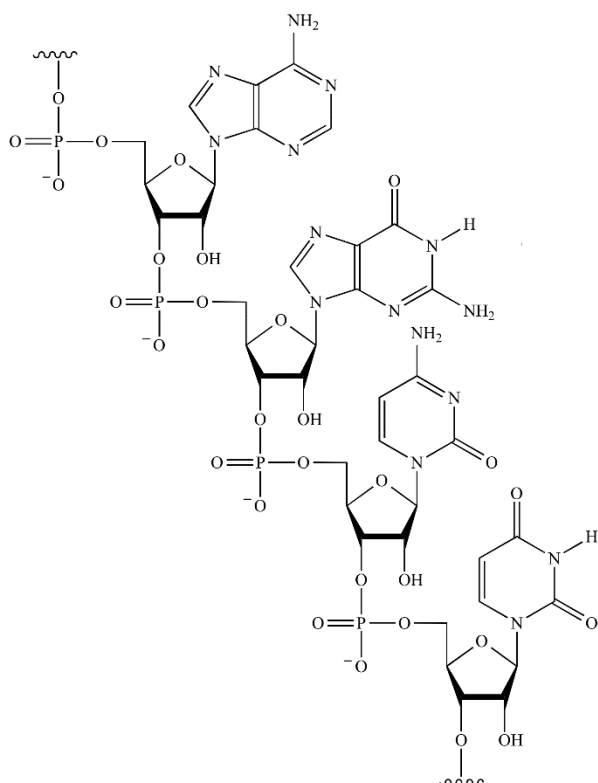


## Seminar 17

### DNA, RNA. Enzymes. Vitamins

#### ➤ DNA, RNA

1. Give examples of nucleic acids.
2. Structurally, nucleic acids are poly \_\_\_\_\_
3. What are the four bases in DNA and RNA?
4. What are structural differences between DNA and RNA?
5. Give the names of nucleosides present in the following RNA sequence:

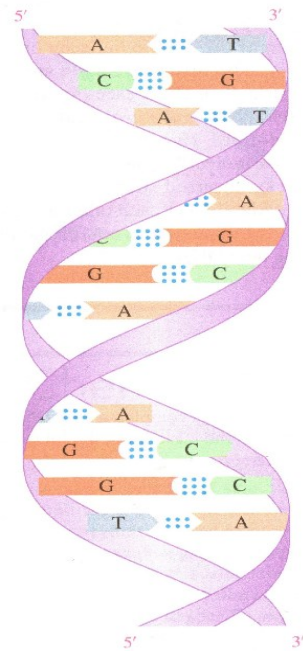


6. The unique sequence of bases is known as \_\_\_\_\_ structure.
7. Characterize the general structure of nucleic acids:

Nucleotides are linked by 3', 5'-..... bonds, i. e. the 5'-phosphate group in one nucleotide is attached to the \_ - \_ \_ group of the following

nucleotide. As many nucleotides are added using ..... bonds, a backbone forms, consisting of alternating ..... and ..... groups. The bases are attached to each ..... and extend from the backbone. Polynucleotide chain has a chain polarity  $5' \rightarrow 3'$ . Mark the  $5'$ - and  $3'$ -end in the RNA sequence above (task 5).

8. Characterize the secondary structure of DNA.



9. The ..... strands of DNA run in the same/opposite direction, i. e. they are parallel/antiparallel. (circle the correct option)

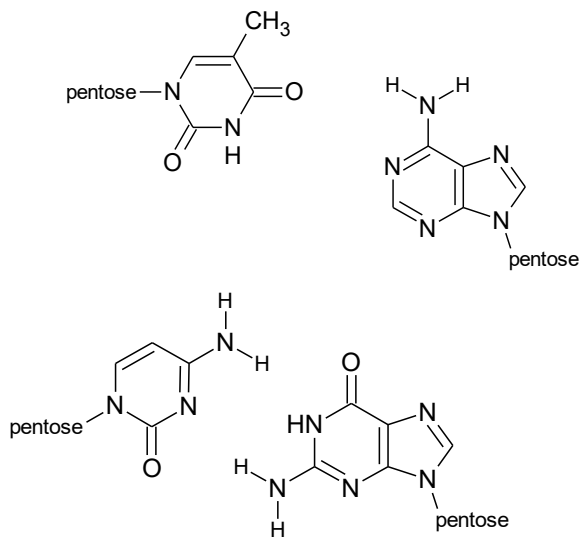
10. What kind of chemical bonds between bases holds together opposite nucleotides in DNA (makes the secondary structure)?

- a) hydrophobic interactions      b) hydrogen bonds      c) covalent bonds
- d) electrostatic interactions

11. How many H-bonds are formed between:

- a) adenine – thymine
- b) cytosine – guanine?

Plot to the schemes:



12. Write the complementary base sequence for the following DNA segment:

3'-ACAGTGCCT-5'

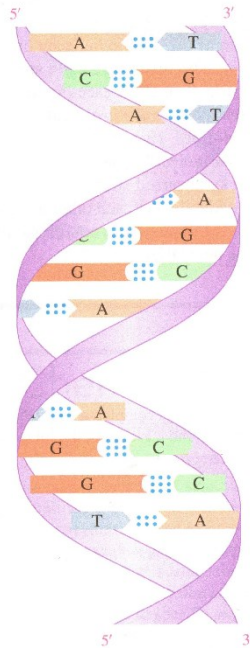
13. A sample of dsDNA contains 10 % of G. What is the % of C and T?

14. Complete the table:

	DNA	RNA
Function		
Cellular localization		
Bases present		
Pentose		
Number of strands		

15. Define the base pairs for DNA and for RNA.

16. Describe the structure of DNA molecule.



17. DNA contains the same number of thymine and ..... molecules and the same number of cytosine and ..... molecules.

18. Why are GC base pairs more stable than AT base pairs?

19. Draw the structural formula for the dinucleotide AT in a DNA molecule.

20. What is the general function of DNA? In which cellular compartments can it be found?

21. Give the three different types of RNA and describe their function.

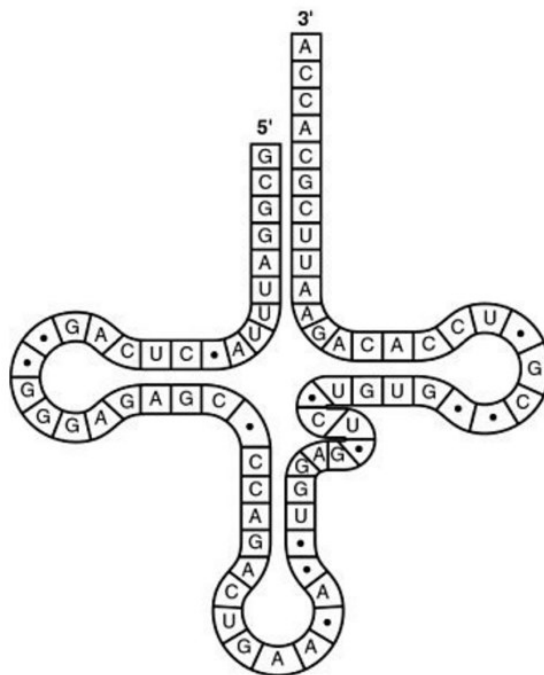
22. All types of RNA are needed for synthesis of .....

23. What is the structure of mRNA?

24. Complete the base sequence in the coding strand of DNA and the base sequence in the mRNA produced by the transcription of this DNA if the sequence of bases in the DNA template strand is:

3'- ATGATCGGATCGATCCAT-5'

25. In the following tRNA molecule, identify the site for amino acid attachment and the anticodon.



26. What type of bonding is responsible for maintaining the specific shape of a tRNA molecule?

27. Why are there at least 20 different tRNAs?

➤ **Enzymes, cofactors, vitamins**

28. What is the chemical composition of an enzyme?

29. Why are enzymes needed for chemical reactions in the body?

30. Match the class of enzymes with the reaction that the enzymes catalyze:

<b>Transferases</b>	Lysis of a molecule using water
<b>Oxidoreductases</b>	Making bonds between molecules
<b>Ligases</b>	Movement of ions or molecules across membranes
<b>Hydrolases</b>	Rearrangement of atoms in a molecule
<b>Lyases</b>	Transfer of electrons
<b>Isomerases</b>	Cleavage of bonds
<b>Translocases</b>	Transfer of a group between two compounds

31. Characterize reactions catalyzed by the following enzymes and identify the class of the enzyme:

- a) Glucokinase
- b) Lactate dehydrogenase
- c) Amylase
- d) Phospholipase A
- e) Aminoacyl tRNA synthetase
- f) Alkaline phosphatase
- g) Trypsin
- h) DNA polymerase
- i) Alanine transaminase

32. Why does an enzyme catalyze a reaction of only certain substrates?
33. What type of forces hold a substrate in the active site of an enzyme?
34. Why do denatured enzymes no longer function properly?
35. What effect will each of the following conditions have on the rate of an enzymatic reaction:
- a) Addition of a strong acid
  - b) Depletion of the substrate
  - c) Removal of the cofactor
  - d) Cooling down the reaction mixture
  - e) Addition of the enzyme
36. Explain why an increase in pH above the optimum will lead to decrease of enzymatic activity.
37. Evaluate the specificity of alcohol dehydrogenase.
38. What is an apoenzyme?
39. What is the role of a cofactor?



40. What is the difference between a coenzyme and a prosthetic group?

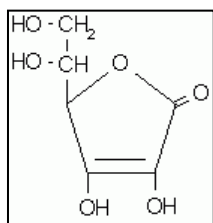
41. What are the following cofactors derived from?

- a)  $\text{NAD}^+$
- b) PLP
- c) FAD
- d) TDP
- e) Coenzyme A

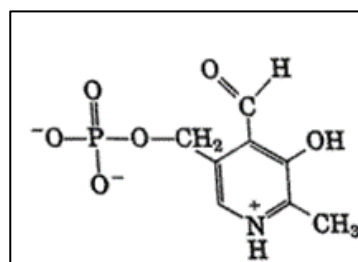
42. Which cofactors (vitamins) are required for the following reactions:

Reaction	Cofactor (vitamin)
Transamination of aspartate	
Blood coagulation	
Acyl group transfer	
Oxidation of ethanol by ADH	
Decarboxylation of tryptophan	
Conversion of succinate to fumarate	
Hydroxylation of proline residues in collagen	
Reduction of pyruvate to lactate	

43. Match each formula with the name of cofactor:

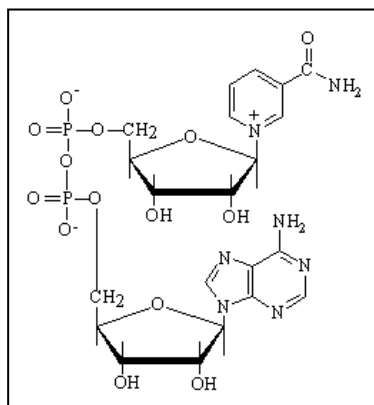


Vitamin C



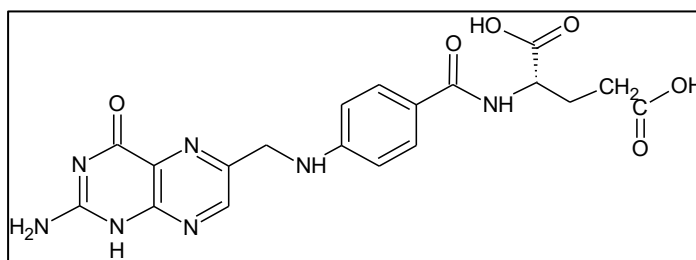
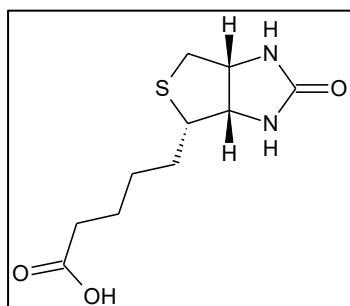
Folic acid

Biotin



NAD<sup>+</sup>

pyridoxal phosphate



44. Why does a noncompetitive inhibitor prevent binding of the substrate to the active site of an enzyme?

45. Which from the following compounds can act as competitive inhibitor of the enzyme succinate dehydrogenase, which catalyzes the oxidation of succinate?

- a) Malonate
- b) Ethylene glycol
- c) FAD
- d) ATP

46. Explain why ions of heavy metals, e.g. lead or mercury cations, are very toxic?