

hello everyone i welcome you all in the series of lectures on biomolecule today is our 12th lecture before going to the details of today's lecture i will like to give a recap of my last lecture ah in the last lecture we discussed about the vitamins and we we learned that ah vitamins are necessary ah for ah in a small amount ah for our you know good health and ah you know they they has to be ah incorporated by dietary in intake ah our body can synthesize only bitumen k and vitamin d ah and that also not sure that it can be ah you know synthesize in appropriate amount ah ah based on the you know nutritional value these ah ah you know ah vitamins has been ah classified in water soluble vitamins water insoluble beta means and there we ah we discussed about the all the beta means vitamin b1 b2 b6 all these ah you know water soluble and water insoluble one their dietary intake and their deficiency can what kind of can lead to the what kind of diseases that we have already discussed then we we switched to ah another biomolecules nucleic acid and we learned that nucleic acid particularly ah d n n a rna are made up of ah d ribose rna is made up of d ribose units ah which are linked together by phosphodiester linkages ah and ah dna is made up of two d ribose five membered sugar unit which is linked with another sugar unit by you know ah phosphodiester linkages also ah these ah sugars are linked with the different bases ah dna has two ah purine bases adenine and guanine ah and you know it has two ah purine bases cytosine and thymine ah whereas rna instead of these all three adenine guanine and cytosine ah instead of thymine it has uracil ah so i will continue with the nucleic acid and there i was talking about the nucleosides that you know a compound containing a base bonded to d ribose r two d oxy ribose is called a nucleoside and particularly we were talking about the nucleosides in rna so this is adenosine and ah with the guanine ah it leads to the guanosine with the cytosine it leads to the cytidine here you can see that this in all these ah nucleosides five membered sugar is common and it is you know kind of link beta linkages beta glycosid linkage with the bases purine and pyrimidine bases so the last one uridine i was doing the uridine structure um similarly uridine also has five membered sugar d ribose and it is linked with the base ok this is uridine uridine now we will talk about the nucleosides in dna nucleosides in dna so as i mentioned that dna has two d oxy d ribose so i

will draw first two d oxide ribose

so two d oxy d ribose and again here base

so base here i will like to correct again the

drying the earlier nucleosides in rna also here i have you know forgotten the bonds

so i am

correcting it adenosine guanosine and cited in now nucleosides in dna what is important here

that only sugar will be 2 prime d oxy as you can see here 1 prime 2 prime three prime four

prime and five prime sorry five prime five prime five prime

so these are these

this is the numbering pattern and this becomes two d oxy

adenosine two prime two prime d oxy adenosine adenosine now i will draw guanosine one guanosine one

so two prime d oxy guanosine two prime d guanosine guanosine similarly cytosine one

so as we know that at two prime

position there will not be hydroxyl group

so this becomes two prime d oxy cytidine two prime d oxy cytidine two prime deoxycytidine and

finally thymidine thymine based

so thymidine thymidine thymidine

so these are the nucleosides in dna now

i will talk about nucleotides what is nucleotides a nucleotide is a nucleoside methane hydroxyl group a nucleo side is a a nucleotide is a nucleoside with an hydroxyl group of the sugar bonded with an hydroxyl group of the sugar bonded of the sugar bonded in an ester linkages in an ester linkages linkage to phosphoric acid to phosphoric acid nucleotides a nucleotide is a nucleoside with an hydroxyl group of the sugar bonded

in an ester linkage to phosphoric acid a nucleotide is a nucleoside

with an hydroxyl group of the sugar bonded in an ester linkages to

phosphoric acid the nucleotides of rna are of rna are more precisely called

ribonucleotides more precisely called ribonucleotides ribonucleotides and those of dna

are called deoxyribonucleotides nucleotides of dna deoxyribonucleotides deoxy

ribo nucleotides d oxy ribonucleotides the base name in nucleotides are the

same as those of nucleosides ok

so how can

we write it in equation form nucleoside nucleoside is equal to base

plus sugar and nucleotide base plus sugar plus phosphate plus phosphate ok so

if we take adenosine and you know couple it with

the phosphate linkage the hydroxyl group of ah sugar if the five position

hydroxyl group of

sugar five prime position gets linked with the phosphoric acid it forms

phosphate then it becomes

nucleotide

so i i will i will write you know ah nucleotides adenosine

nucleotides it should be based

so so this is the base i am writing first and s two and as i mentioned

that at five prime position it will form ester linkage with

phosphoric acid

so i am here giving the

so adenosine 5 prime monophosphate adenosine 5 prime monophosphate five prime

monophosphate amp adenosine 5 prime monophosphate

so here monophosphate is there now if ester is with the diphosphate

so again i will draw the structure

so since we are drawing adenosine

so adenine the base will be same and here diphosphate linkage will be diphosphate

so so this is adenosine five prime diphosphate five prime diphosphate diphosphate and this is known as adp in

turning adenosine five prime diphosphate and finally triphosphate adenosine adenosine triphosphate atp

that is you know energy coin which gets synthesized in mitochondria of the cell and this is power coin commonly known as

so this is tri triphosphate adenosine adenosine triphosphate five prime triphosphate triphosphate atp atp

so we we learn about the

nucleosides and nucleotides basically nucleosides are compounds formed by the you know

condensation of base and sugar whereas nucleotides are formed of base sugar and phosphate now

nucleic acids are composed of nucleotide subunits nucleic acids are composed of nucleotide subunits nucleators

so nucleic acids are composed

of long strand of nucleotide subunits nucleic acids are composed of long strands of nucleotide subunit nucleotide sub units subunits a dinucleotide

contains two nucleotides of unit a dinucleotide contains two nucleotides of units subunits and oligonucleotide contains contains three to ten nucleotides of units

nucleotide subunits a polynucleotide contains a polynucleotide contains many nucleotide subunits many nucleotide subunits

so dna and rna are polynucleotide

here i will like to mention dna and rna are polynucleotides again i will rephrase whatever just now i

discussed the nucleic acids are composed of nucleotide sub units nucleic acids you know

ah basically ah are having long strain of nucleotides and if a dinucleotide is there then

it will contain only two nucleotide subunits and oligonucleotide contains ah 3 to 10

nucleotide subunits a polynucleotide contains a number of nucleotide units so dna and rna are polynucleotides

so lets talk about the

biosynthesis of nucleic acid biosynthesis of nucleic acids biosynthesis of nucleic acids

nucleic acids are biosynthesized from biosynthesized from nucleoside

triphosphate synthesized from nucleosides triphosphates nucleoside triphosphates nucleoside triphosphates using enzymes called enzymes called dna polymerases

for the synthesis of dna are rna polymerases

for the synthesis of rna

so i will repeat again nucleic acids are biosynthesized from

nucleoside triphosphate using enzymes called dna polymerases dna polymerases for the synthesis of dna our rna polymerases for the synthesis of rna for the

synthesis of rna ok

so let us talk about

the biosynthesis now as i mentioned that basically here i am going to talk about the

dna synthesis

so i will take base here and then since the dna i am talking

so it will be two prime d oxy again another sugar unit base now triphosphate so this is type asset a

phospho ester band this is a phospho ester band this is the first phospho ester bond and this

is five prime basically this is the five prime position now it can react with another monophosphate it denotes two d r c phosphate

so here again base and at the five prime position it has right

so again here hydroxyl group at the three prime

this will attack on the phospho ester and then again cleavage will

take place this is again here phi prime and three prime is there this process

again can lead to the another sugar unit base here and then at the five prime position fast foster group now this will again attack and three prime position

so we can see

that three prime hydroxyl group is forming the phosphodiester

linkages ah while attacking on the phospho ester group at the five prime

so we

are moving from phi prime to three prime three prime ah nucleotide at

two at the three pi min here nucleotide add to the three prime end three prime end

so now we understand that

how the biosynthesis of nucleic acid happens how does it ah keep on in the nucleotide keep on adding the you know phospho digester

linkages at the 3 prime position

so let us talk about the primary

structure of a nucleic acid primary structure of a nucleic acid nucleic acid

so the primary

structure of nucleic acid nucleic acid is the sequence

of bases in the strand sequence of bases in the strand remember that while

talking about

the primary structure of protein also we discussed ah that you

know what is the you know um sequence of amino acid in the

primaries and the disulfide disease here also in the primary structure of

nucleic acid basically the sequence of bases in the strand

ah we we learn about

so remember that nucleotide nucleotide at the phi prime end nucleotide at five prime

end of the strand has iron strand has an unlinked five prime tri phosphate group and unlinked five prime triphosphate group triphosphate group and the nucleotide

at the three prime end nucleotide at three prime end has an unlinked unlinked

three prime hydroxyl group as you can

see in the biosynthesis three prime hydroxyl group hydroxyl group to explain it again the

biosynthesis of nucleic acid you can see that you know this ah nucleotide ah is reacting at

the three prime position three prime position it has unlinked you know hydroxyl group

where as at the five prime position it has phospho ah triphosphate

basically it has triphosphate

so just for the representation i can write here different basis

so this becomes five prime end and this is three prime end

three prime end will have only hydroxyl group now let us talk

about the secondary structure of dna the secondary structure of dna secondary structure of dna watson and creek concluded with the aid of rosalind franklin's x-ray data basically the

secondary structure of dna was proposed by watson and creeks based on the information provided by rosalind franklin he provided the i mean rosalind flank when c provided the x-ray structure and based on that watson and crick proposed the secondary structure of the you know dna

so dna

what is that dna consists of two e strands dna consists of two strands of nucleotide nucleotides with the sugar phosphate backbone on the outside with the sugar phosphate backbone on the outside on the outside and the bases on the inside and the bases on the inside the strands are anti parallel

another information is the strands are anti-parallel parallel they run in opposite direction means they run in opposite direction there are in opposite direction the strands are held together held together by hydrogen bonds by hydrogen bonds between the bases on one strain on one strand and the base is on the other strand and the base is on the other strand on the other strand and i would like to mention here that dna is

strands are complementary the dna strands are complementary the dna strands are complementary chagos data showing that adenine binds with thymine and guanine binds with cytosine chargoff data showing that showing that adenine binds with thymine and guanine binds with the cytosine cytosine

so strogaf's data shows i mean

adenine binds with thymine and guanine binds with the cytosine thus if you know the sequence of bases in one strand you can figure out the sequence of bases in

the other stand

so if you know the sequence of if you know the sequence of bases in one strand you can figure out the sequence of bases in the other resistance figure out the sequence of bases in the other stand the other stand

so to make it more clear i will like to draw the structure of ah basically dna

so this is the here the phosphate linkages again again phosphate linkages we h again this is

so this is phi prime phi prime and this is three prime now if it has thymine thymine then it will bind with base adenine

so adenine ibuilda here and again again here five membered in here five membered

so here adenine and here it has guanine so it will bind with the you know cytosine cytosine and again here if i am taking

thymine then again the complementary will be draining again if i have thymine

so it will have renin phosphate linkages

so on it will go let me put the hydrogen bonds here in these two complementary

strain

so what is here here again it has three prime position and this side it has five prime position five prime position

so this strand is coming from three prime to five prime side whereas this is strand is coming from phi prime to three prime side now let us make the hydrogen

bonds between the bases

so thymine and adenine has two hydrogen bond whereas guanine and cytosine has three hydrogen bond and the distance between these two bases are three point four

angstrom similarly thymine and again and if it has g guanosine and cytosine so this

will have one two three

so bases on inside bases on inside bases on inside and sugar phosphate backbone on outside backbone on outside

so we saw that how

phi prime and three prime this end is you know ah bonded with ah three prime five prime strand by hydrogen bond hydrogen bonding dictates

base pairing hydrogen bonding dictates base pairing base pairing the base pairing is dictated by

hydrogen bonding

so let us see thymine and adenine

so let

me draw the structure of thymine thymine with the adenine

so this is thymine and adenine two hydrogen bonds it has two hydrogen bonds and here it is connected with

the nine position with the sugar here also it is connected with the sugar

so thymine and adenine thymine pyrimidine base and adenine is a pure purine base now let us talk about the other pair thymine adenine and cytosine and gua guanine

so let me draw the

structure of cytosine first

so this is a again in cytosine and guanine this is the hydrogen bond again you can see the three hydrogen bonds are there

in this two pair cytosine and guanine it has three hydrogen bonds three hydrogen bonds

so i think

now it is clear that you know how dna ah is made up of it is made up of ah you know two strands and these two strands are complementary to each other and they are they

are bound with each other because of the hydrogen bonding between the base pairs ah now let us

talk about the double helix the double helix

so the two antiparallel dna strands are

not linear but are twisted into a helix around the two antiparallel dna strains

are not linear you know the way ah you know i wrote in the primary structure but

they are ah helical and they are twisted ah around a common axis

so i can i can draw

this structure around common axis

so i can if i can take like this like this like this

so this is the common axis around that

so this is where you know actually the base pairs

are planar and parallel to each other ah on the inside of the helix base pairs base pairs are

planar and parallel to each other

so these are the base pairs you know to ah make it more clear the double helix resembles like a circular staircase the double helix resembles a circular staircase resembles a circular staircase the base pairs are the rungs and the

sugar phosphate backbones are the hand rails the base pairs

these base pairs are rung and the sugar phosphate

backbones are the hand rails base pairs are the rungs and sugar phosphate

backbones are the handrails sugar phosphate backbones are the handrails

handrails the o h group of the

phosphodiester linkages has a p k about two the o h group of the phosphor dye

ester linkages has a p k about two about two

so it is in the basic form at you

know it is in the negative form basically

so it is in its basic form in its basic form means negatively

charged at physiological peers negatively charged at physiological ph

physiological the negatively charged phosphates

repel nucleophiles thereby preventing cleavage of the phosphodiester bands

negatively

charged phosphate repels nucleophiles and that is why ah basically in since it is

negatively charged at the physiological ph and that is why they repels

nucleophiles

so that it cannot attack and ah you know it cannot cleave the phosphodieter linkage now

finally i will talk about the dna and heredity heredity

so dna condense contains hereditary information

there must be a method to decode that information i told that dna contains hereditary

information and there should be a method to decode that hereditary you know

message basically ah how does it happen ah as we know that the sequence of

bases in dna sequence of bases in dna provides a blueprint for the synthesis of

rna for the synthesis of rna for the synthesis of rna the synthesis

of rna from dna blueprint is called transcription the synthesis

of rna from dna blueprint is called transcription transcription the synthesis of

rna from dna blue print is called

transcription now the sequence of bases in rna

so this this is i am you know

explaining the decoding process that how dna hereditary material you know decodes

the hereditary information the sequence of bases in rna determines the sequence

of amino acid in a protein determines the sequence of sequence of amino acids in

protein amino acids in protein and the protein synthesis from rna

blueprint is called translation

so from mrna we synthesize protein the synthesis of protein from rna

blueprint is called translation translation translation rn is used for protein

biosynthesis

so here i introduce that the rna used for protein biosynthesis the rnas used for protein biosynthesis rna

molecules are much more shorter than the dna and they are single stranded although

dna molecules have billions of base pairs dna molecules have billions of base

pair billions of base pairs rn molecules really have

more than ten thousand nucleotides rna molecules rarely have more than ten

thousand nucleotides more than ten thousand nucleotides there are several kinds of rna what are these rna several kinds messenger rna this like messenger rna commonly known as mrna messenger rna is mrna whose sequence of bases determine the sequence of amino acids here whose sequence of bases this is determines the sequence of amino acids sequence of amino acids ribosomal rna which is commonly known as rrna a structural component of ribosome a structural component of ribosomes the particles on which biosynthesis of protein take place the particle on which biosynthesis of protein takes place biosynthesis of protein takes place and the final one is transfer rna transfer rna which is commonly known as trna trna is the carrier of amino acids amino acids used for protein synthesis amino acid used for protein synthesis

so the rnas used for the protein biosynthesis i discussed and as i told that rna molecules are much shorter than the dna molecules and generally single stranded and rna has you know only up to 10 000 nucleotides and there are several kinds of rna messenger rna where the sequence of bases determine the sequence of amino acid in the protein ribosomal rna a structural component of ribosome ah the particle on which the biosynthesis of protein takes place and transfer rna ah the carrier of the amino acids used for protein synthesis basically transfer rna used as a carrier so this much about the you know ah nucleic acid ah

so ah now ah i will like to again ah you know count all the topics whatever we have discussed in biomolecules we had we have discussed about the sugars we have discussed about the ah enzymes ah we have discussed about the ah vitamins we have discussed about the nucleic acids all these bio molecules we have discussed and i hope now you have better understanding about the biomolecules ah please practice ah your question papers relevant to the preparation and that you know i think after consulting these lectures you will not have any doubt thank you very much for the attention you