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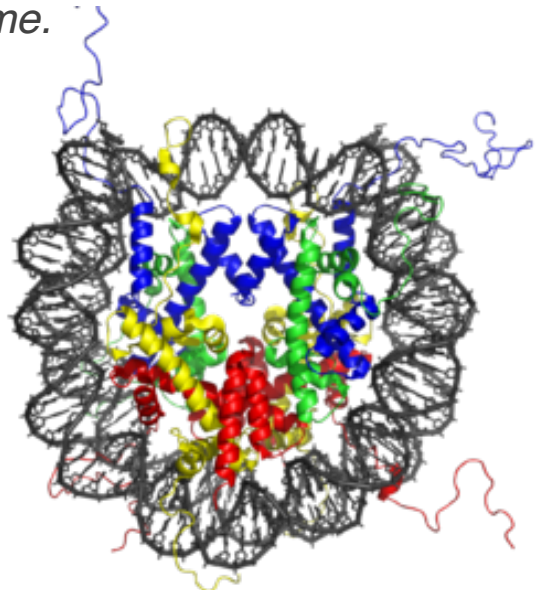
DNA Nucleosome Structure, Prof. Wilma Olson

Broad Overview

- General Research goal of Prof. Olson’s lab is to build computational models of DNA packaging
- The problem for the summer is to better understand how Nucleosomes interact with each other on Nucleosome Decorated DNA

Nucleosomes: First level of folding

- DNA wraps around group of 8 Histone Proteins (2 copies of each H2A , H2B, H3 and H4) to create a *Nucleosome.*
- 145-147 Base Pairs in length, around 1.8 turns
- DNA has net negative charge
- Histones have net positive charge

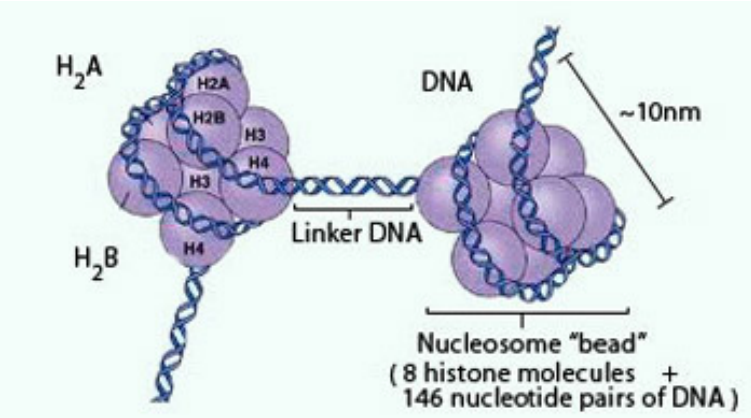


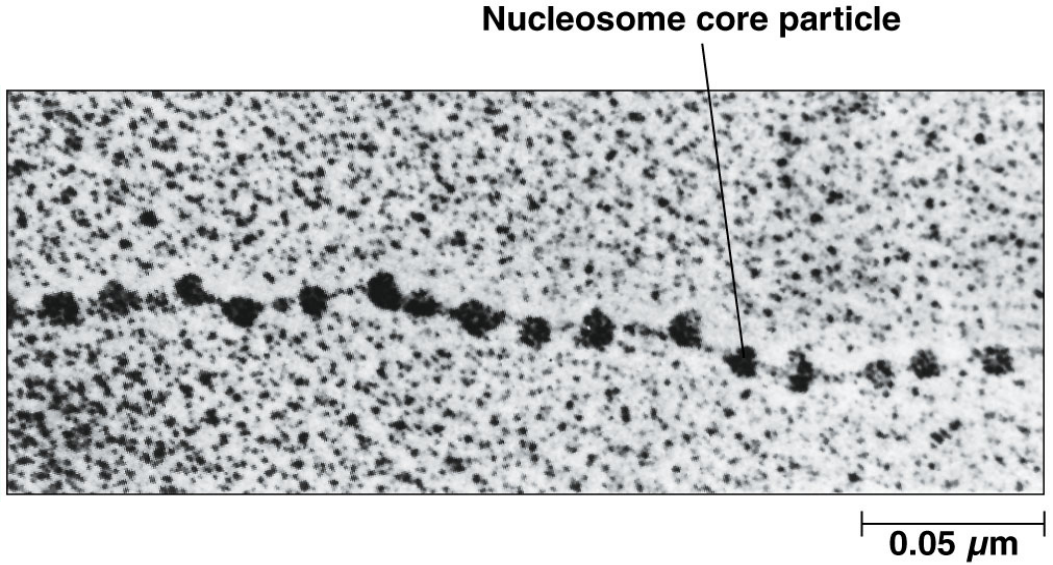
Nucleosome- DNA wrapped around Histone Proteins

https://en.wikipedia.org/wiki/Nucleosome#/media/File:Nucleosome_1KX5_colour_coded.png

Nucleosome decorated DNA like“Beads On a String”

- About 30-90 BP between each Nucleosome on DNA strand
- Want to understand how these Nucleosomes behave and interact
- This summer we will use this understanding to create better models of Nucleosome interaction





https://www.wonderwhizkids.com/dna-packaging

https://www.mun.ca/biology/desmid/brian/BIOL2060/BIOL2060-18/CB18.html

Protein Data Bank

- Database of over 140,000 Biological Macromolecular Structures and how these structures pack in crystals
- We will look at a subset of these structures, around 150 Nucleosomes
- The way these Nucleosomes pack in crystals is similar to the way they pack in DNA

https://www.rcsb.org/

Applying Group Theory and Linear Algebra

- PDB gives information on location of each atom in the nucleosome, too much
- Group Theory and Linear Algebra simplify and generalize

https://www.rcsb.org/

In Summary

- We will use the information on Nucleosome packing structure and symmetries from PDB
- Apply Group theory and linear algebra to this PDB information
- Specific goal of creating a guide for how nucleosomes pack in DNA and interact with each other

Thank you

- Thanks to Dr. Gallos and the whole DIMACS staff in organizing and running this REU, providing this research opportunity
- Thanks to Prof. Olson and her research lab for welcoming me to work with them this summer
- Thanks to the NSF for providing the funding for this REU through grant CCF-1559855

Links to pictures used

- https://www.theatlantic.com/technology/archive/2012/11/what-dna-actually-looks-like/265713/
- https://en.wikipedia.org/wiki/Nucleosome#/media/File:Nucleosome_1KX5_colour_coded.png
- https://www.mun.ca/biology/desmid/brian/BIOL2060/BIOL2060-18/CB18.html
- https://www.rcsb.org/
- https://www.wonderwhizkids.com/dna-packaging