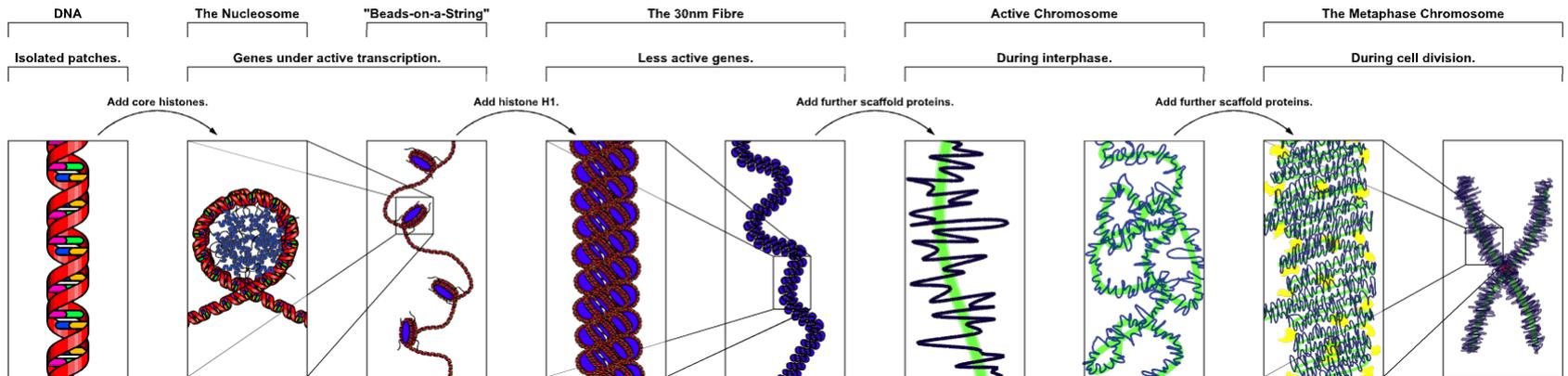
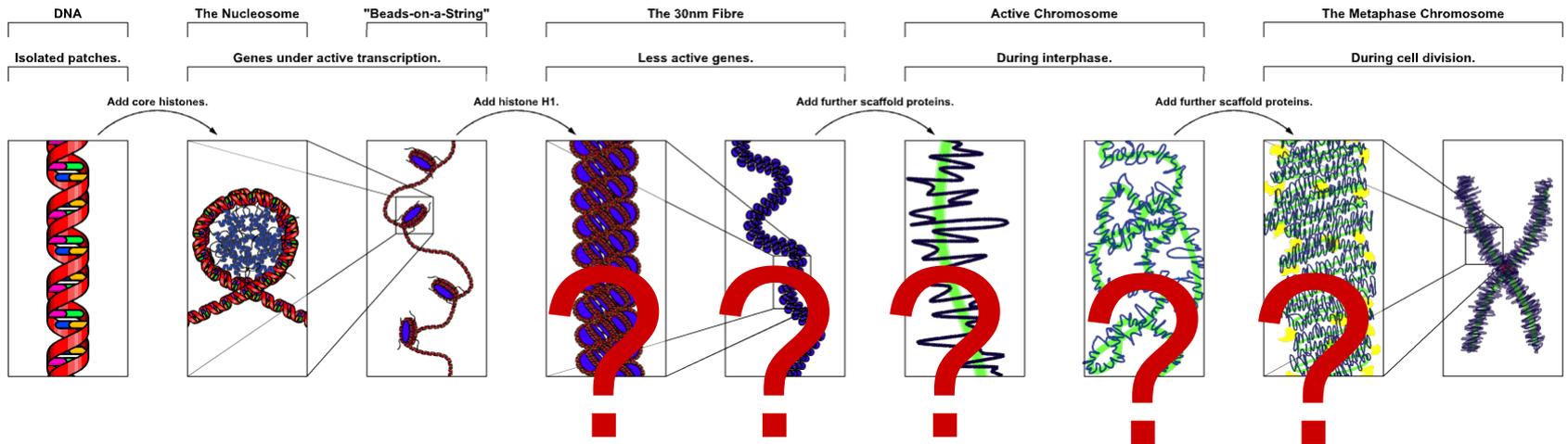


# DNA has multiple levels of organization



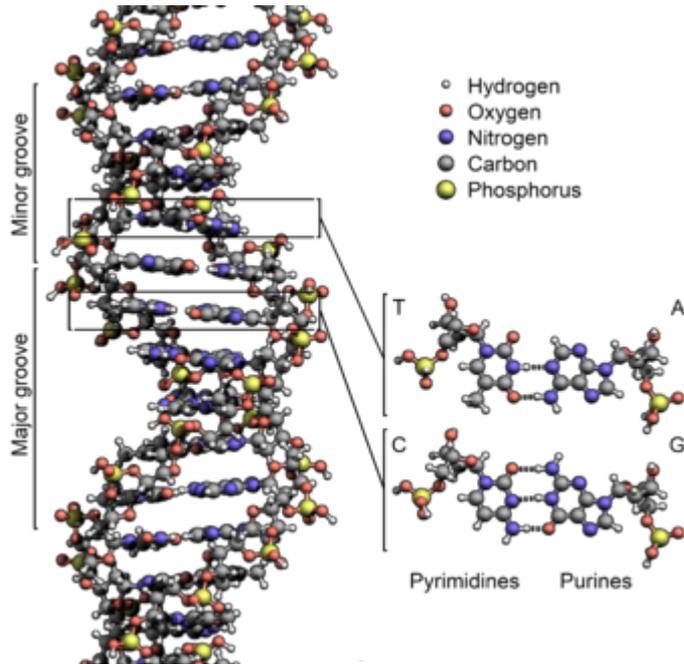
from Wikipedia entry for "Chromatin"

# DNA has multiple levels of organization

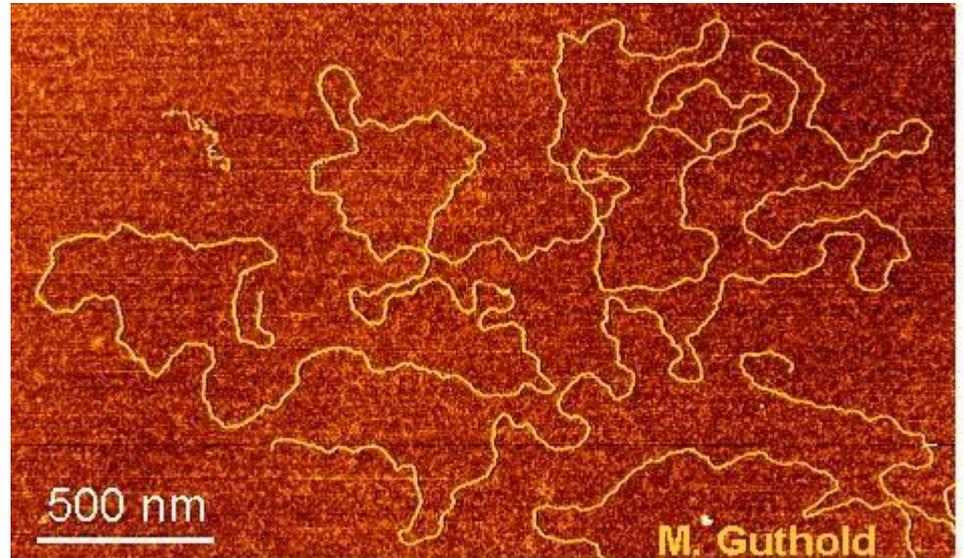


from Wikipedia entry for "Chromatin"

# Naked DNA



from Wikipedia entry for DNA

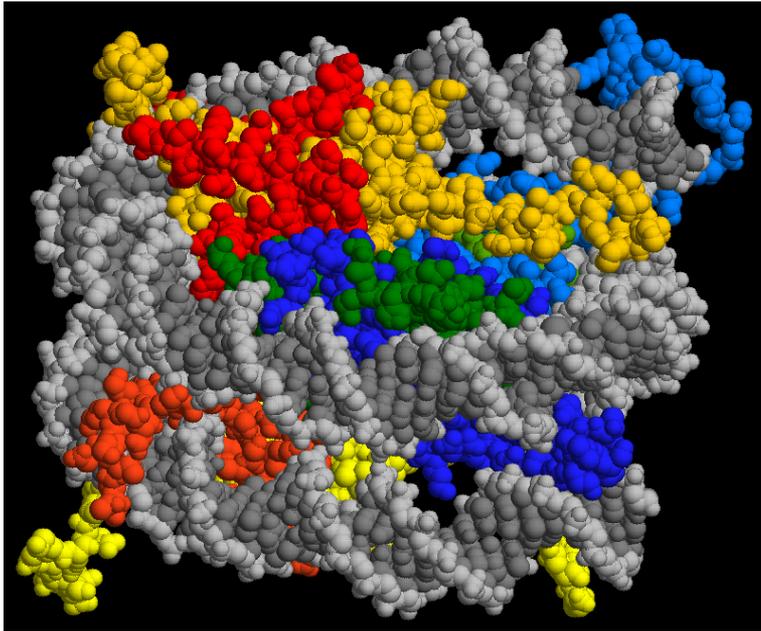


$\lambda$ -DNA

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

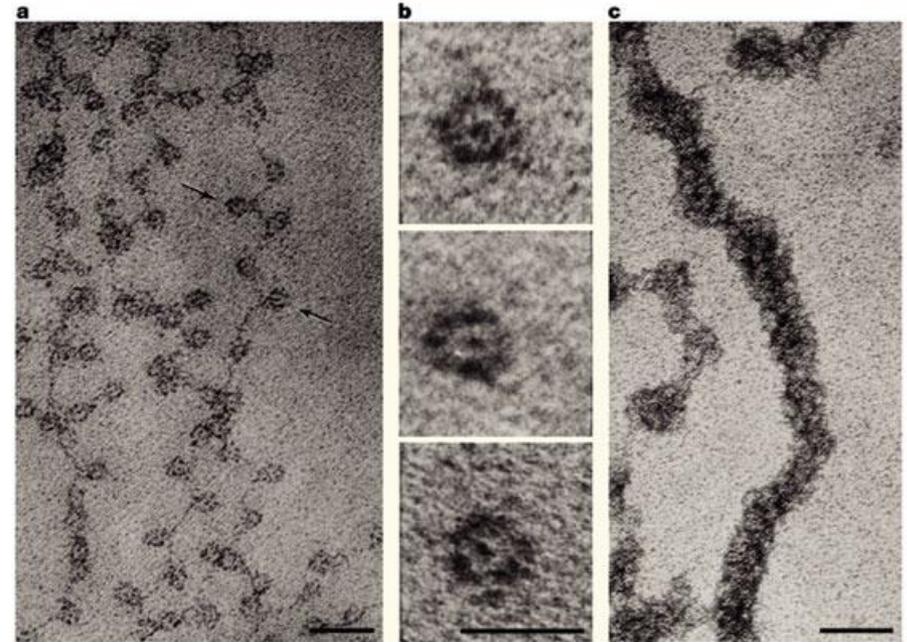
- highly charged ( $\sim 1e / bp$ )
- Kuhn length  $\sim 106$  nm or 310 bp
- the largest human chromosome would have gyration radius of  $\sim 100$  micron (SAW)

# Nucleosomes provide the second level of DNA organization



from Wikipedia entry for "Nucleosome"

- 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



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