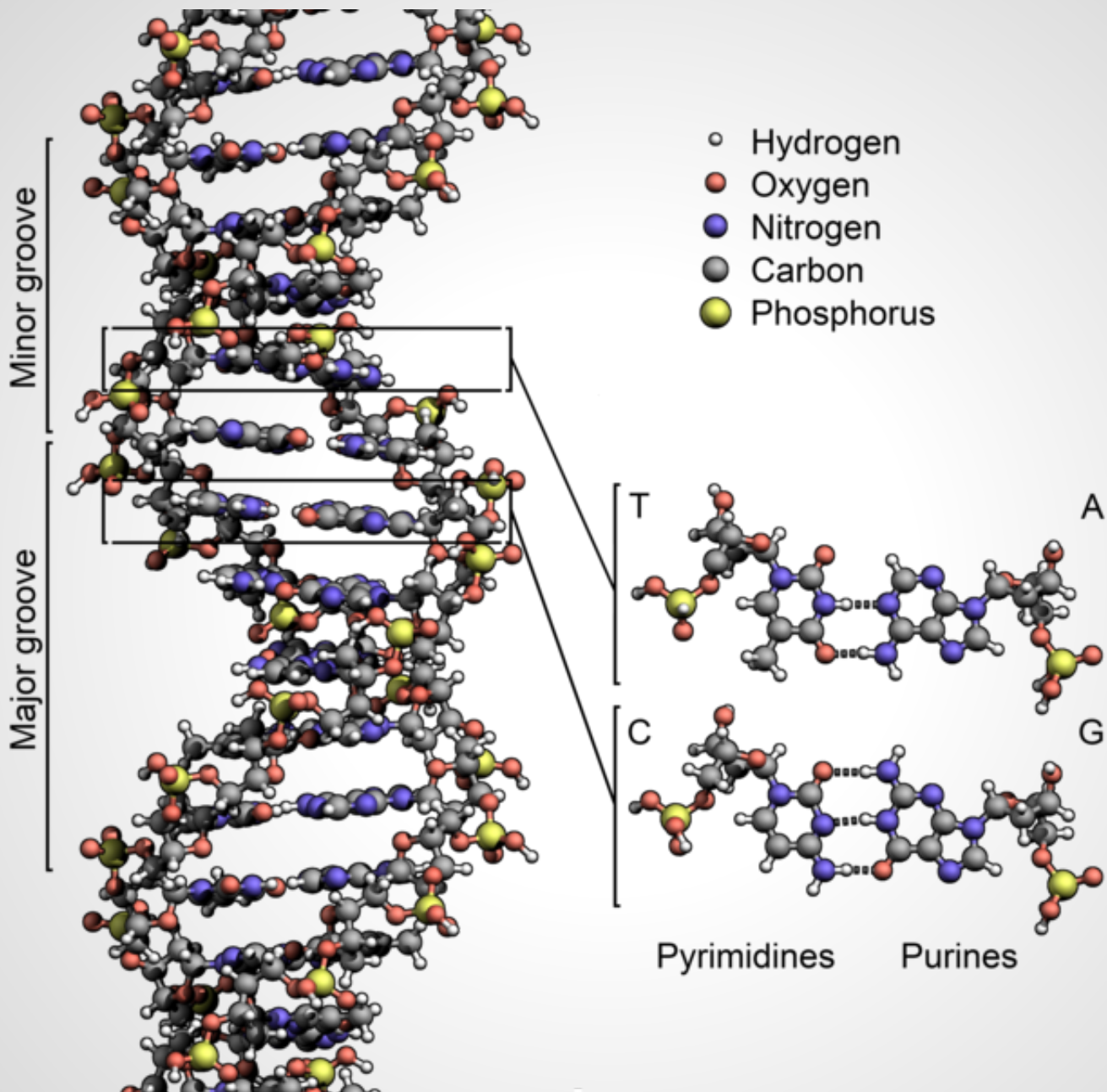


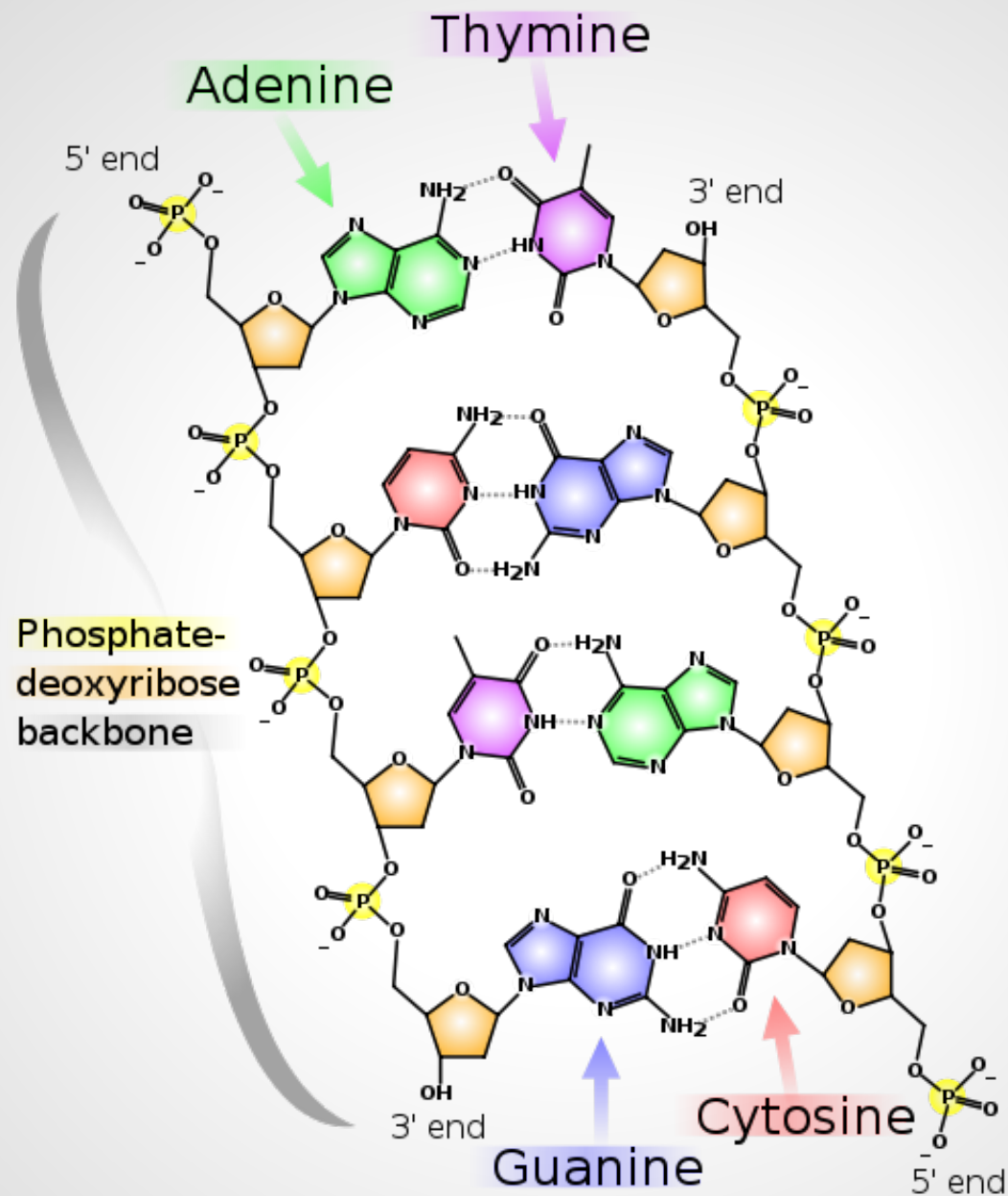
Chromatin Folding

Ethan Schwartz
Dr. Wilma K. Olson

DNA

- Two anti-parallel polymers made of nucleotides
 - Sugar-phosphate backbone
 - One of four nucleobases attached to each sugar (adenine, cytosine, guanine, thymine)
 - Double helix shape
 - Implies particular elastic properties
- Sequence of bases encodes genetic info
- Identical DNA contained in nucleus of every cell in body (~10 μm in diameter)
 - Thus, what changes the genetic expression in different types of cells?
- If unwound, DNA is ~6 feet in length

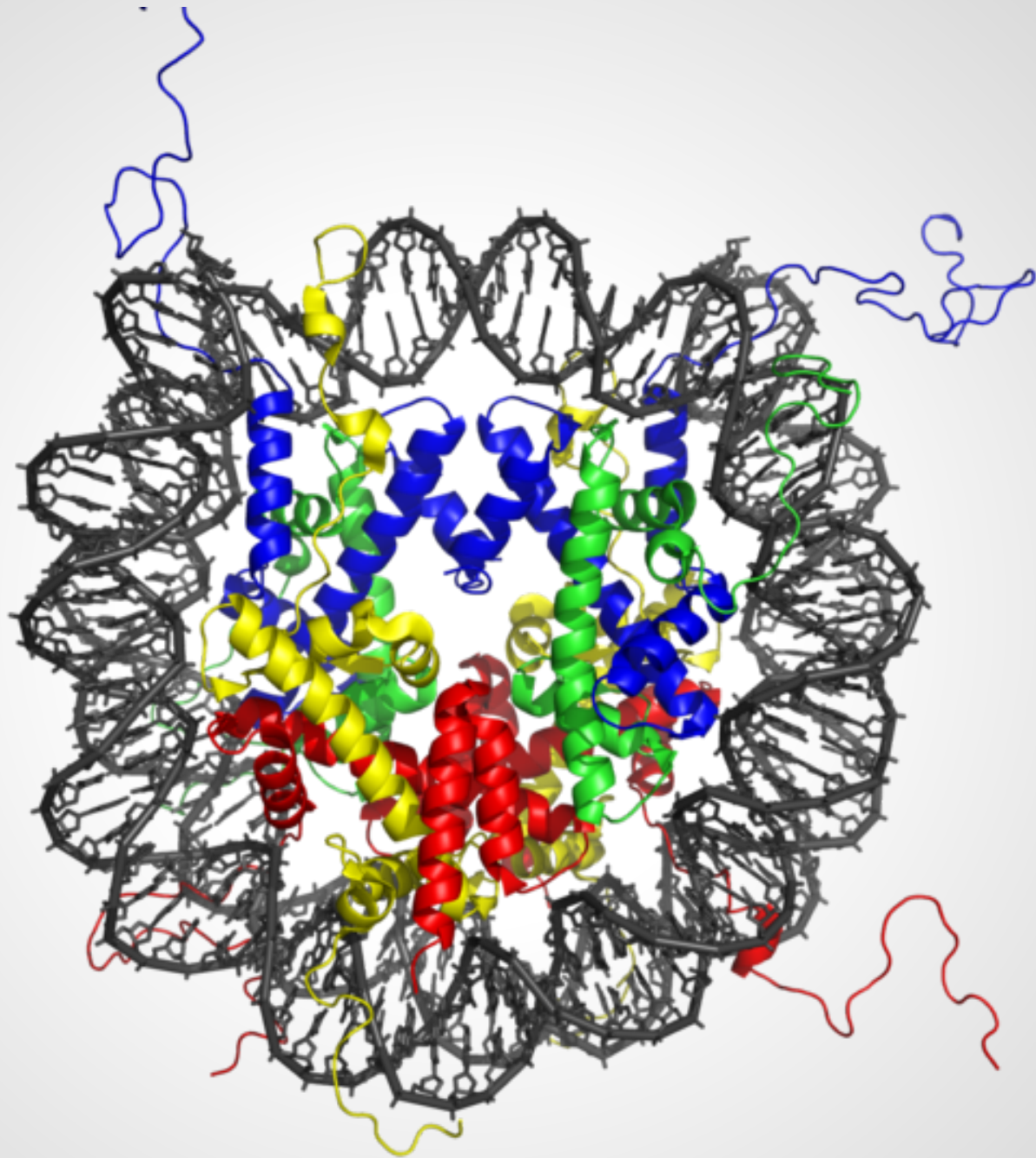




Chromatin - Structure

- DNA is organized into DNA-protein complexes known as chromatin
- DNA wraps around eight histone proteins to form nucleosomes
- Multiple nucleosomes are linked together via linker DNA (i.e. nucleotides)

8 nm
diameter



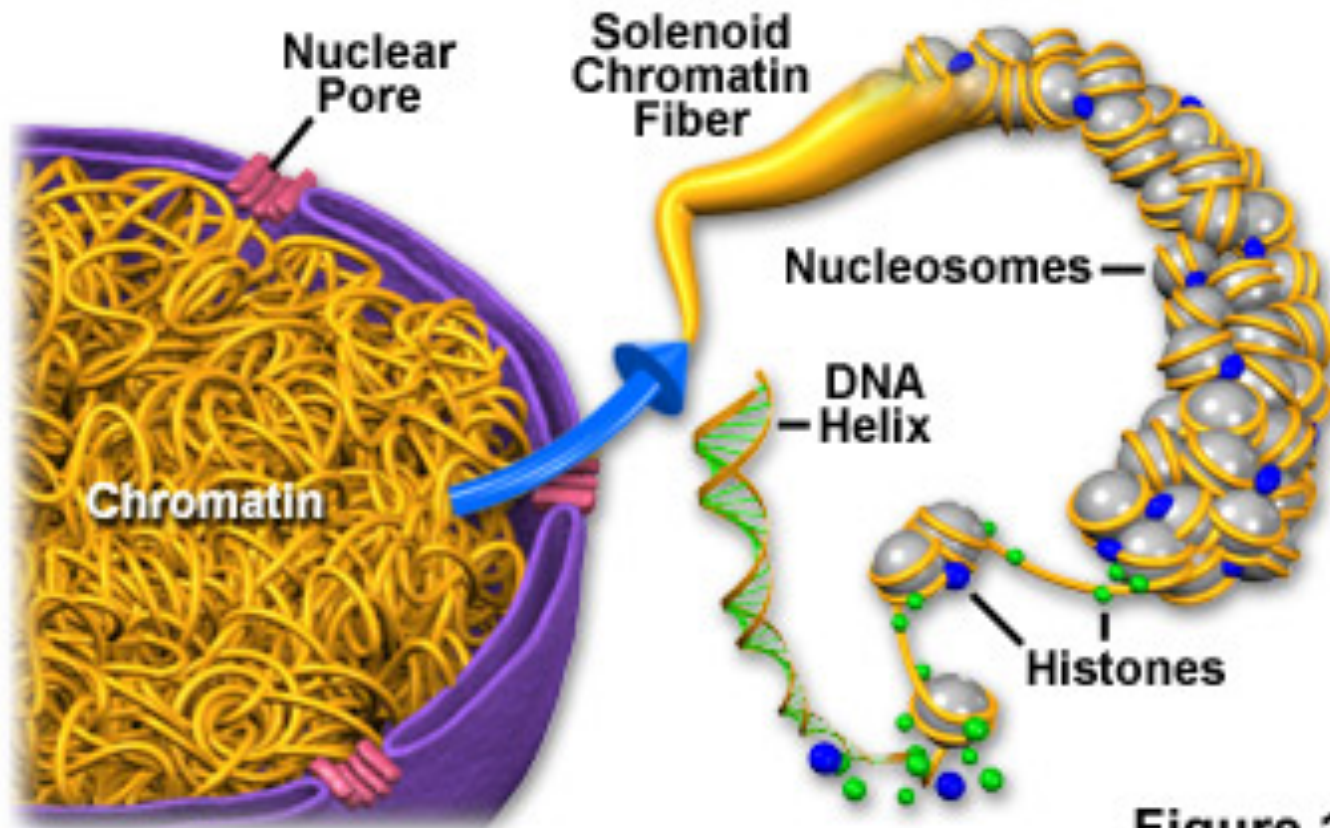
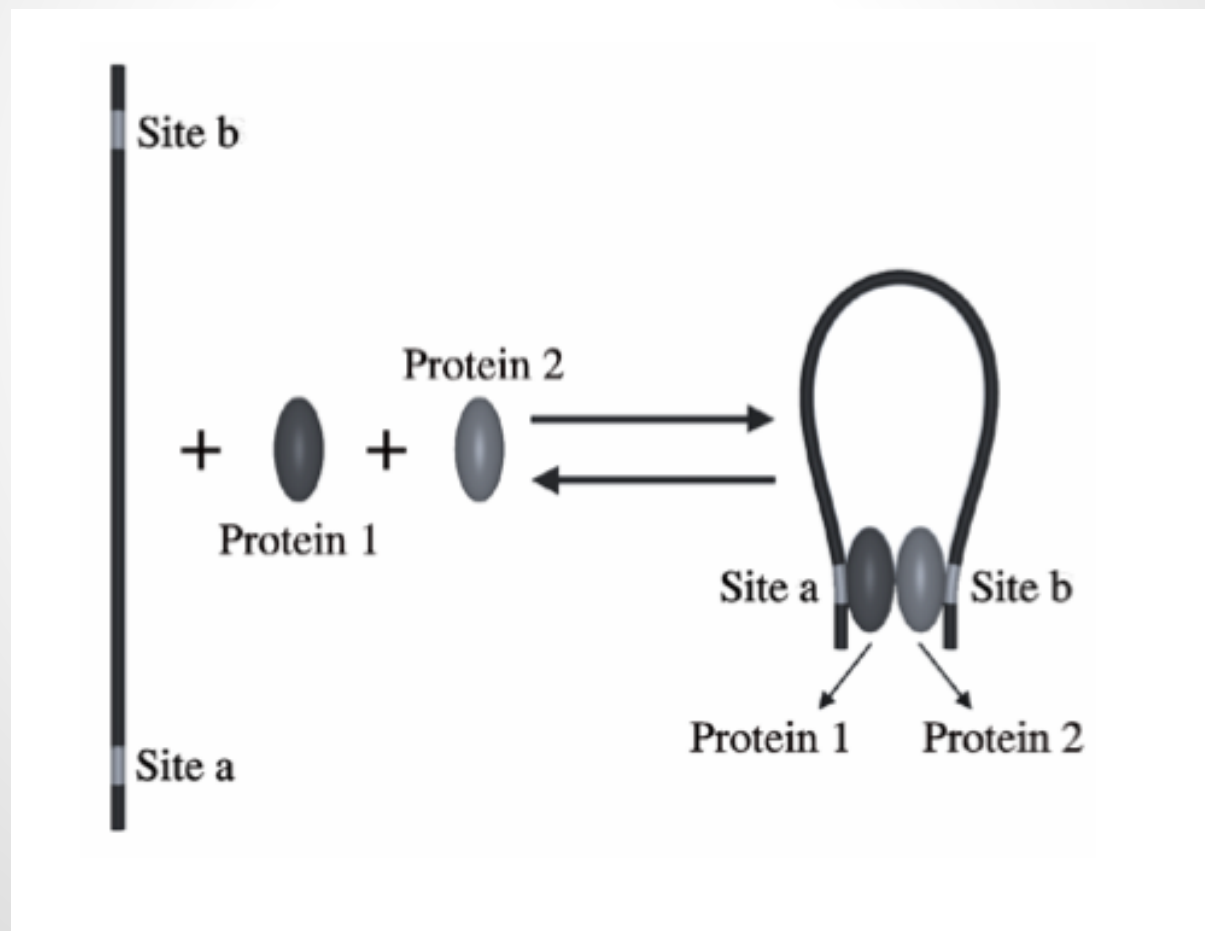
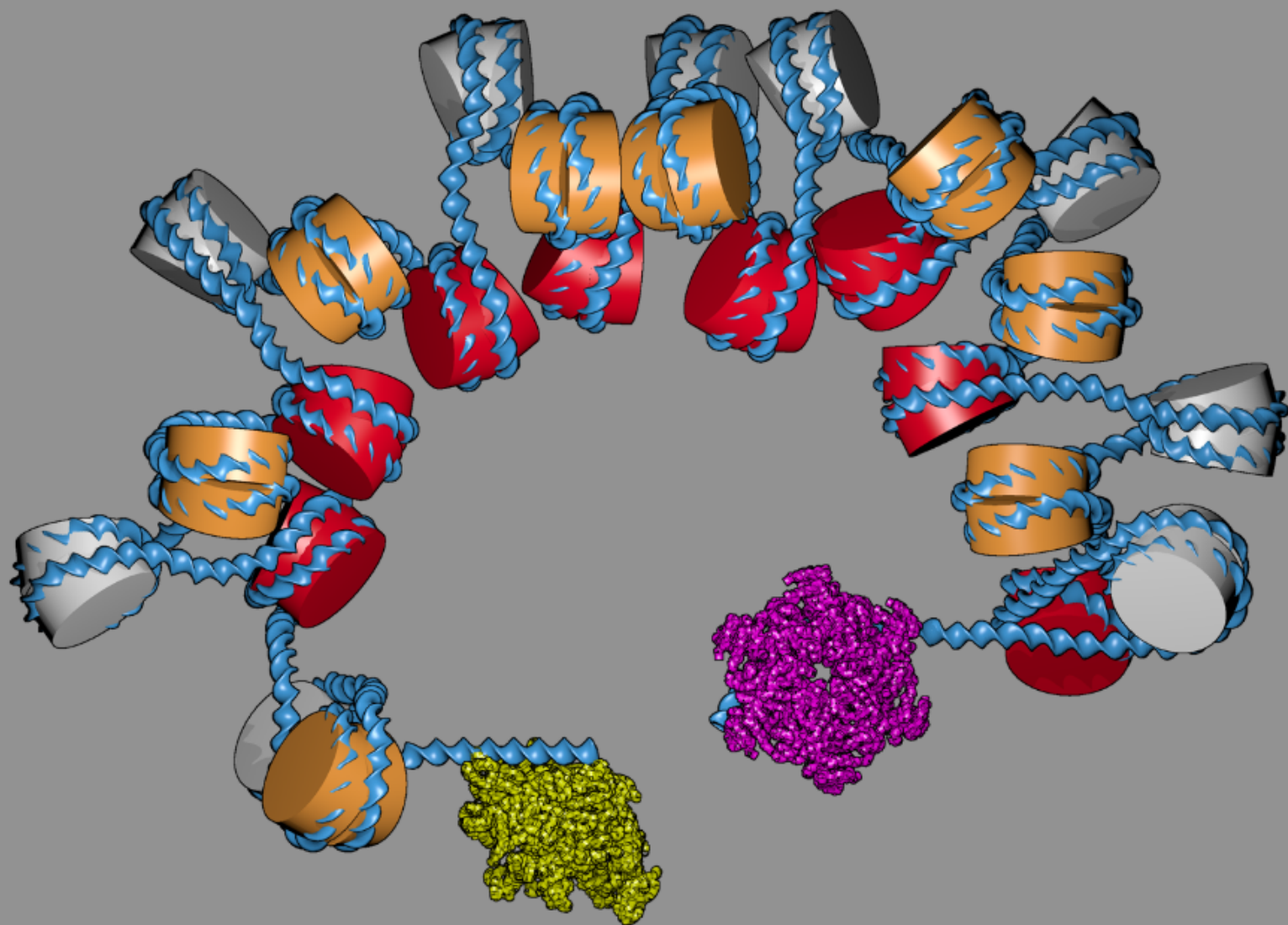


Figure 1

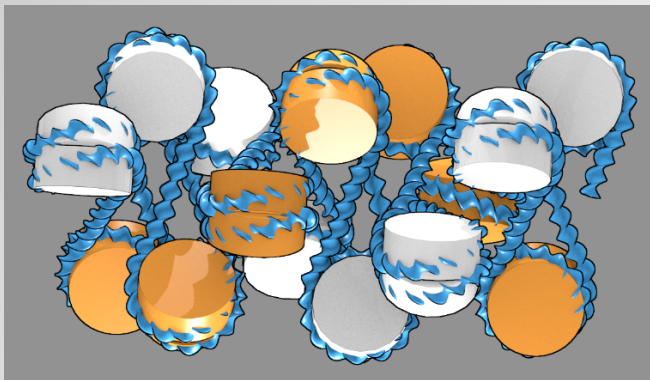
Chromatin - Long-Distance Communication

- Although the genetic messages in DNA are stored in a linear sequence of base pairs, genomes do not function in a linear fashion

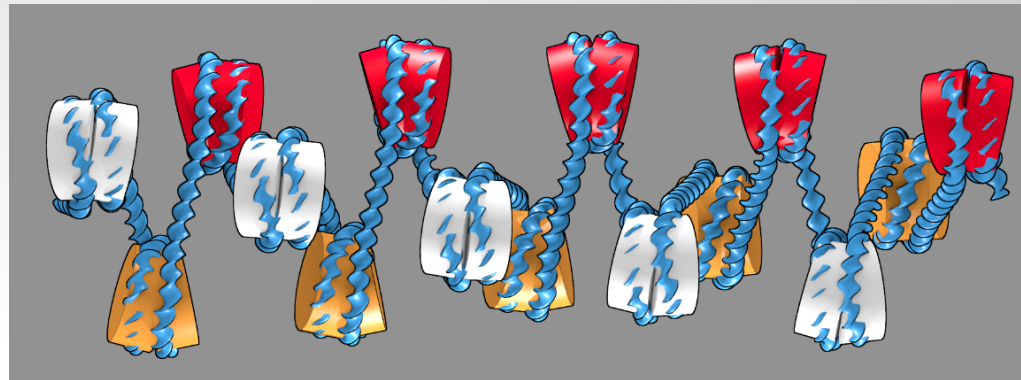




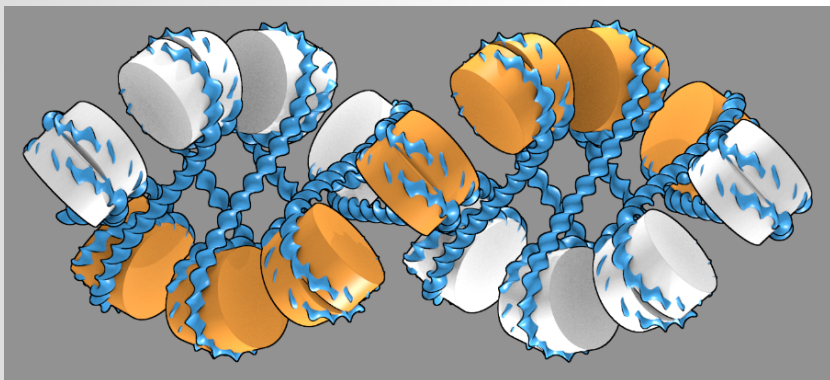
- Sequence determines nucleosome positioning
 - Nucleosome positioning determines probability of long-distance communication
 - Nucleosome positioning determines linker length
 - Linker length determines fiber geometry and chromatin properties



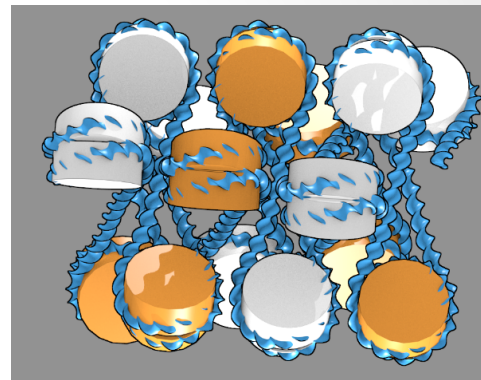
25 bp-fiber



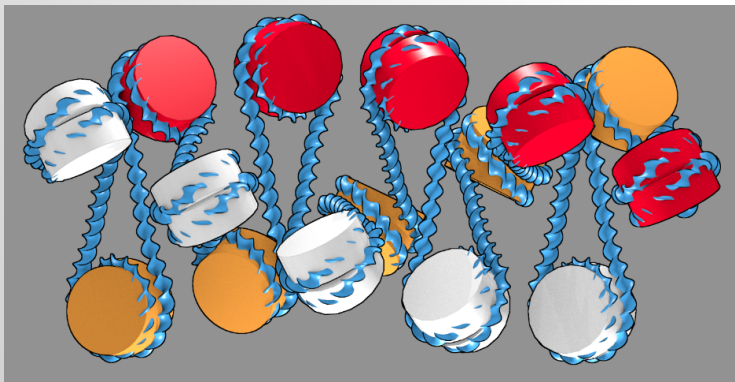
30 bp-fiber



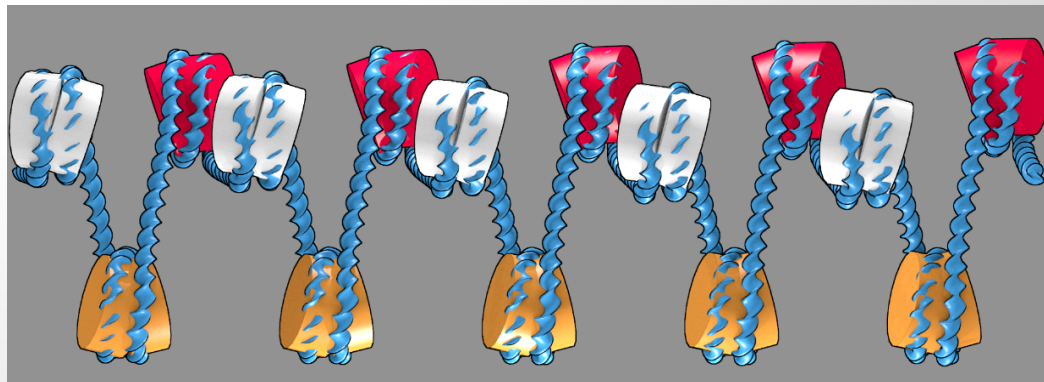
33 bp-fiber



35 bp-fiber



37 bp-fiber

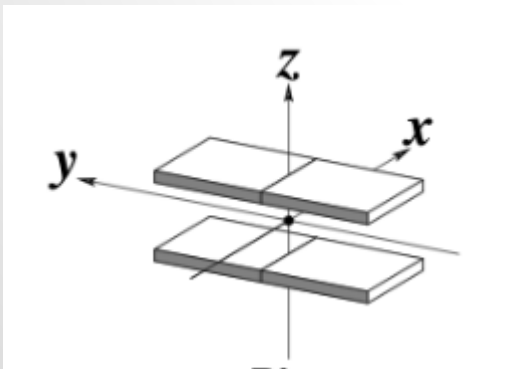
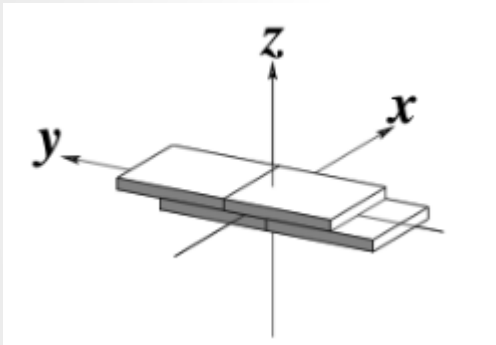
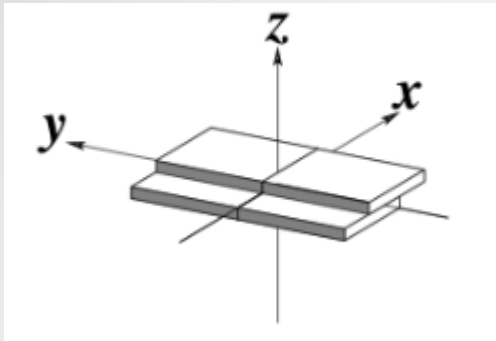


40 bp-fiber

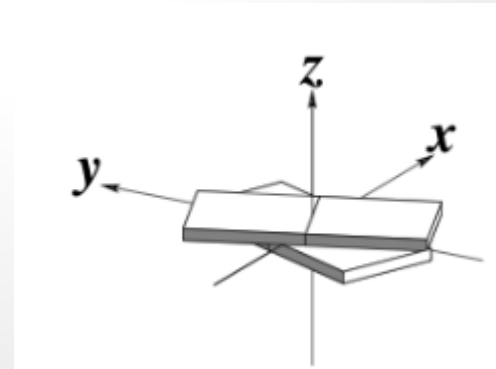
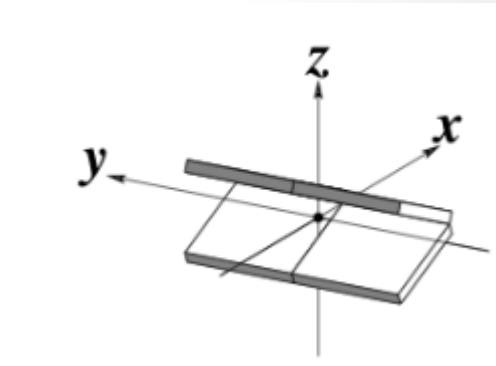
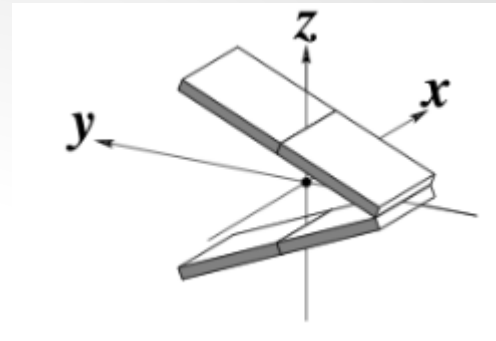
Data

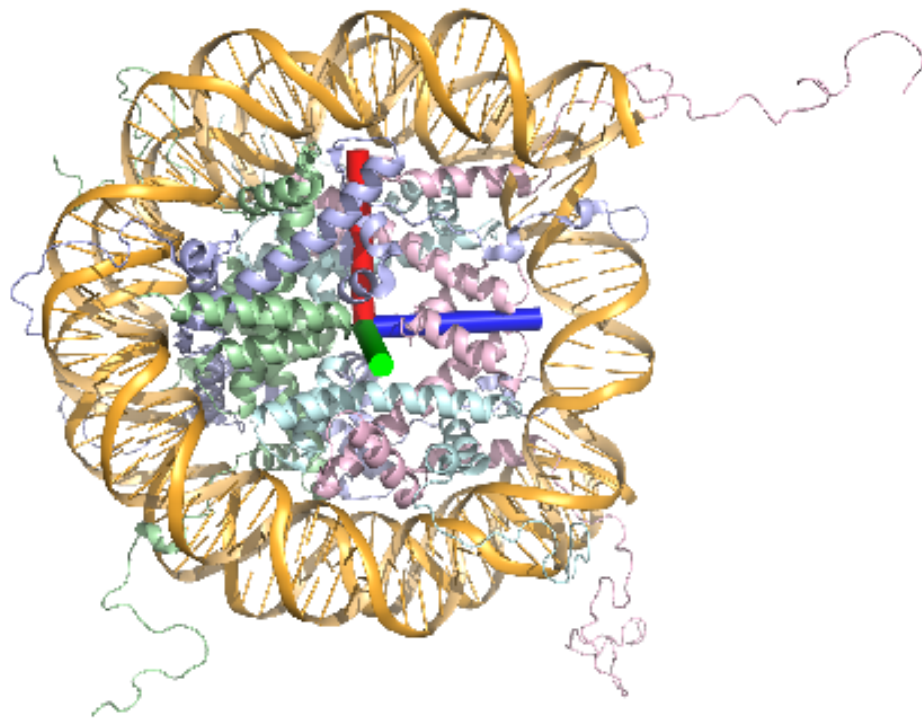
- Perform Monte Carlo simulations on different chromatin configurations
 - Determine physical and mechanical properties of chromatin
 - Stiffness, packing, end-to-end distance
- 6 rigid body parameters describe nucleosome-nucleosome interactions
 - Statistical analysis (covariance analysis)

Translational

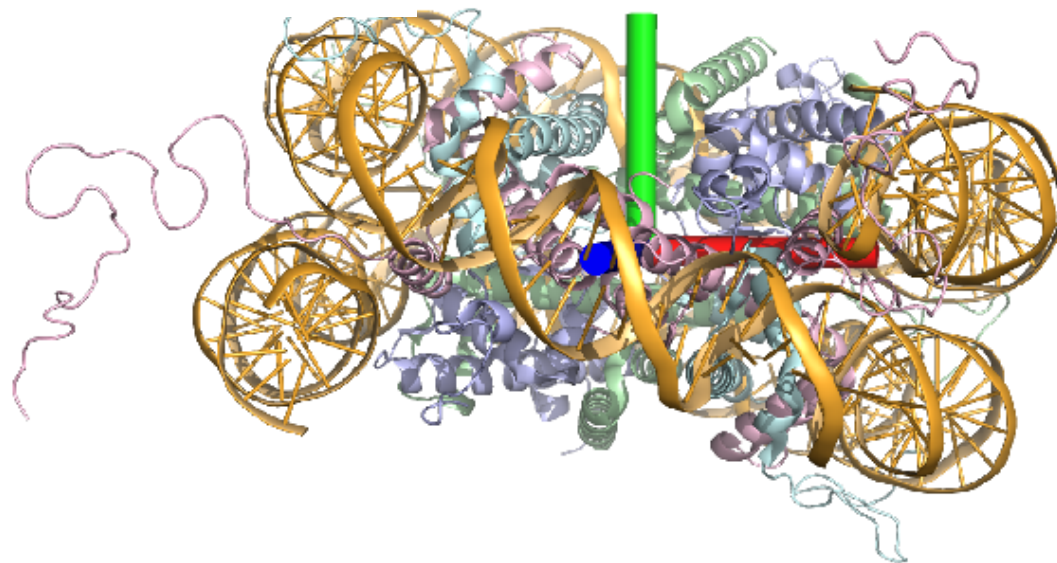


Rotational





1KX5



Implications

- In vivo ("within the living") chromatin structure is relatively unknown
 - Simulations may give insight to variable chromatin configurations within the cell
 - Facilitate understanding of changes in chromatin organization during the cell cycle
 - Variations in chromatin folding and packing may lead to differences in expression of genetic material

Acknowledgements

Dr. Wilma K. Olson, Nicolas Clauvelin, Pamela Perez, and Gautam Singh.