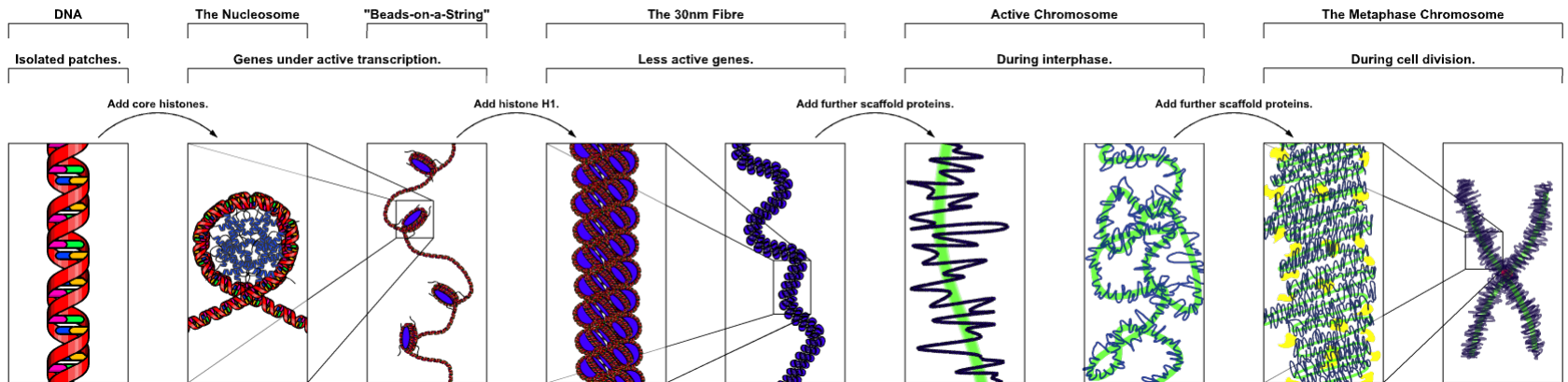
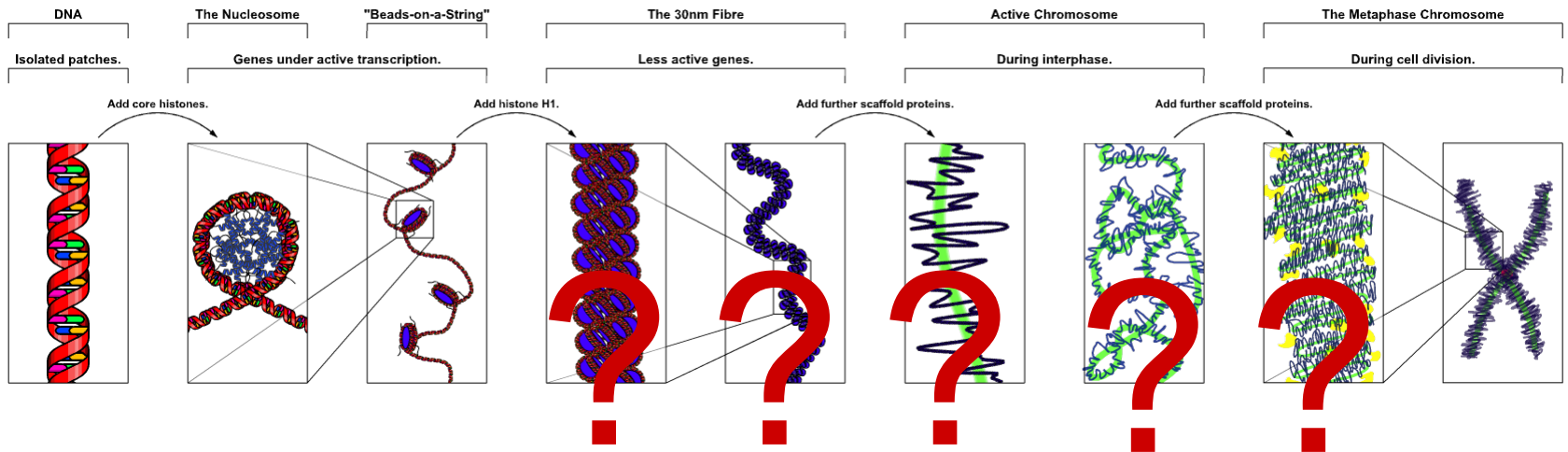


DNA has multiple levels of organization



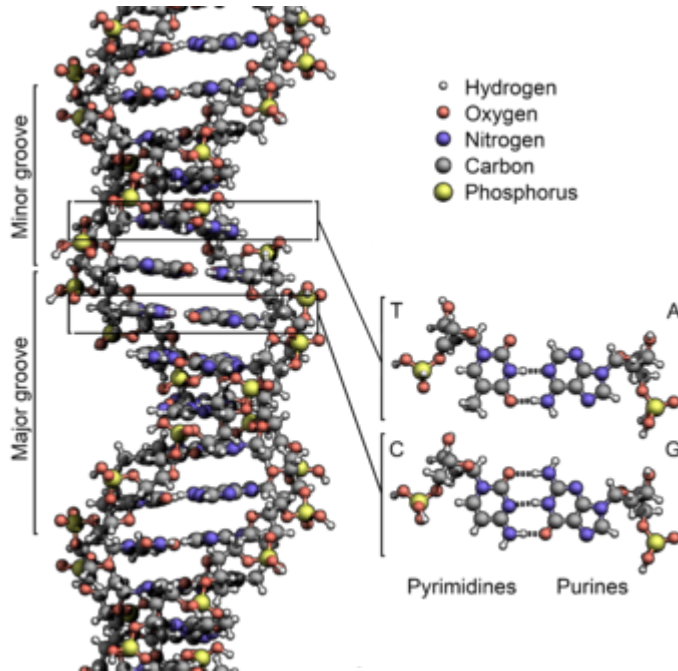
from Wikipedia entry for "Chromatin"

DNA has multiple levels of organization



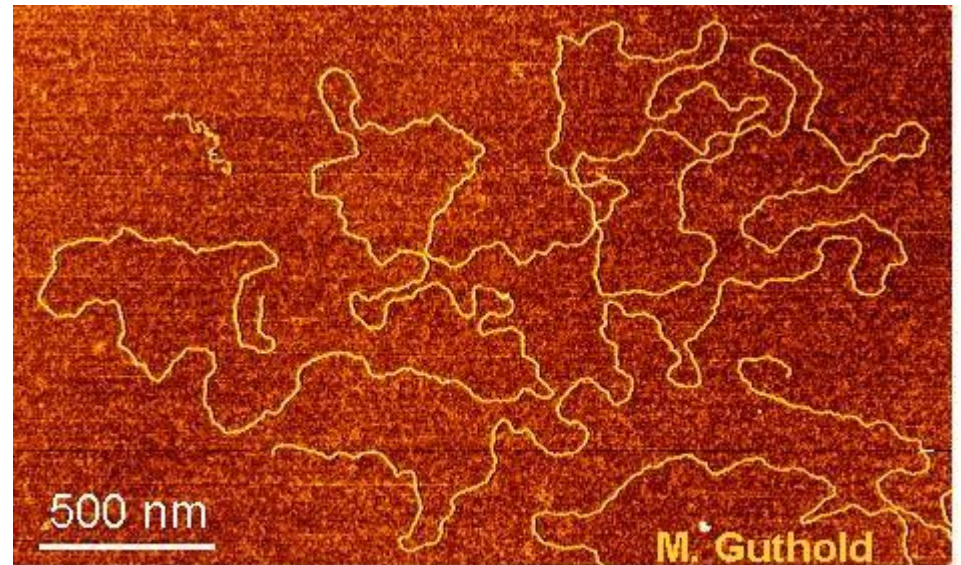
from Wikipedia entry for "Chromatin"

Naked DNA



from Wikipedia entry for DNA

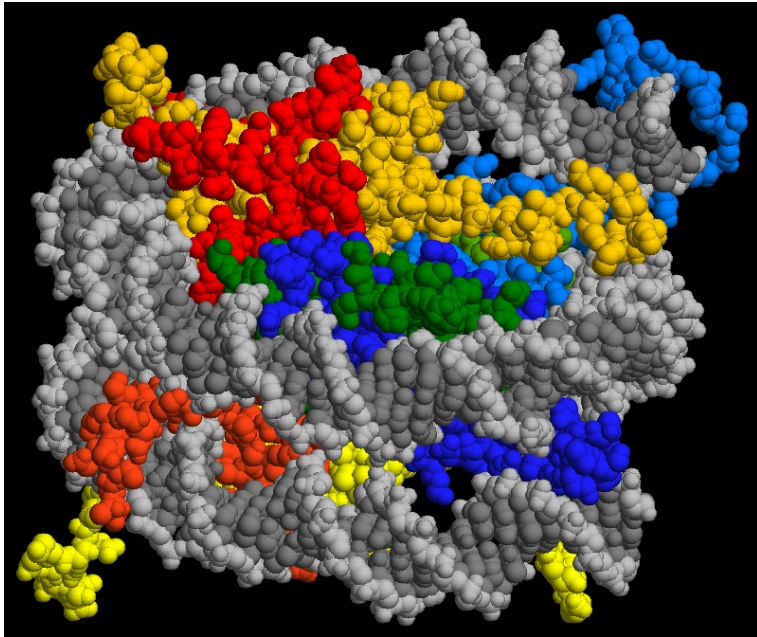
- highly charged ($\sim 1e / bp$)
- Kuhn length ~ 106 nm or 310 bp
- the largest human chromosome would have gyration radius of ~ 100 micron (SAW)



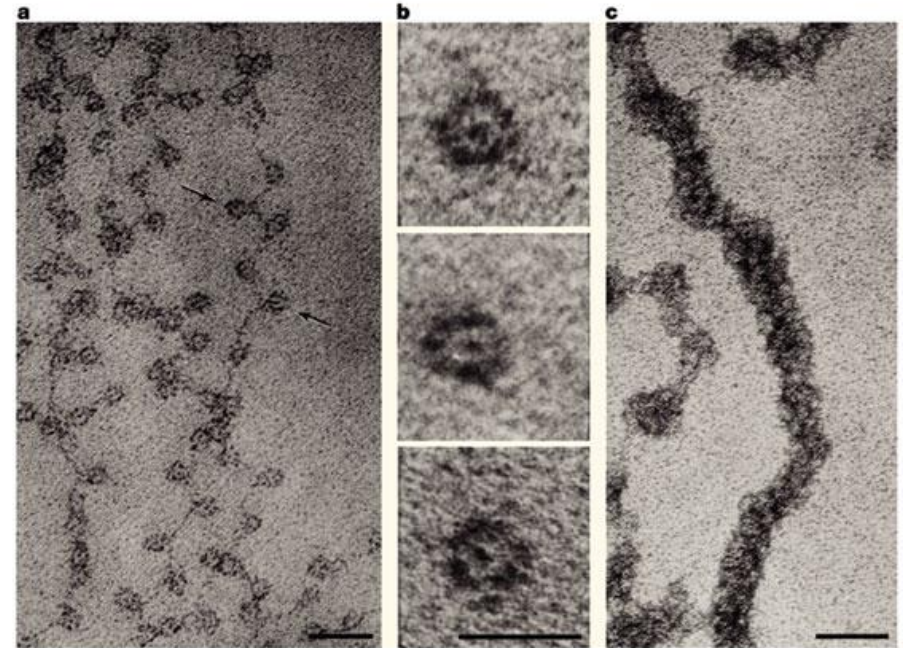
λ -DNA

AFM image of Lambda DNA (~ 16 micrometers long),
from M.Guthold website

Nucleosomes provide the second level of DNA organization



from Wikipedia entry for "Nucleosome"



Nature Reviews | Molecular Cell Biology

from D.E. Olins and A.L. Olins, *Nature Reviews Molecular Cell Biology* **4**, 809-814 (October 2003)

- 146 bp / nucleosome + ~10 bp / linker
- neutralize ~50% of DNA negative charges
- interact with each other to form higher-order fibers (parameters are still discussed)
- provide additional linear compaction of ~5-50, depending on salt conditions and state of nucleosomes
- can have hundreds of different biochemical modifications providing extra informational storage