Biopolymers [pln41]

Biopolymers are assembled by living organisms. *Synthetic polymers* are assembled in the lab or in an industrial production line.

Three major kinds of biopolymers:

- *Nucleic acids:* Polymeric nucleotides of linear structure. Examples are DNA [pln39] and RNA. Aperiodic sequence of bases carries genetic information, e.g. blueprint for composition of proteins.
- *Polypeptides:* Polymeric amino acid residues linearly joined by peptide bonds. Examples include (short) peptides and (longer) proteins. Aperiodic sequence of side chains provide shapes and interactions conducive to very diverse biological functions upon folding.
- *Polysaccharides:* Polymeric carbohydrates of structure ranging from linear to highly branched. Biological functions include energy storage (e.g. starch) and structural support (e.g. cellulose).

DNA vs Proteins: commonalities and differences.

Non-random aperiodicity:

- Aperiodic structure of DNA (sequence of base pairs) encodes genetic information on biological functions. Two distinct base pairs are realized: AT and CG. Nucleotide triplets form codons.
- In aperiodic structure of proteins (amino acid residues with side chains) that information is translated into building materials. 20 distinct residues are realized.

Hierarchical structure: primary, secondary, tertiary, quaternary

- DNA: (i) Nucleotide sequence, (ii) double helix, (iii) nucleosome, chromosome.
- Proteins: (i) amino acid sequence, (ii) α-helix and β-sheet, (iii) and (iv) folding into functional units.

Helicity:

- DNA: Double helix has aperiodic features on the inside. Genetic information needs protection.
- Proteins: α-helix (and β-sheets) have aperiodic parts on the outside. Building blocks with specific shapes and interactions need exposure.