Fundamentals of Nucleic Acid Structural Biology

- Nucleic Acids:
    - Definition
    - Building Blocks (Nitrogenous base, Sugar, Phosphates)
- Sugar:
    - Sugar Puckering
        - Differences between Deoxyribose and Ribose
        - C3’-endo and C2’-endo configuration
    - Sugar Numbering
    - Chemical Properties of Sugar positions
    - Why DNA and RNA differs and how the sugar participates in their chemical-physical difference?
        - Glycosidic Bond
        - 2’-C position
        - Furanoses
        - 5’-C position
- Nitrogenous Bases:
    - Purines
        - Imidazole and Pyrimidine subsystem
            - Numbering
    - Pyrimidines:
        - Numbering
- Phosphates
    - How phosphates influence Nucleic Acid Folding?
    - Polyanionic nature of Nucleic Acids
- Nucleotide and Nucleoside definition
    - Sin and Anti conformation
- Nucleic Acid Classes
    - DNA
        - DNA double helix
            - Geometrical Features

                - Conformation : (A-DNA, B-DNA, Z-DNA)
                - Biotech Application: Johnson & Johnson DNA Vaccine
                - DNAzymes: DNAmoreDB
        - RNA
            - RNA is a polymorphic and self-folding molecules
            - RNA as a catalyst
            - RNA folding is a hierarchical process
            - Torsional Angles:
                - Alpha
                - Beta
                - Gamma
                - Delta
                - Epsilon
                - Zeta
                - Chi
            - What is the difference between an RNA and DNA double helix?
- Nucleotide – Nucleotide Interactions
    - Edges:
        - Watson Crick edges
        - Hoogsteen edges
        - Sugar edges
            - Proposed Topics:
                - A-minor motifs
                - Ribose-zipper
    - Pairing families and relationships:
        - Isostericity of canonical interactions
        - Non-canonical Interactions
            - Wooble Interaction
    - Stacking Interactions
        - Negative and Positive Stacking Interactions
- Nucleotide modifications:
    - How many natural occurring modifications are currently known?

    - Proposed Topic: Modifications and SarsCovid2 Evolution
        - Role of ADAR and APOBEC enzymes: How adenosine to inosine hydrolytic deamination is suggested to influence Covid-19 evolution?
    - Structural Properties and molecular roles of:
        - M6A: $N^6 - methyladenosine$
        - D: Dihydrouridine
        - M1A: $N^1 - methyladenosine$

- RNA structural motifs
    - Hairpin Loop
    - Bulge Loop
    - Internal Loop
    - RNA Junction
- RNA Tertiary Interactions:
    - Kissing Loops
    - Pseudoknots
- tRNA structures and modification landscape
- ModeRNA

SUGGESTED READINGS

Fundamentals of RNA Structure and Function 2022 ISBN : 978-3-030-90213-1 (Chapter 1 – 2)

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Westhof E. Isostericity and tautomerism of base pairs in nucleic acids. FEBS Lett. 2014 Aug 1;588(15):2464-9. doi: 10.1016/j.febslet.2014.06.031. Epub 2014 Jun 17. PMID: 24950426.

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