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1. Vitamins are classified into two. They are fat soluble vitamins, such as vitamins A,D,E and K and water soluble vitamins, such as folic acid and B complexes.

   Biochemical significance of Vitamins

   a. Vitamins are essential for growth, maintenance and reproduction. However they are not used for energy production.
   b. Fat soluble vitamin are required for normal colour vision, blood clotting, bone formation and maintenance of membrane structure.
   c. Vitamins A and D act as steroid hormones.
   d. Deficiency of fat soluble vitamins produce night blindness, skeletal deformation, haemorrhages and hemolysis.
   e. Most of the water soluble vitamins function as coenzymes involved in carbohydrate, lipid and amino acid metabolism.
   f. Deficiency of water soluble vitamins leads to beriberi, glossitis, pellagra, microcytic anemia, megaloblastic anemia and scurvy
   g. Some vitamin analogs are used as drugs. For example, folic acid analogs are used as anticancer agents and antibiotics.

2. Water soluble vitamins such as Riboflavin and Niacin act as coenzymes in most metabolic pathways.

   Riboflavin is a precursor of coenzymes flavin mononucleotide and flavin adenine dinucleotide which are required by several oxidation- reduction reactions in metabolism of carbohydrate,protein, lipid, nucleic acid and electron transport chain.

   Niacin is a precursor of enzymes nicotinamide adenine dinucleotide and nicotinamide adenine dinucleotide phosphate which are involved in various oxidation and reduction reactions catalysed by dehydrogenase in metabolism. They are therefore involved in many metabolic pathways of carbohydrate, lipid and protein. Generally, NAD+ linked dehydrogenase catalyse oxidation reduction reactions in oxidative pathways such as citric acid cycle and glycolysis.

3. Nucleosides are composed of a nitrogenous base and a pentose sugar. Nucelotides are composed of a nitrogenous base, a pentose sugar and phosphate group. Nucleic acids are polymers of nucleotides held by 3’ and 5’

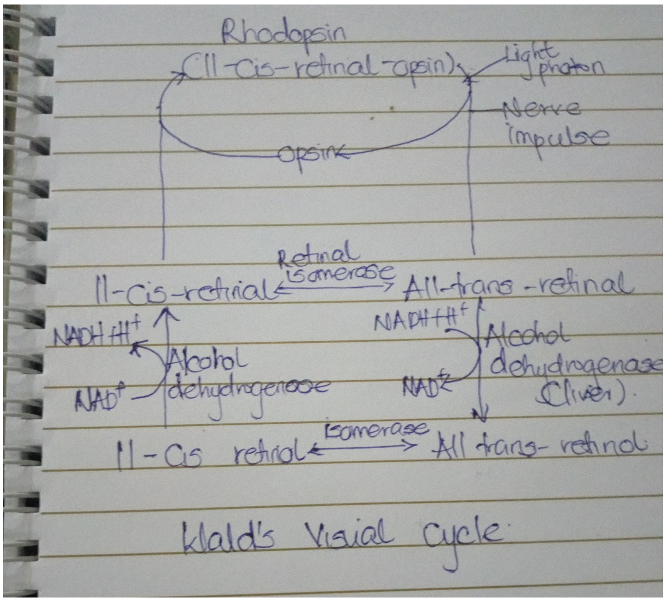
phosphate bridges.

The addition of pentose sugar to a base produces a nucleoside. If the sugar is ribose, ribonucleosides are formed. Adenosine, guanosine, cytidine and uridine are the ribonucleosides of adenine, guanine, cytosine and uracil respectively. If the sugar is a deoxyribose. Deoxyribose nucleosides are produced.

The term mononucleotide is used when a single phosphate moiety is added to a nucleoside. This adenosine monophosphate contains adenine+ ribose+ phosphate.

Bases	**Ribonucleoside**	**Ribonucelotide(5’- monophosphate)**
Adenine	adenosine	adenosine 5’- monophosphate
Guanine	Guanosine	guanosine 5’- monophosphate
Cytosine	cytidine	cytidine 5’- monophosphate
Uracil	uridine	Uridine 5’ - monophosphate

4. The primary event in visual cycle, on exposure to light, is the isomerization of 11-cis-retinal to all-trans retinal. This leads to a conformational change in opsin which is responsible for the generation of nerve impulse. The all-trans retinal is immediately isomerized by retinal isomerase to 11-cis retinal. This combines with opsin to regenerate rhodopsin and complete the visual cycle. However the conversion of all-trans retinal to 11- cis retinal is incomplete. Therefore, most of the all- trans retinal is transported the liver and converted to all-trans retinol by alcohol dehydrogenase. The all-trans retinol undergoes isomerization to 11-cis retinol which is then oxidized to 11-cis retinal to participate in the visual cycle.



5. An individual vision on exposure to bright light changes the color of rhodopsin from red to yellow by a process called bleaching. Bleaching occurs in a few miliseconds and many unstable intermediates are formed during the process

An individual who shifts from a bright light to a dim light, rhodopsin stores are depleted and vision is impaired. However, within a few minutes, known as adaptation time, rhodopsin is resynthesized and vision is improved.

5. Vitamin D3 also known as cholecalciferol is generated in the skin of animals when light energy is absorbed by a precursor molecule 7-dehydrocholesterol.

Cholecalciferol is further metabolized within the body to the hormonally active form as 1,25- dihydroxycholecalciferol. This transformation occurs in two steps.

a. Within the liver: cholecalciferol is hydroxylated to 25-hudroxycholecalciferol by enzyme 25-hydroxylase.
b. Within the kidney: 25-cholecalciferol serves as a substrate for 1-alpha-hydroxylase, yielding 1,25- dihydroxycholecalciferol, the biologically active form.

6. Effects of acids and alkalis on nucleic acids

   In DNA, hydrolysis occurs in acid medium. Hydrolysis of glycosidic bonds occurs only at pH greater than 3 and cleaving of phosphodiester bond into components at pH less than 2.

   Extremely low pH digests the DNA completely and this is why our stomach pH is low

   DNA in alkali medium

   DNA is not hydrolysed by alkali pH because it does not contain the 2'- OH for base catalysed hydrolysis mechanism. The higher the hydrogen ion concentration, there is extensive deprotonation and this results in denaturation of the double stranded DNA.

   RNA in acid medium

   RNA is more resistant to acid hydrolysis compared to DNA and requires certain extreme conditions.

   RNA in alkali medium can be easily hydrolysed as it contains 2'-OH. The nucleophilic attack OH on 2'-OH and converts it to nucleophile which results in intramolecular displacement. This results in cleavage of phosphodiester bonds.

7. The double helical structure of DNA was proposed by James Watson and Francis Crick in 1953. The structure of DNA double helix is conjugated to a twisted ladder. The salient features of Watson-Crick model of DNA are described below

   a. The DNA is a right handed double helix. It consist of two polydeoxyribonucleptide chains twisted around each other on a common axis.
   b. The two strands are anti-parallel
   c. The width of a double helix is 2nm
   d. Each turn of the helix is 3.4nm with 10 pairs of nucleotides.
   e. The two strands are held together by hydrogen bonds formed by complementary base pairs. The A-T pair has 2 hydrogen bonds, while the G -C pair has 3 hydrogen bonds.

- The hydrogen bonds are formed between a purine and a pyrimidine only.

f. The complementary base pairing in DNA helix proves Chargaff's rule. The content of adenine equals to that of thymine and guanine and cytosine.

g. The genetic information resides on one of the two strands known as template strands.

8. Differences between DNA and RNA

	DNA	RNA
I.	Sugar moiety is deoxyribose	Sugar moiety is ribose
II.	The bases present are adenine, thymine, guanine and cytosine	The bases present are adenine,uracil,guanine and cytosine.
III.	It has double stranded molecules	It has single stranded molecule
IV.	It is stable and not hydrolysed easily by alkalis	It is unstable and hydrolysed easily by alkalis
V.	The lifetime of DNA is comparatively high	RNA has short life
VI.	No natural DNA is catalytic	RNA can be catalytic

9. Functions of Nucleotides
   a. They act as activated precursors of DNA and RNA
   b. ATP- is a central to energy metabolism
   c. GTP- drives protein synthesis
   d. CTP- drives lipid synthesis
   e. They act as metabolic regulators.