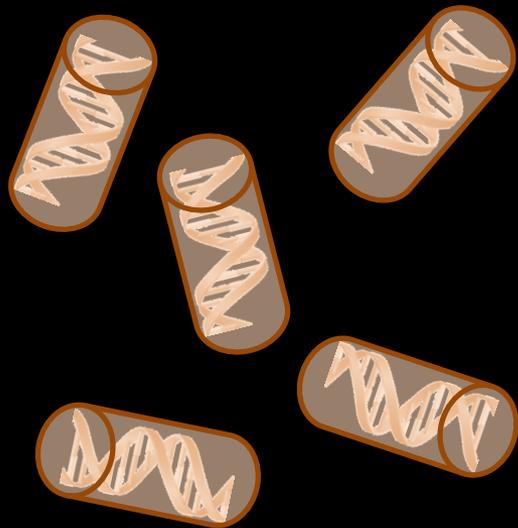
high concentration
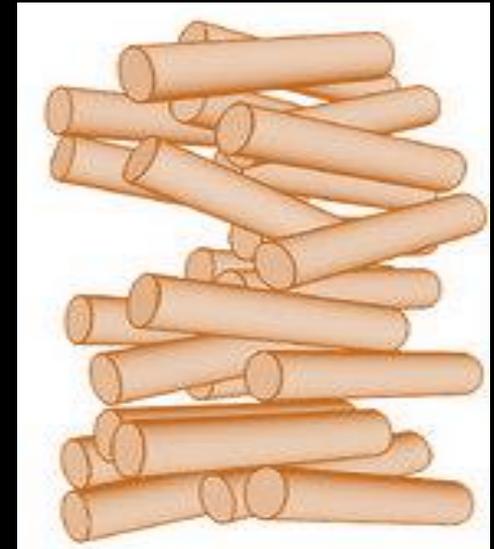
Properties of DNA ⟶ properties of the LC phase

M. Rossi *et al.* PRL **110** 107801 (2013)

Applications:

DNA nanotechnologies

Chromosomes

packing
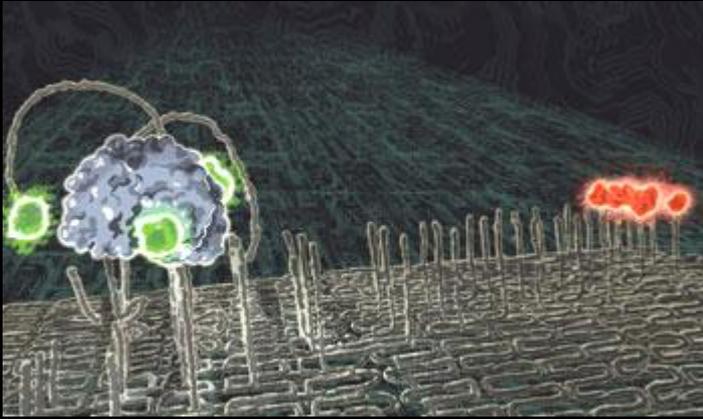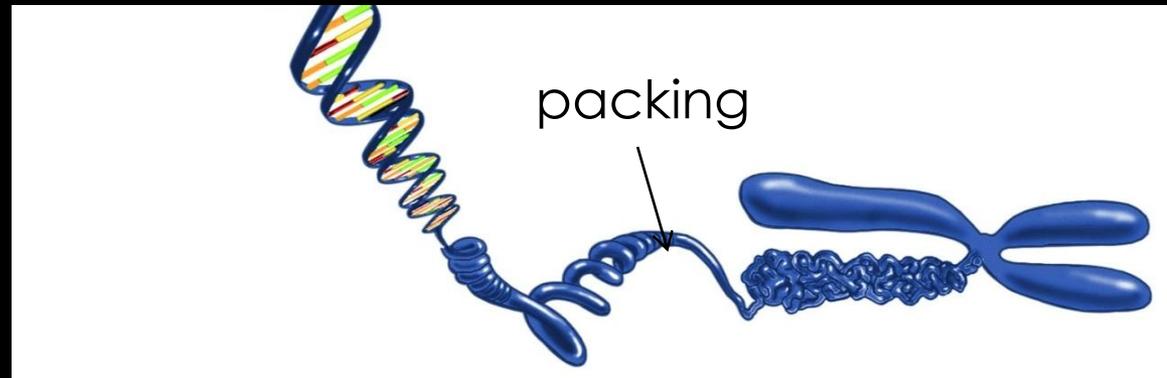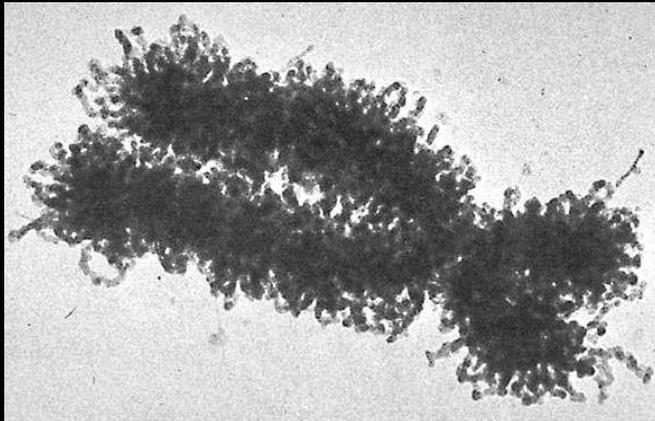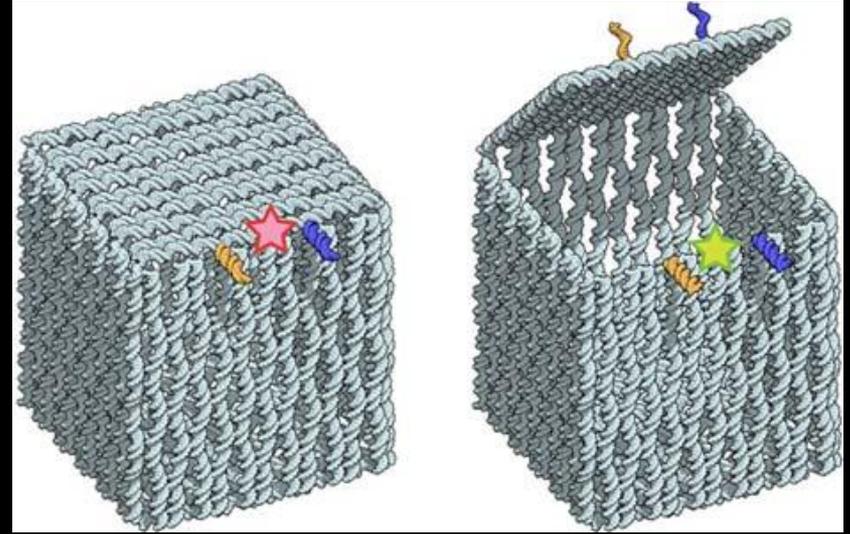
Human Chromosome 12 -electron microsocopy, E. Du Praw

Why DNA?

- Well known structure
- Selective interactions
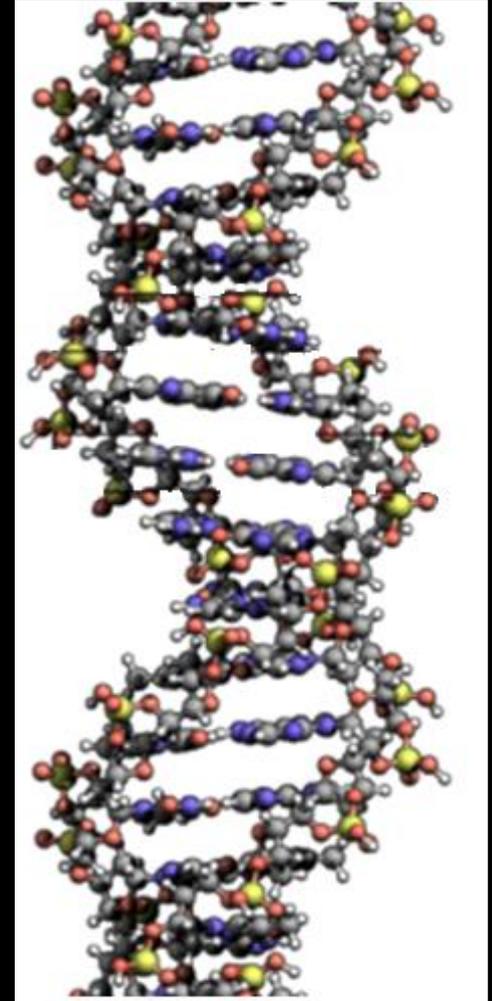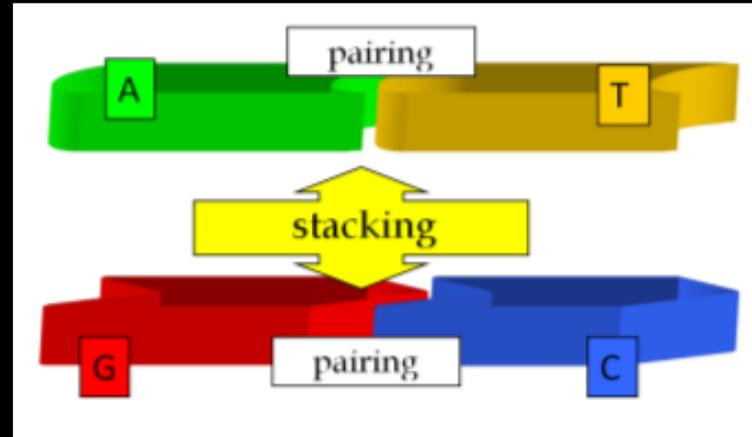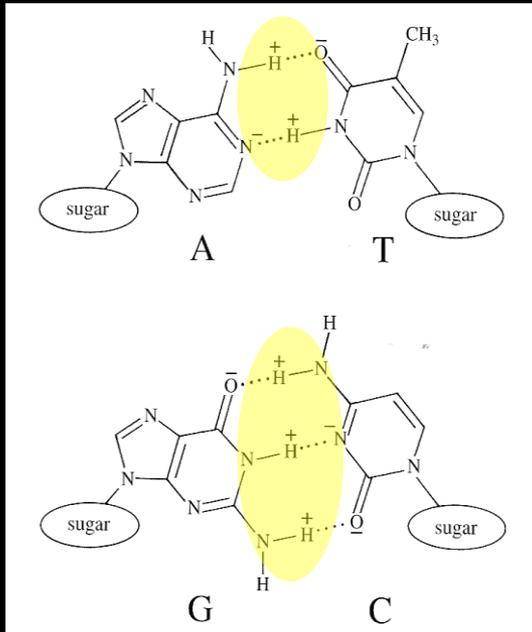
- Tunable interactions (temperature, ionic strength, concentration,..)

CHAPTER 2

(Today)

DNA to study coil to globule transition

Protein folding

Nature **401**, 400-403 (1999)
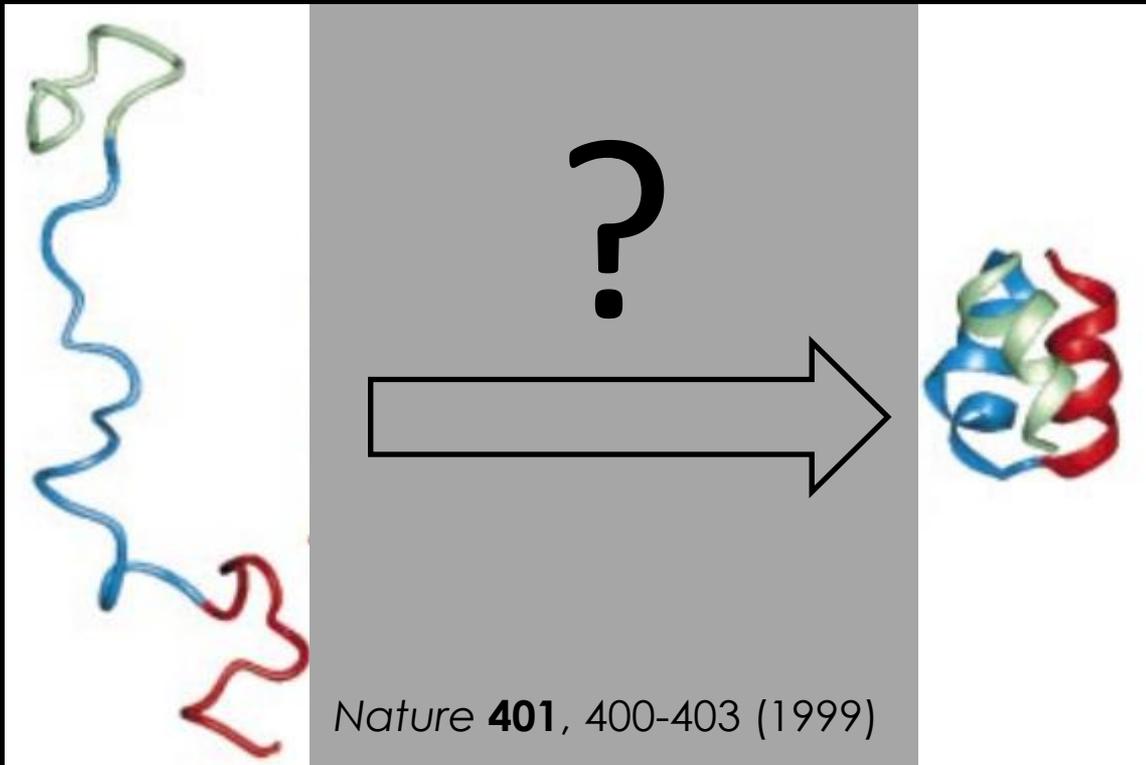
Denatured state
Not functional

native state
Functional

Protein:

Non specific interactions

- hydrogen bonds   - Van der Waals
- hydrophobic
- electrostatic
- steric

Sequence $\longrightarrow$ unique3D folded structure

Protein:

Non specific interactions

- hydrogen bonds   - Van der Waals
- hydrophobic
- electrostatic
- steric

Sequence $\longrightarrow$ unique3D folded structure

Unresolved questions

• how does the native structure result from the **interatomic forces** ?

• how can the native structure be predicted from the **sequence** ?

• how can a protein fold so **fast** ?

Why folding process?

- change of native structure
  - Tau protein/ a-synuclein :
    Alzheimer's and Parkinson's deseases

Healthy Brain Cell   Parkinson's Brain Cell

"clogged" garbage disposals (lysosomes)

S. Orenstein and Dr. E. Arias, Albert Einstein College of Medicine

Unaffected Microtubules

Tau proteins

Alzheimer's Disease Microtubules

Phosphate groups

Neurofibrillary tangle
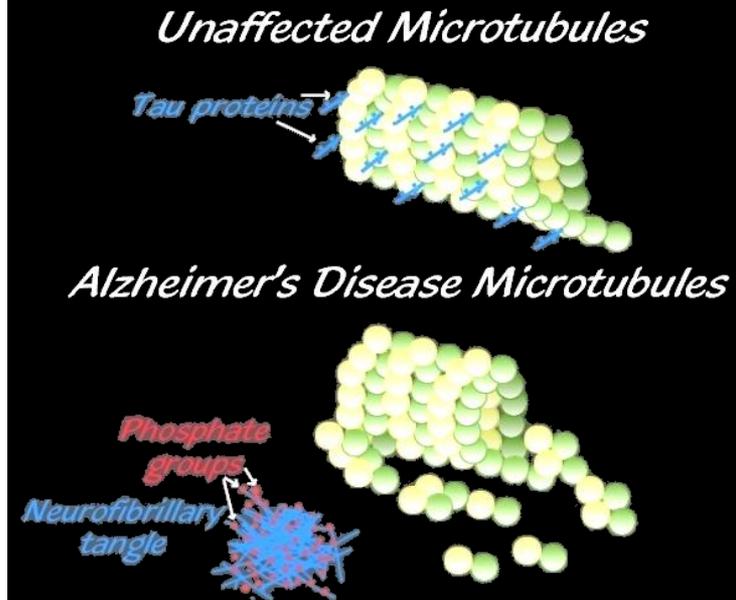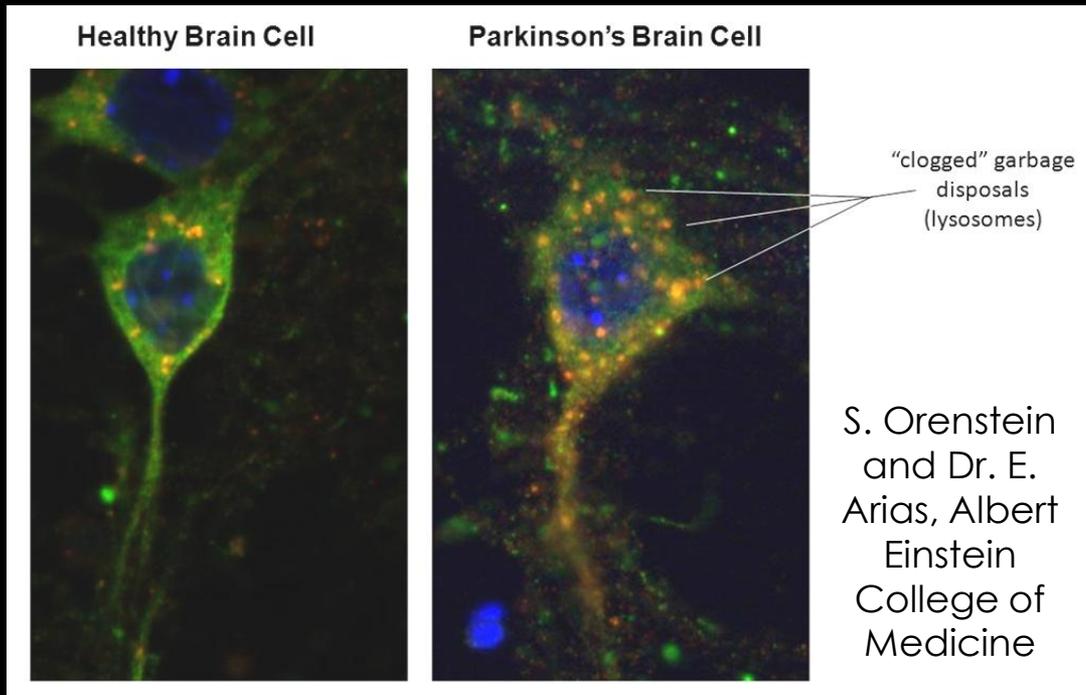
- Protein inhibition
  - HIV-1-protease

DNA: a model for proteins

Viral sDNA: a heteropolymer

AFM image of filamentous phage
Mol. Biol. **13**, 51

100 nm

DNA: a model for proteins

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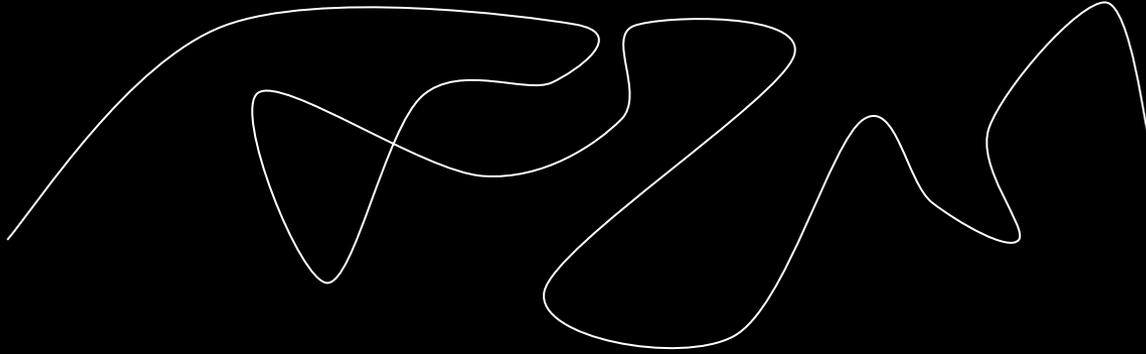
AFM image of filamentous phage
Mol. Biol. **13**, 51

DNA: a model for proteins

Viral sDNA: a heteropolymer

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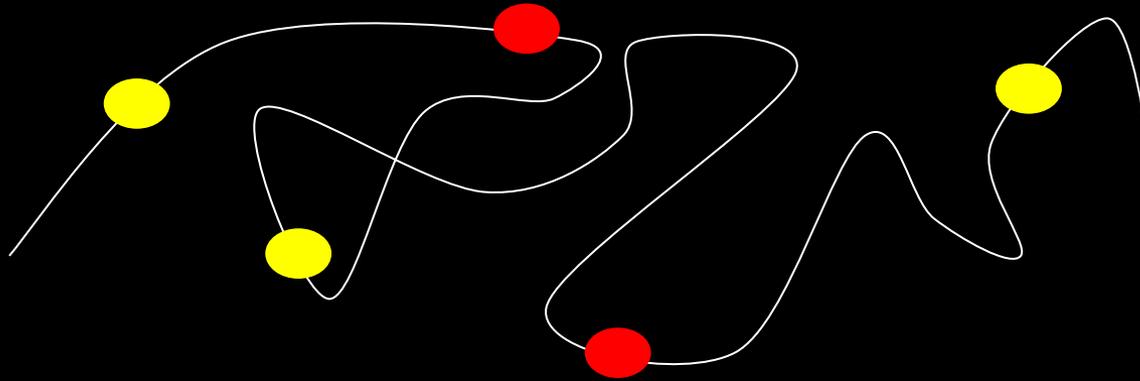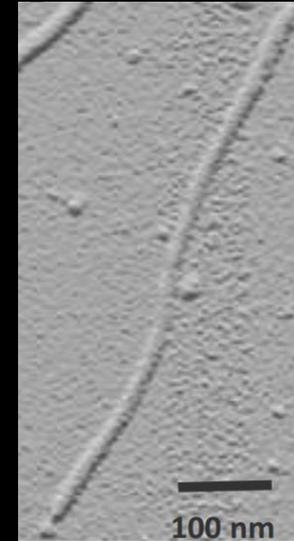
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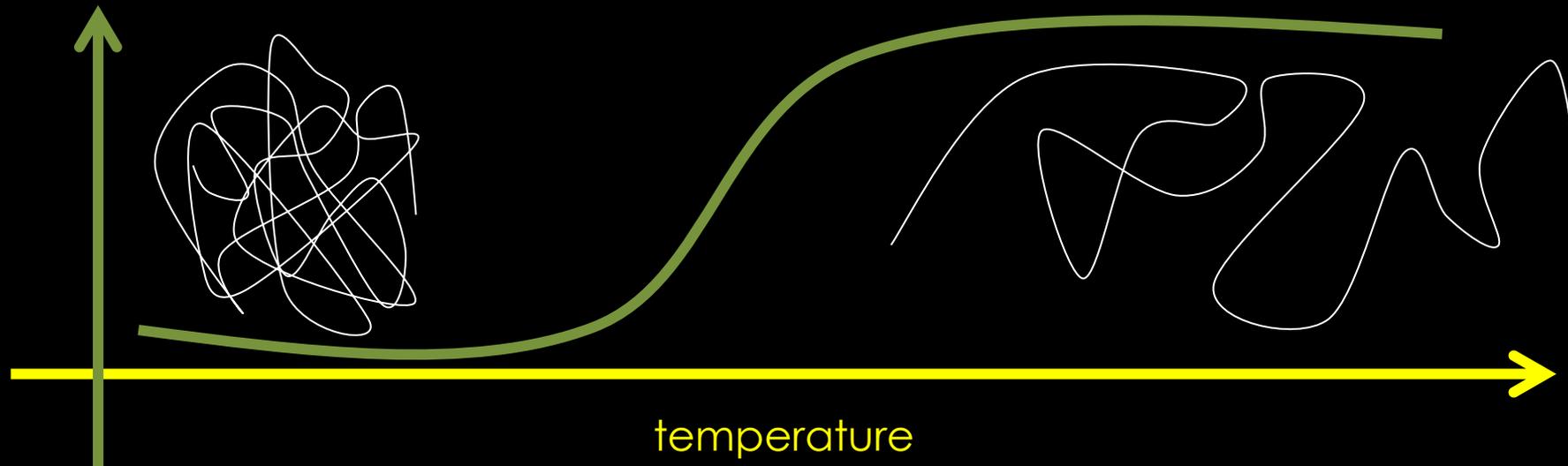
temperature

M13mp18 – 5000 bases out of 7000

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Specific interactions: does the transition change?
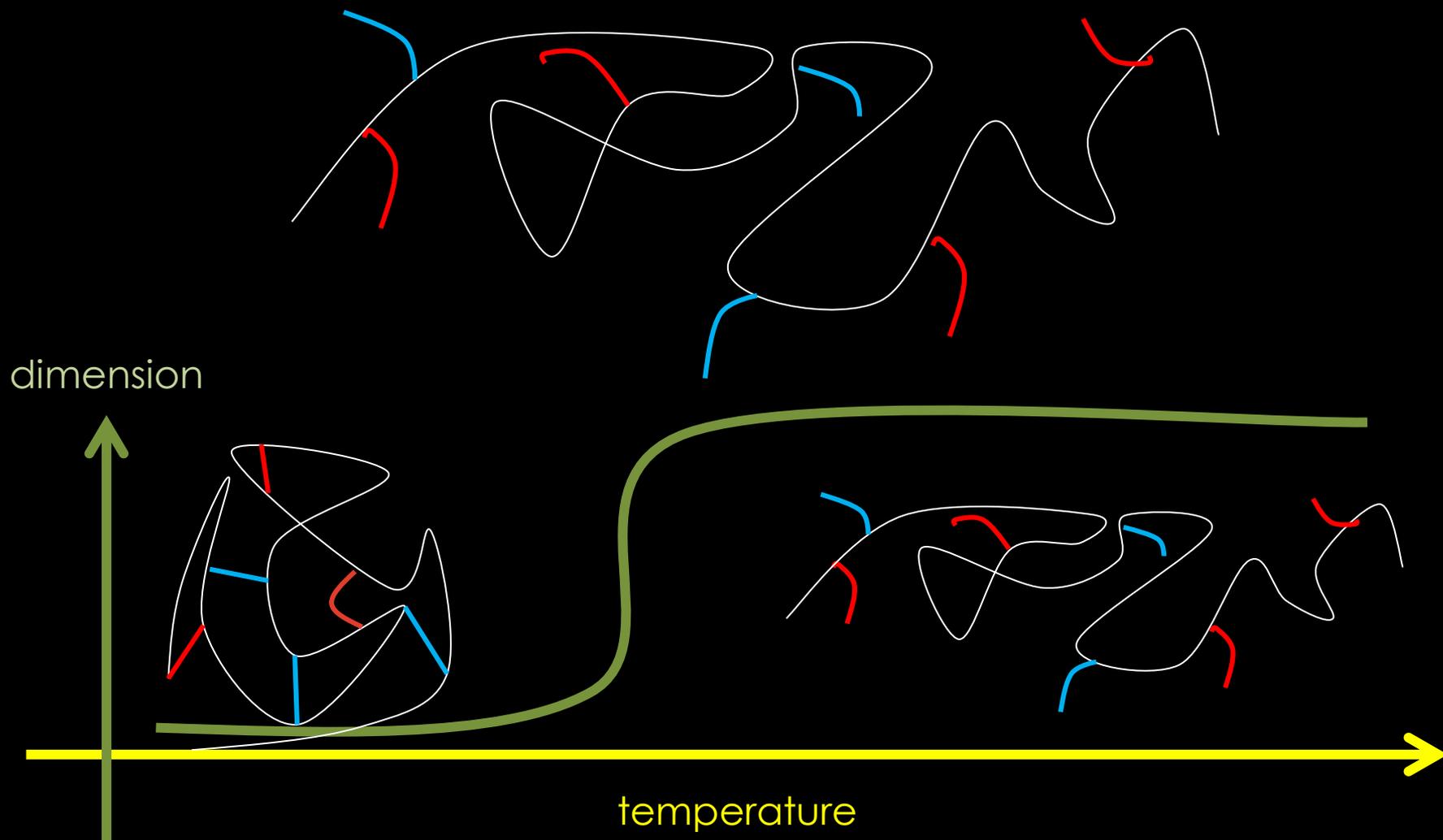
Unresolved questions

Does linear sDNA fold?

How does local/cooperative is the process?

Is there a DNA theta point?

How important is topology?

Thanks for the attention!

And they lived happily ever after