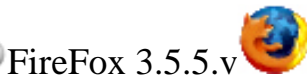


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A. RSU Protocol of Task to Student: <http://aris.gusc.lv/06Daugavpils/Research/NucleosomeAS.pdf>

B. Task for student practical introduction for the use of Interactive Molecule viewers:



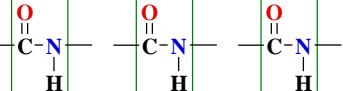
Chemscape MDL RasWin Firefox 3.5.5.v lunch the application California Lutheran University professor David Marcey 2003. prepared DNA binding proteins Histones

Octamere molecules <http://aris.gusc.lv/ChemFiles/CLUnucleosome/nucleosome.htm> created by assistant professor Aris Kaksis 2025 for practical work at Riga Stradin's University.

To investigate the atoms making up the molecule structure using the CPK color scheme 1965 at Display conditions: Stick (on Menu Stripe) Ball & Stick Spacefill

Atom Name	Symbol	Color	Valence Number
Carbon	C	Gray lightly or Black	4
Hydrogen	H	White	1
Oxygen	O	Red	2 (donor acceptor ligand up to 4)
Nitrogen	N	Bluish	3 + 1(donor acceptor ligand up to 4)
Sulfur	S	Yellow	-2 , +6
Phosphor	P	Yellow Intensive dark	5 (& 3)
Sodium ion	Na ⁺	Blue	+1 (coordination up to 6)
Magnesium ion	Mg ²⁺	Green	+2 (coordination up to 6)
Calcium ion	Ca ²⁺	Gray Dark	+2 (coordination up to 6)
Iron ion	Fe ²⁺	Yellow Gray	+2 (coordination up to 6)
Iron ion	Fe ³⁺	Yellow Gray	+3 (coordination up to 6)

USA patent Journal publication of scientists Corey, Pauling, Koltun for atomic modeling Protein Backbone is Ca trace



Polypeptide of Amino Acids Side chains: Hydrophobic Polar pH=7.36 Acidic-COO⁻ negative Basic-NH₃⁺ positive

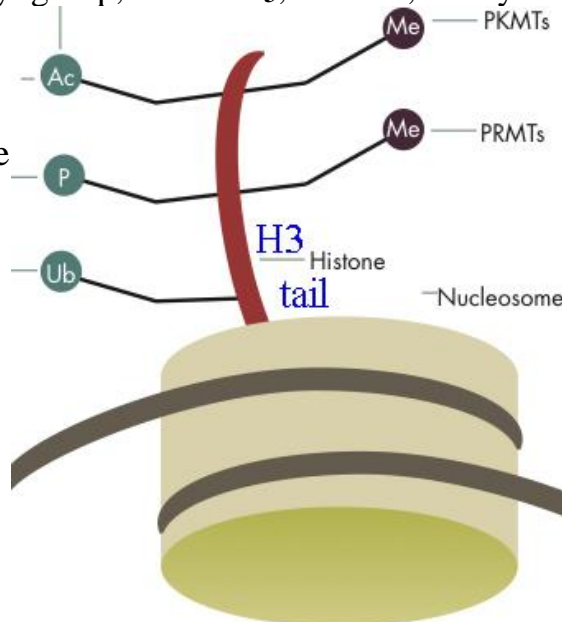
3. Call 8 Histones the Nucleosome core Particle quaternary structure eight Protein subunits?
4. Explain eight Histone proteins similarity pattern! 2*H2A, 2*H2B, 2*H3 and 2*H4.....
5. Which are copies each to other? H2A+H2A, H2B÷H2B, H3÷H3, H4÷H4.....

H3 tails said strand modification shapes in DNA functions for human HOMEOSTASIS Acetyl transferases link acetyl group, -CO-CH₃; Me, methylation enzymes of =N- or -O-CH₃:

Ac, acetylation enzymes: Deacetylases remove Acyl; P, Phosphorylation -OPO₃²⁻ enzymes=kinases, phosphate hydroxyl group ester formation or remove; Ub, ubiquitination enzymes Ligases polypeptide chain cleavage and remove for degrading

HEALTH ENDPOINTS:

Cancer
Autoimmune disease
Mental disorders
Diabetes



PKMT: Lysine (K) Lys methyl transferase; PRMT: Arginine (R) Arg methyl transferase; Methylation, Demethylation H2A, H2B, H3, H4 EPIGENETIC FACTORS The binding of epigenetic factors to histone "tails" alters the extent to which DNA is wrapped around histones and the availability of genes in the DNA to be activated for expression.

6. What geometric meaning has the octameric disk? Draw core of 8 subunit disk picture!
7. What six amino acid residues on histone tail polypeptide chain epigenetic markers linkage site endpoints are targets for: Thr22-OH, Lys23-N⁺H₃, Arg26-N⁺H₃, Lys27-N⁺H₃, Ser28-OH, Thr32-OH.....
- 7.1. acetylation, -CO-CH₃ amino AA -N⁺H₃ groups of residues for amino acids -HN-CO-CH₃ acyl group? Lys23-N⁺H₃, Arg26-N⁺H₃, Lys27-N⁺H₃
- 7.2. phosphorylation, HOPO₃²⁻ at AA-OH hydroxyl groups of residues for amino acids AA-OPO₃²⁻ ? Thr22-OH, Ser28-OH, Thr32-OH.....
- 7.3 methylation -CH₃ positions at amino AA-N⁺H₃ groups of residues for AA-HN-CH₃ methyl group? Lys23-N⁺H₃, Arg26-N⁺H₃, Lys27-N⁺H₃
8. What kind secondary structure motifs comprise each Histone tertiary structure fold protein?

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..... alpha1-loop1-alpha2-loop2- alpha3.....

9. What two hetero dimmers constitute the Histone disk?two each of H3-H4 and H2A-H2B

10. How many hetero dimmers of 2 protein subunits make up Histone disk–Nucleosome core Particle?.....two each of H3-H4 and H2A-H2B

11. What is size of Nucleosome core Particle **Histone** in angstroms Å along the symmetry axis? Select “Distance” and make five measurements of histone disk diameter in angstroms Å!

.....67.9Å.....67.3Å.....67.0Å.....73.1Å.....67.9Å.....

12. Which four helices of H3 and H4 Histones form the four-helix bundle **tetramer**?

..... alpha2-loop2- alpha3+alpha2-loop2- alpha3.....

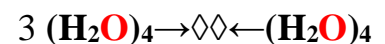
13. With which **dimer tetramer** begins association the DNA in the first step of Nucleosome assembly, DNA packaging in the nucleus of Cells about Chromosomes?(H3-H4)₂

14. What three intermolecular forces (underline those) bind in hetero dimmers like H3-H4 arrangement with two monomers of totally known in medical chemistry five intermolecular forces?

What three intermolecular forces (underline those) bind the four-helix bundle **tetramer** and how hetero dimmers H2A-H2B binds to **tetramer** (H3-H4)₂ if each quaternary structure hetero dimer binds to the **tetramer** via another, homologous, four-helix bundle (alpha2 and alpha3 from both H2B and H4), joining the H2B and H4 histone folds of totally known in medical chemistry five intermolecular forces?

1.Hydrogen,2.Hydrophobic,3.Salt bridge,4.sulfur -S-S- disulfide bridge,5.coorditative donor-acceptor bond

15. Draw structural molecular units of three chosen intermolecular bonds which binds to **tetramer** (H3-H4)₂ two **dimers** H2A-H2B:



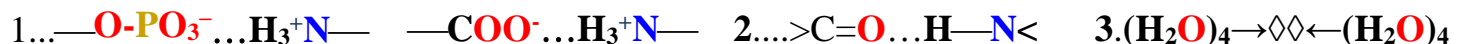
16. How many double helical DNA base pairs are wrapped around the quaternary structure of histone octamere disk in a DNA super helix two turns?

.....146 bp of double helical DNA are wrapped around histone octamere disk.....

17. What three intermolecular forces (underline those) bind to the histone octamere in a DNA super helix two turns around?

1 Hydrogen,2Hydrophobic,3Salt bridges,4sulfur-S-S-disulfide bridges,5coorditative donor-acceptor bonds

18. Draw structural molecular units of three chosen intermolecular bonds DNA & Histones:



19. What is the DNA two fold diameter size in angstroms Å around octamere of the symmetric quaternary structure with DNA 146 bp fragment?

Select “Distance” and make five measurements of DNA disk diameter in angstroms Å!

.....101,2Å.....100.4Å.....101.2Å.....103.2Å.....104.0Å.....

20. What times wraps DNA super helix around histone octamere core disk?

...DNA super helix wraps around the histone octamere core disk in 1.65turns.....

21. What base pairs are half coil around nucleosome?.....each half 73 base pairs.....

22. Are left-handed (clock wise) or right-handed (counter clock wise)?

..... left-handed DNA super helix wraps around the histone core

23. Human DNA total length is 2.1meters

constitute 4 934 582 000±5000base pairs

with two type base pairing adenine=thymine with two hydrogen bonds and guanine≡cytosine with three hydrogen bonds as human DNA total size!

24. What the number of histone octamere nucleosomes are necessary in cell division process to synthesize human chromosomes if in one set 23 chromosomes contain DNA with content

.....4 934 587 000 base pairs ?

..... 4934587000/146*2=2*33798541=67.6 million nucleosomes.....