"Chapter 6"

Page No.
Date:

"Gene - Its nature, regulation & manipulation"

Definitions of gene :→

(I) It is a segment of nucleic acid usually DNA, rare RNA.
(II) It occupies a specific locus on chromosome.
(III) It has a unique sequence of nucleotide base pair.
(IV) It carries coded information for a specific polypeptide.
(V) Can undergo crossing over & mutations.
(VI) It may have continuous or split information.
(VII) It is able of replicate itself and can produce phenotypic expression.

Cistron :→ It was introduced by Benzer in 1955. It is a segment of the DNA, which carry information for the production of one polypeptide chain.

★★ Types of gene :→

(i) **Housekeeping or Constitutive genes** :→ The genes which are constantly transcribed and expressed in all the cells, because the products they code are needed constantly for

cellular activities.

(ii) Non-constitutive or luxury gene :→ The genes which remain inactive an one express only in certain cells, wh they need any product.

(iii) Structural genes :→ The genes which code for mRNAs whic in turn synthesizes specific polypeptid on the ribosomes.

(iv) Regulator gene :→ The gene which code for repressor protein for regulating the trans -iption of cistron.

(v) Operator gene :→ The gene which acts as a switch to turn on and off the transcripti of a structural gene as cell requires.

(vi) Promoter gene :→ The genes or sequences on DNA where RNA polymer are binds for the transcription of structural proteins.

(vii) Split genes :→

Introns : The genes which are transcribed b not translated.

Exons : The genes which are transcribed as well as translated.

Page No. _____
Date:

Split genes: The genes which carry information in Pieces rather than a continuous stretch are called split genes.

(viii) Overlaping genes :→ Some genes code for two different polypeptides called overlapping genes. For eg: in some Bacteria & viruses.

(ix) Transposon's (Jumping genes) :→ In repetitive DNA sequences change there position in DNA are called jumping genes.

★ Regulation of gene expression : The rate of protein synthesis is regulated by genetic apparatus and environmental factors. In accordance with the need of a cell. The mechanism which stimulate the expression of certain genes and inhibit the expression of others as required in the cells is called control or regulation of gene expression.

Regulation of gene expression in Prokaryotes: Bacteria can regulate the synthesis of enzymes in a way that the enzymes are produced only when the substrates are there to act upon.

Lactase or Lac operon Hypothesis : This hypothesis was given by Francois Jacob and

Jaeques Monod in 1961, for the regulation of gene action as a result of their studies on the metabolism in E. Coli.

☆ Operon : It is a segment of DNA which is composed of one or more adjacent structural gene on operator gene, a promoter gene and a regulated gene. Operon work in co-operation with Repressor protein and induces substances.

Operon are of two types :

(I) Inducible. →
(II) Repressible.

A regulator gene code for a protein is Repressor.

Repressor combine with operator gene to repress or stop its action. So it is called Regulator protein. It stops transcription of structural genes by turning off the operator gene.

☆ Inducer :→ It is a chemical substance which inactivate the repressor by modifying its structure. Inducer join the repressor form Repressor – Inducer complex, this complex prevents the repressor to operator gene of operators.

Page No.
Date:

I Inducible Operon :→ This operon is switched on when a chemical, called Inducer is present. Lactose or lac-operon of E.coli is an example of Inducible operon. It has following components.

(I) Structural gene :→ When Lactose is added to the E.coli culture. The structural genes produce specific polypeptides which acts as enzyme to catalyse the lactose. In the cell, the operon has 3 structu-ral genes, Lac Z, Lac Y, Lac A, which lie adjacent to each other. which further transcribe mRNA and translate into enzymes i.e. β-galactosidase, Lactose permease, Transacetylase.

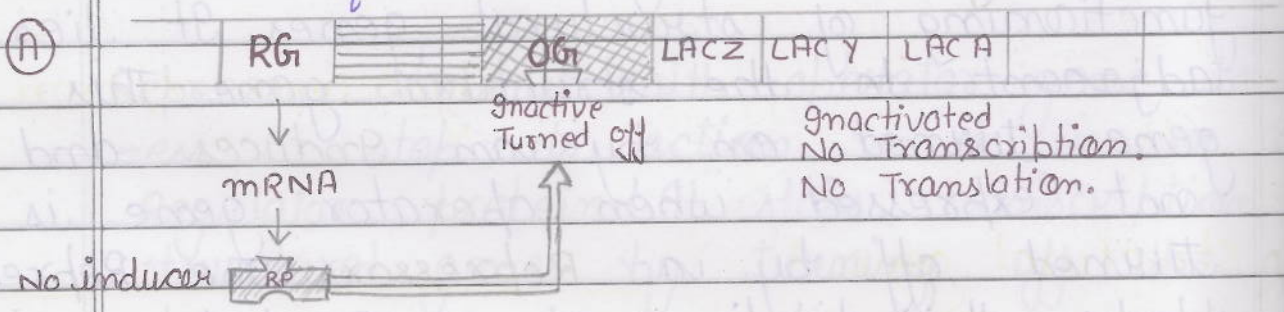
(II) Operator gene :→ The gene which controls the functioning of structural genes. It lies adjacent to the structural gene. This gene turned on by an Inducer and not expressed when operator gene is turned off by a Repressor. The Repressor blocks the binding of RNA polymerase to the promotor, so gene turned off.

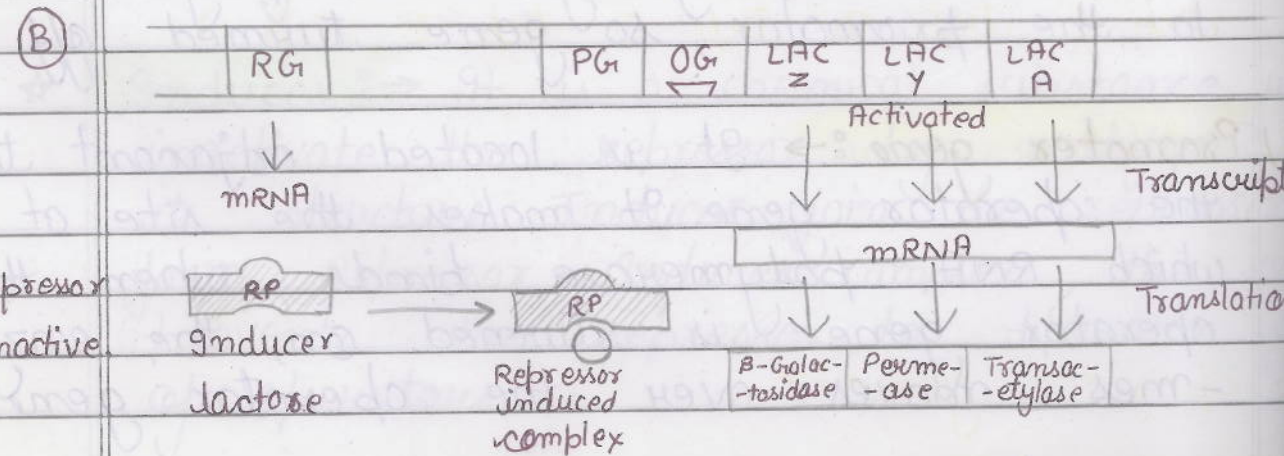
(III) Promoter gene :→ It is located adjacent to the operator gene. It makes the site at which RNA polymerase binds, when the operator gene is turned on, the enzy-mes moves over the operator gene

to reach the structural genes and tra-ription starts. Promoter gene determine DNA strand act as a template for m transcription.

(IV) Regulator gene :→ This gene control the operator gene in co-operation with chemical compound Inducer present in the cytoplasm.

Repressor - Inducer complex this complex prevents the repressor to bind with operator gene of operon. This frees the operator gene so that RNA polyme- are can move from promoter to stru- ure gene, then they transcribe mRNA and further change to enzyme, which are required.





Page No.
Date:

** Result of lactose addition to E.coli culture: Some lactose molecules are carried into the cell by the enzymes Lactose Permease molecules as a small amount of this enzyme is present in the cell even when the operon is not working. These few lactose molecules are converted into active form which act as Inducer and bind the repressor - Inducer complex which fails to join with operator gene, which in turned on. The three structural genes are expressed as three enzymes to metabolise lactose to galactose & glucose.

Inducible operon function in catabolic path-way

(II) Repressible operon :→ The operon in switched off when a chemical substance called co-repressor is present. Tryptophan operon of E.coli in example of Repressible operon.

(i) Structural genes : The tryptophan operon com-prises 5 structural genes denoted as trp E, trp D, trp C, trp B, trp A they lie close to each other on chromosome. These genes form mRNA and then enzymes, which convert raw material into tryptophan

(ii) Operator gene :→ This gene is lying adja-

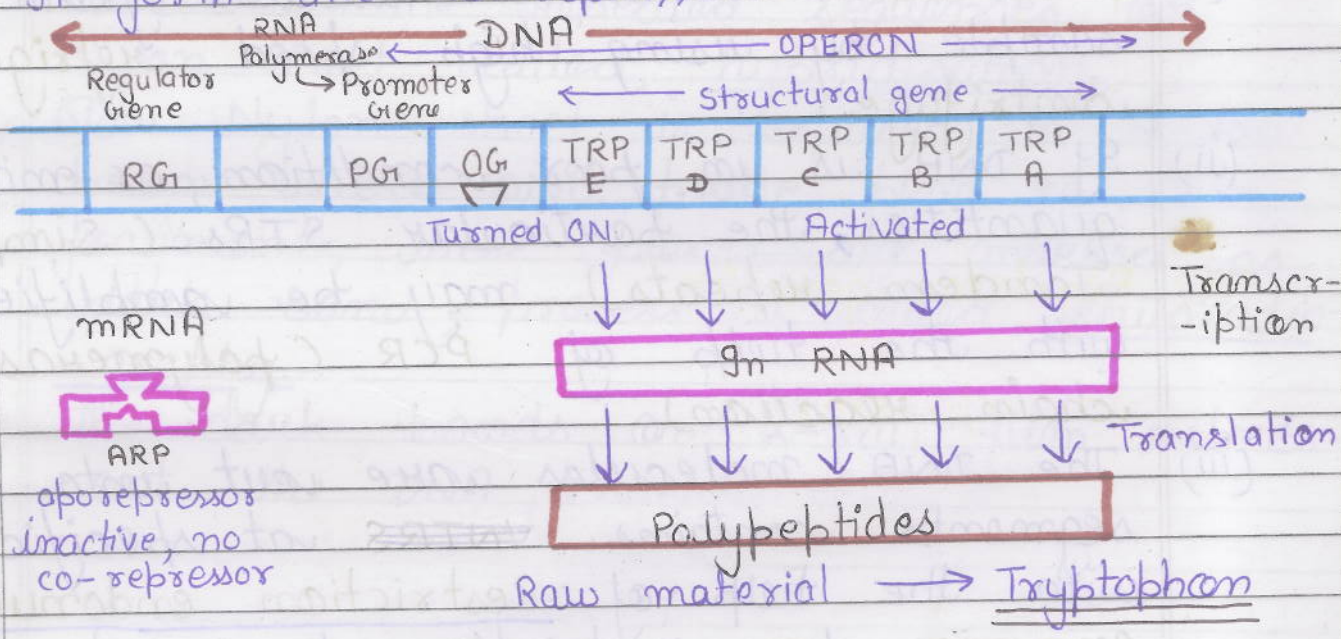
-acent to structural gene. It remain turned on, because it is not joined by the aporepresor protein produced by the Regulator gene So the structu gene produce enzymes. They lacks catalyse the synthesis of Tryptophon from raw material.

(III) Promoter gene :→ This gene lies to the op -tor gene. It mark the site where RN polymerase enzymes binds. When opera gene is turned on, this enzyme mov over the operator to structural gene & transcription starts.

(IV) Regulator gene :→ It controls the operator g in co-operation with a substance called co-repressor. The co-repressor may be end product of metabolism or received by the cell from outside. The regulat gene codes for a protein called apor -ressor and form complex and later join the operator gene, which is turn off. The structural genes stop transcrib When organism gets tryptophon in exc from outside it conserves raw materi and energy by suspending the synth -is of this compound, in its own bo This phenomenon is called feedback re -ssion.

Page No.
Date:

Co-repressor :- It is a non-protein compound which may come from outside or from metabolism within the cell. Its concentration controls transcription in the cell, If conc. of co-repressor uses **aporepressor - co-repressor** complex is formed, the complex joins the operator gene and stop the production. If the co-repressor level falls, aporepressor fails to get co-repressor and does not join operator gene, It form the co-repressor.



Page No.
Date:

"DNA Finger Printing"

In 1977, it was invented by Sir A Jec
-es.

* Sources of DNA finger printing :→ The sa
of DNA may be obtained from the t
of blood, semen, urine stain, saliva, cigar
Buds, vaginal swab, single hair etc.

Procedure for DNA finger printing :→

(i) The DNA molecules are isolated from g
sample by using high speed refrigera
centrifuge.

(ii) If DNA is in poor condition, or minut
quantities, the particular STRs (Simple
Tandem repeats) may be amplified
with the help of PCR (polymerase
chain reaction)

(iii) The DNA molecules are cut into sm
segments contains VNTRS at specific s
with the help of Restriction endonucle
enzymes for restriction fragments arra
-ed lengthwise analysis. These
segments contain VNTRS.

(iv) Now DNA fragments are arranged on
agarose gel slab by Electrophoresis
fragments arranged lengthwise along g
and electric charges.

(v) The double standed DNA now split into
single standed by using alkaline chemi

(vi) Now place the Nylon nitrocellulose sheet on agarose gel slab. So DNA fragments copied on it with the help of Southe-rn blotting technique (Invented by E.M southern)

(vii) Now DNA probes are prepared in lab, which contains repeated sequences of nucleotides complementry to those on VNTRS.

(viii) These probes are made radioactive which bind to the repeated sequences on Nylon sheet called hybridisation.

(ix) Now Nylon sheet is exposed to R-ray beam where DNA probe bind to DNA fragment, these places are marked as dark band, process is called Autoradio-graphy.

(x) The dark bands on x-ray film represent the DNA fingerprint.

"Chapter-6"

Page No.
Date:

"DNA : The genetic material"

Evidences or Proof that DNA is Genetic Material

★ Experiment 1 :->

Griffith's and Avery's transformation experiment :->

In 1928 S.F. Griffith experimented with Streptococcus pneumonial (Diplococcus) a bacterium that causes Pneumonia.

There are two strains of bacterium :

(a) A smooth virulent strain (S-strain), protected by polysaccherides capsule and cause Pneumonia.

(b) A rough harmless strain (R-strain) without capsule not cause pneumonia

(I) When rough bacteria injected with live smooth bacteria, mice died due to pneumonia.

(II) When rough bacteria injected to mice, they did not die.

(III) Mice injected heat-killed smooth bacteria mice survived.

(IV) Now mice injected with mixture of live rough bacteria and heat-killed smooth bacteria. It cause Pneumonia

(V) and killed the mice.

"Vit. B_{12} – Vit K" – [E.Coli & Streptococcus in intenstine]

Page No.
Date:

(V) Griffith found smooth bacteria in the blood of dead mice from this he concluded that a chemical substance transform from the death, smooth bacte-ria, into rough bacteria and later transform into smooth bacteria.

(VI) These transformed smooth bacteria recovered from the dead mice, when grown in culture produced smooth bacteria.

(2) Bacteriophage experiment :→

Bacteriophage :→ A virus which intect bacte-a and kill them is called Bacteriopha

In 1952 Alfred D. hasshey and Martha chase did experiment with bacter Escherichia Coli and bacteriophage T_2, both inhabing in human intestine.

(i) They are different radio active isotopes to label DNA and Protein. Ist they label Protein coat of Bacteriophage T_2 with radioactive Sulphur S^{35}. Because protein contain sulphur and DNA does not contain sulphur.

(ii) Now T_2 bacteriophage used to inject norm-al bacteria.

(iii) Now protein coats were separated form bacterial cell walls by shaking and centr-fugation.

(iv) It is found that radioactivity was associated with protein coats & none was inside the bacterial cell, this show

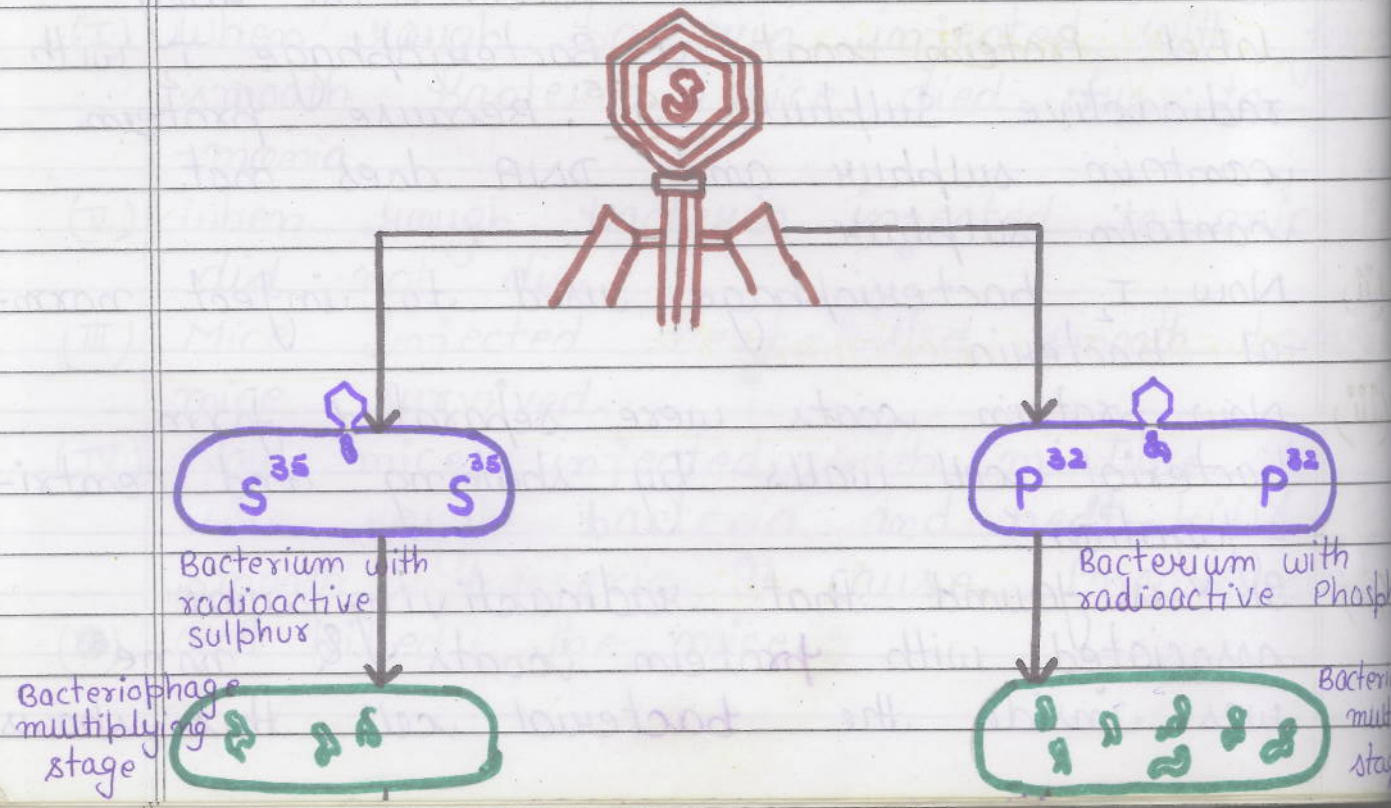
that protein coat of Bacteriophage did n
enter inside bacterial cell.

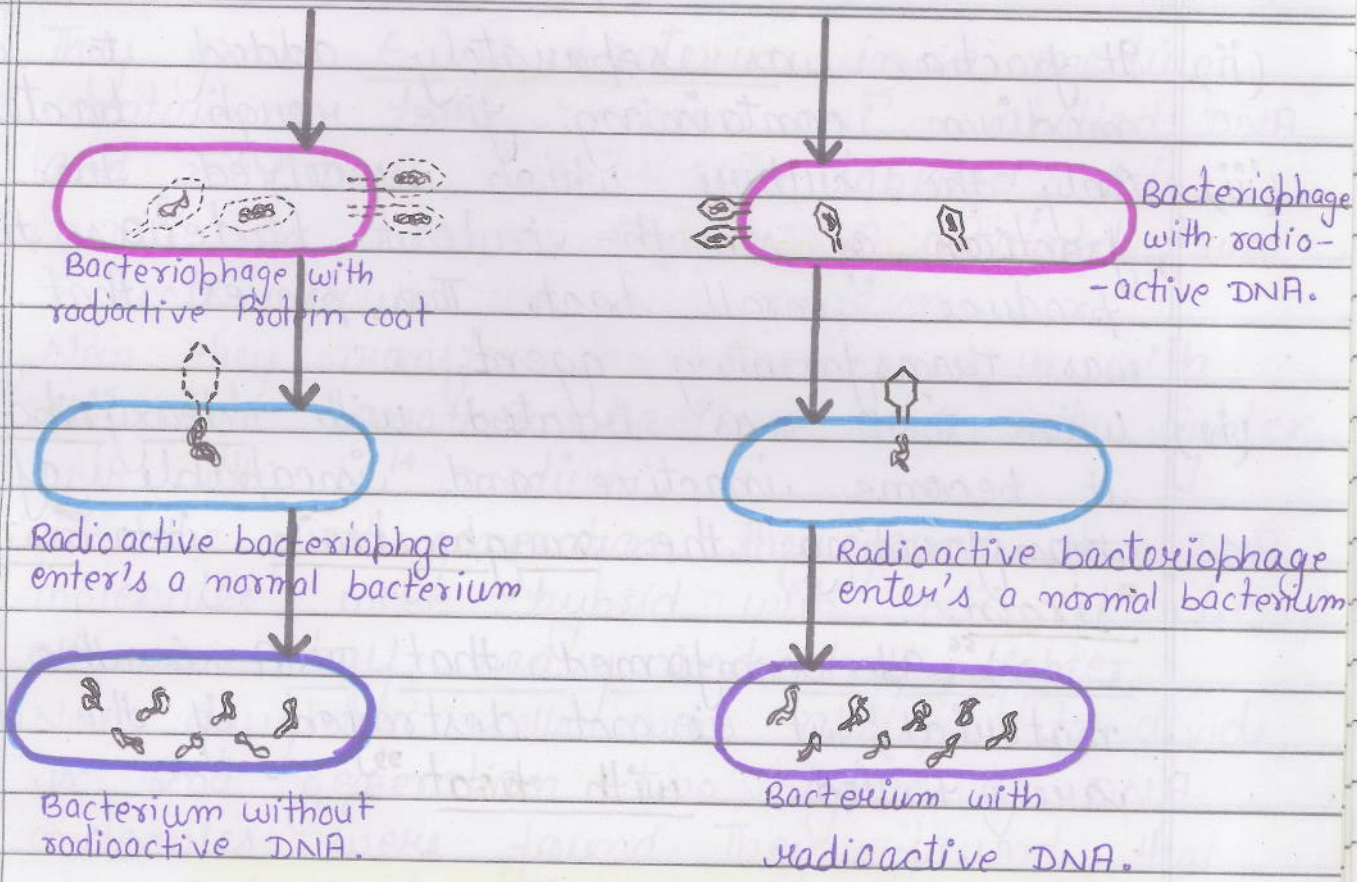
★★ In second case :→

(i) Now Hassley & Chase did experiment with DNA core. Now DNA core of bacteriopha is labelled with radioactive P^{32}, Phosph -orus, because DNA contain Phosphorous and Protein does not contain it.

(ii) Now bacteriophage used to infect the bacteria.

(iii) After centrifugation, it was confirmed that radioactivity was observed inside the bacterial cell, it proves that DNA is the material which pass to bacterial cell not protein. Hence it i proved that DNA is the genetic materi





Experiment of Harshey and Chare to show that DNA is the Hereditary or genetic material in the Bacteriophage T_2.

© Transformation :→ It is a phenomenon in which DNA is isolated from R-strain of bacteria, introduced from S-strain of bacteria is called Transformation.

AVERY's Experiment :→ In 1944, O.T. Avery, C. Macleod and M. Mc Carty.

(i) They separate the extract of smooth, virulent bacteria, into protein, DNA and carbohydrates fraction.

(ii) It fraction was separately added to culture medium containing five rough bacteria.

(iii) Only the culture which received the DNA fraction of smooth-virulent bacteria that produce smooth bact. This proves that DNA was transforming agent.

(iv) When DNA was treated with deoxyribonuc it become inactive and incapable of transforming the rough strain into smooth strain.

"It confirmed that DNA is the gen material, it is not destroyed if the cells are killed with heat"

☆☆ **Replication and Synthesis of DNA**

It is the process of synthesis of another daughter DNA from its parent DNA is called replication.

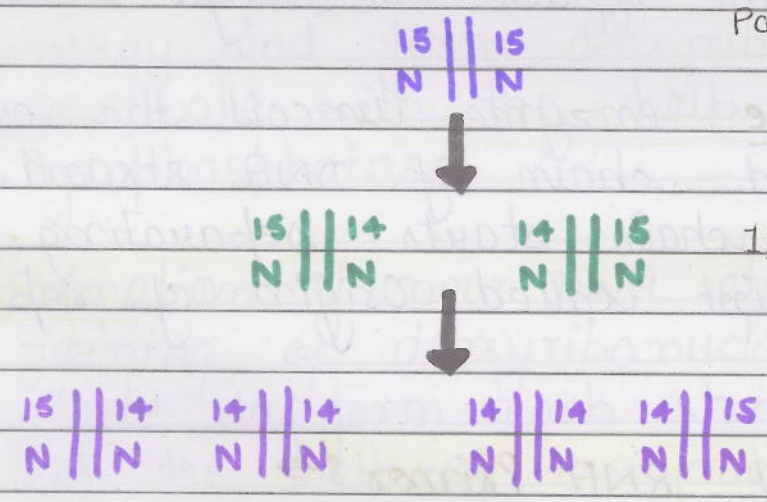
Mode of Replication :→ Mode of replication is said to be "Semi-conservative"

Replication :→ Occurs in nucleus in eukar-es. In prokaryotes it occur in cytoplasm

Discovery : Semiconservative mode of DNA wa demonstrated by Taylor in 1957.

☆☆ Experimental evidences was given by Meselson and Stahl in 1958.

1. They grow E.Coli bacteria in a medium containing heavy nitrogen N^{15} - labelled DNA, and get DNA with N^{15} - labelled, this DNA was heavier than DNA obtained from E. coli grown in N^{14} - medium.
2. Now they transfer the heavier DNA with N^{15} into another bacterial cell with lighter DNA with N^{14} medium.
3. In the first generation they found that DNA molecules were hybrid with $N^{15} - N^{14}$. i.e. all were half heavy and half lighter.
4. Now daughter cells were allowed to divide, in 2nd generation two types of DNA molecules were found. They found that 50% half heavy with $N^{15} - N^{14}$ hybrid and 50% light with $N^{14} - N^{14}$ density. This contains the semiconser-vative mode of replication



☆ Mechanism for DNA replication :→ Mechanism of replication involves complex process which require many enzymes, Protein

factors and metal ions.

(I) Activation of Deoxyribonucleotides :→
There are four types of deoxyribonucleos monophosphate are found, they are, de A de GMP, de CMP, de TMP. (Adenosine, Guanos Cytidine, thymidine, monophosphates). are activated by enzymes Phosphorylase producing phosphate & form dATP, de GTP, de CTP & de TTP.

(II) Exposure of parent DNA bases :→
(i) The parent DNA double strand uncoils splits into single DNA strand by break -ing of Hydrogen bonds.
(ii) The unwinding is done by enzyme Hel by using ATP and Non-enzymatic si Stranded DNA-binding Protein (SSB) stabilize the chain in single strand.

(iii) Topoisomerase enzyme uncoil the coiling of unwinded chain of DNA strand.
(iv) Now DNA chain starts separating at specific point called Origin of replicati fork.

(III) Formation of RNA Primer :→
(i) A short chain of RNA is formed on the DNA template of the 5th end is called RNA Primer.

Ligase
Pyrophosphatase
Helicase

Page No.
Date:

(iii) RNA Primer is formed with the help of enzyme RNA Primase. Because enzyme DNA Polymerase cannot initiate the synthesis of new DNA strand.

(iiii) DNA Primer is formed of free ends of one DNA strand and at the fork end of other strand, later primer removed and gaps filled to form DNA strand.

(IV) Base Pairing :→ All the bases like Deoxyribo-nucleoside triphosphates joined by the pairing rule of watson & Crick i.e. A-T, G-C, C-G and T-A.

(V) Conversion to Deoxyribonucleoside monophos-phate :→

Now the deoxyribonucleoside triphosp-hates join to each other at each single DNA chain, breaks off their inner high energy and form deoxyribonucleoside monop-hosphate with the help of enzyme Pyrophosphatase.

(VI) Formation of new DNA chains :→ By the joining of deoxyribonucleoside monophosp-hate to form each single DNA chain with the help of enzyme DNA Polymerase α and δ and with metal ions Mn^{+2} and Mg^{+2} They produce the double chains which are identical to each other.

Page No.
Date:

☆ Leading and Lagging strands :

(1) Leading strand ⇒ The DNA Polymerase pol
-rise the deoxyribonucleotides in th
5'-3' direction. Because the two stra
of DNA are anti-parallel, so new strand
formed on old strand in opposite dir
from 5'-3' is called leading strand

☆☆ Okazaki Fragments : On the other parent
strand, short DNA segments are form
in 5'-3' direction, starting from RNA
Primers. These DNA segments are calle
Okazaki fragments.

(2) Lagging strand :⇒ A separate RNA primer
formed for the synthesis of each okazak
fragment. These fragments joined. Jo
and form continuous strand that is
lagging strand.

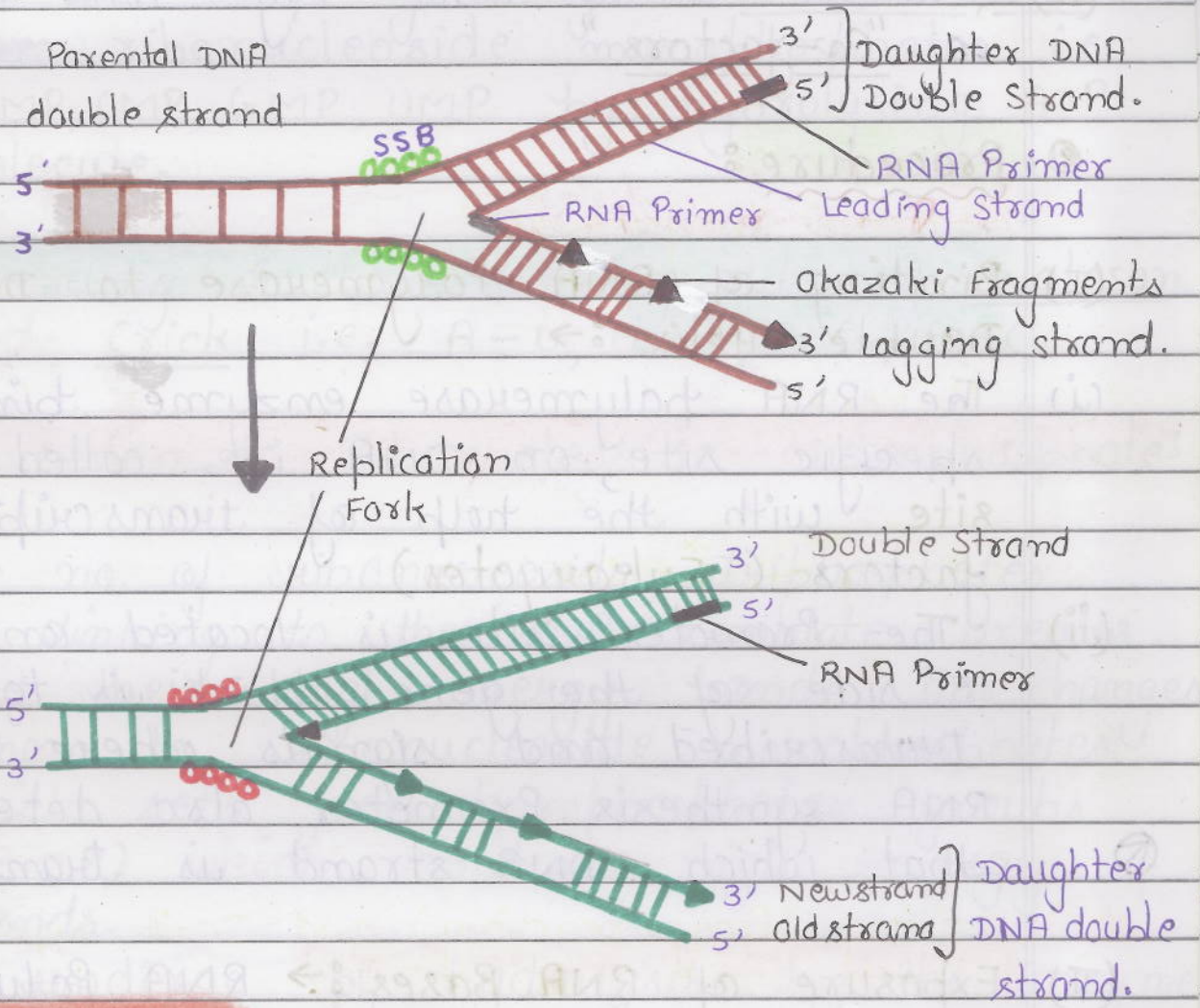
(VII) Editing (Proof-reading) and DNA repairs :

(i) To know the accurate base pairing of re
-cation, sometime wrong bases do get in
they are noted and removed by DNA
Polymerase.

(ii) Abnormal region of DNA are enclosed b
enzymes Nucleases and missing segme
of DNA strand resynthesized by DN
Polymerase

(VIII) Helix Formation : Each daughter's double DNA strand become spirally coiled to form Double Helix.

** Diagramatic representation :→



** Transcription :→ It is the process of synthesis of RNA from any one of DNA template is called Transcription.

Discovery : It was discovered by Jerarel Hurwitz, Samuel B. Weiss and Audrey Stevens in 1950 in Vitro experiment.

Page No.
Date:

Mechanism of Transcription :→

Material required =>

(i) Enzyme "RNA Polymerase."
(ii) DNA template.
(iii) Four types of ribonucleoside triphosph
(iv) Divalent metal ions Mg^{+2} and Mn^{+2} a "Co-factors"

Procedure :

(I) Binding of RNA Polymerase to DNA Double Helix :→

(i) The RNA polymerase enzyme binds t specific site, on DNA i.e. called Pro site with the help of transcription factors (Eukaryotes)

(ii) The Promoter site is located on the 5' side of the gene which is to be transcribed and signals where to st RNA synthesis. Promoter also determin that which DNA strand is transcribe

(II) Exposure of RNA Bases :→ RNA Polymera moves along the DNA & unwind the DNA complex into two chains. In the region of gene which is to be transcri This exposes the A, T, C & G. Only one strand in called sense stra of DNA and other strand act as anti -se and non-coding strand.

(III) Base pairing :→ The Ribonucleoside triphospha-tes. i.e. Adenosine triphosphate, Guano-sine triphosphate, Cytidine triphosphate & Uridine triphosphate (ATP, GTP, CTP, UTP). act as raw material are activated with the help of enzyme Phosphorylase form ribonucleoside monophosphates i.e. AMP, CMP, GMP, UMP by hydrolysing ATP molecule.

According to base pairing rule of Wateson and Crick i.e. A-U, U-A, C-G, G-C.

(IV) Conversion to Ribonucleoside monophosphate:

(i) The no. of ribonucleoside triphosphates on linking to the DNA template breaks off their high energy bonds. This changes them to ribonucleoside monophosphates which sets free pyrophosphates groups (P~P) which contain high energy bonds.

(ii) It undergo by hydrolysis by the enzyme Pyrophosphatase.

(V) Formation of RNA chain :→

(i) Each ribonucleoside monophosphate joined to DNA template the ribonucleotide arrived earlier, make the RNA chain longer.

(ii) The process is catalysed by enzyme Polymerase and divalent ions Mg or Mn^{+2}.

(VI) Separation of RNA chain :->

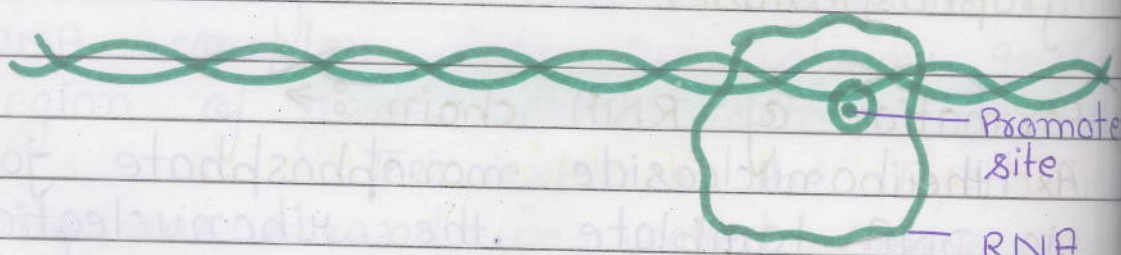
(i) As the transcription proceeds, RNA mo dissociates from DNA.

(ii) When the polymerase reaches to te -ator signal on the DNA, it leaves DNA, One gene forms several molecu of RNA, which are released from th DNA.

(VII) Return of DNA segment to original As the chain grows and separated from DNA, the DNA molecule gets hydrogen bonded to the mis-sense strand, and two are spirally coiled to assume the double helix form.

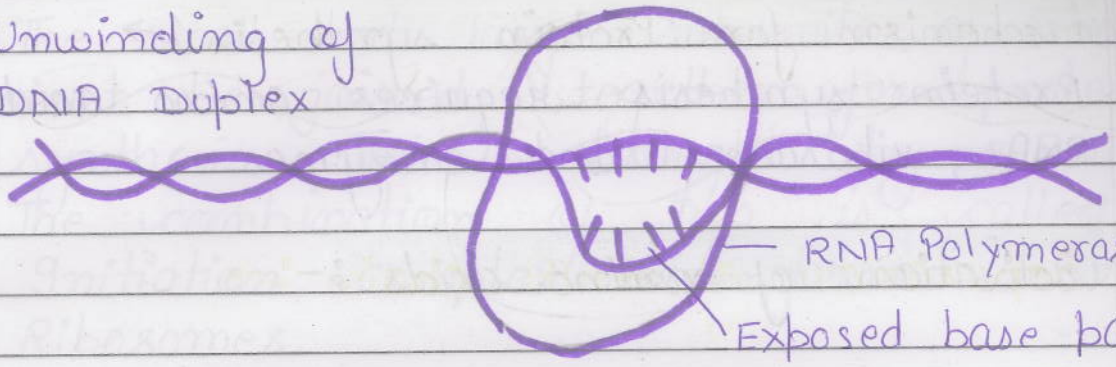
(I)

(II)

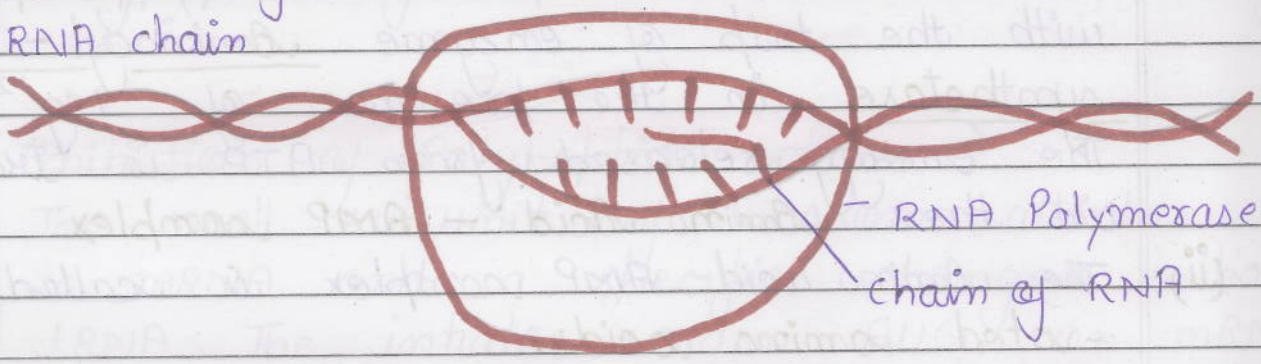


Binding and RNA with DNA duplex

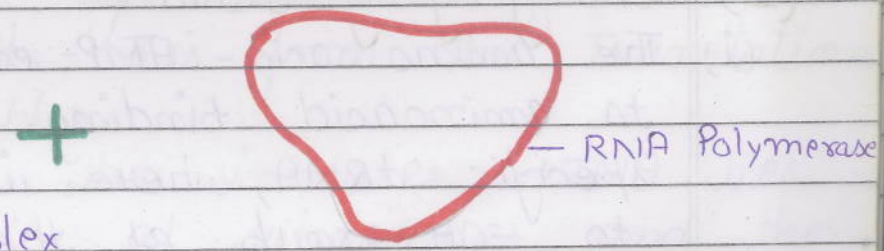
(III) Unwinding of DNA Duplex



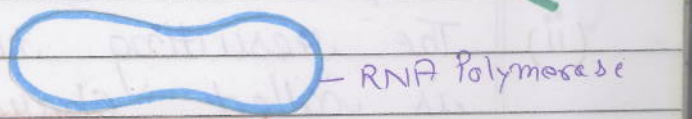
(IV) Initiation of RNA chain



(V)



(VI) Return of DNA Duplex



⇐ **Translation: (Protein synthesis)**

It is the process by which triplet base sequences of mRNA guides the linking of a specific amino acid to form a polypeptide.

Page No.
Date:

Mechanism for Protein synthesis :→

Protein synthesis requires amino acids, RNAs, ribosomes and enzymes.

(I) Activation of amino acids :-

(i) The amino acids react with ATP to fo amino acid - AMP complex and Pyrophosph with the help of enzyme Aminocyl - tR synthetase, in the presence of Mg^{+2}. The energy released from ATP is trap in the Amino Acid - AMP complex.

(ii) The Amino acid - AMP complex is called -vated amino acids.

Amino acid + ATP $\xrightarrow[Mg^{+2}]{\text{Activating enzymes}}$ Amino Acid- enzyme + PP

(II) Changing of tRNA :-

(i) The amino acid - AMP - enzyme complex to aminoacid binding site of its specific tRNA, where its -COOH group to -OH group of the termina triplet CCA.

(ii) The resulting tRNA - amino acid comple is called Charged tRNA. The AMP a enzymes are freed, these freed enz can activate and attach another acids.

(III) Activation of Ribosomes :-

The small and large subunits of ribosome must be joined together for protein synthesis. This is brought by mRNA chain. The combination of two is called Initiation complex and form active Ribosomes.

(IV) Polypeptide formation :- It involves 3 stages :

(a) Initiation of Polypeptide chain ⇒

(i) The small subunit of ribosome attaches to mRNA and a specific changes initiates tRNA. The intiates codon AUG on mRNA signals the start of Translation.

(ii) The initiates tRNA join the initiation codon by its anticodon and carries the amino acid methonine. Now the large subunit of ribosomes join the small subunit. This form the translation Initiation complex.

(iii) At this stage the initiates tRNA lies at the P site of ribosomes and the A site is vacant to let another charged tRNA to enter.

(b) Elongation of Polypeptide chain :-

(i) In the elongation stage of translation, amino acids are added one by one to the 1st amino acid. It is

done with certain proteins called El
-on factors.

(iii) A charged tRNA anticode sequence o
and specific amino acid attached
its carrier end. This tRNA shift to
site of ribosomes and A site lies
vacant for another charged tRNA.

(iii) With the help of Peptidyl Promolerase
shifts amino acid on another tR
at A-site of ribosomes and form b
called Peptide bond. Bond is formed
b/w -COOH grp. and free $-NH_2$ group
another amino acids.

(iv) Now tRNA at A site carrying mole
P-site, the process is called Transl
It require energy which is provided
by Hydralysis of GTP to GDP.

(v) Now the mRNA move with its cod
to the A site. the unchanged tRNA
shift from P site to E site and th
leaves the ribosomes.

(vi) Now the next cycle starts, a third
tRNA with its specific amino acid
es at the A site of the ribos
eins by anticodon and further
the chain and further elo
rm Polypeptide by repeating
cess.

(c) and release of Polypep

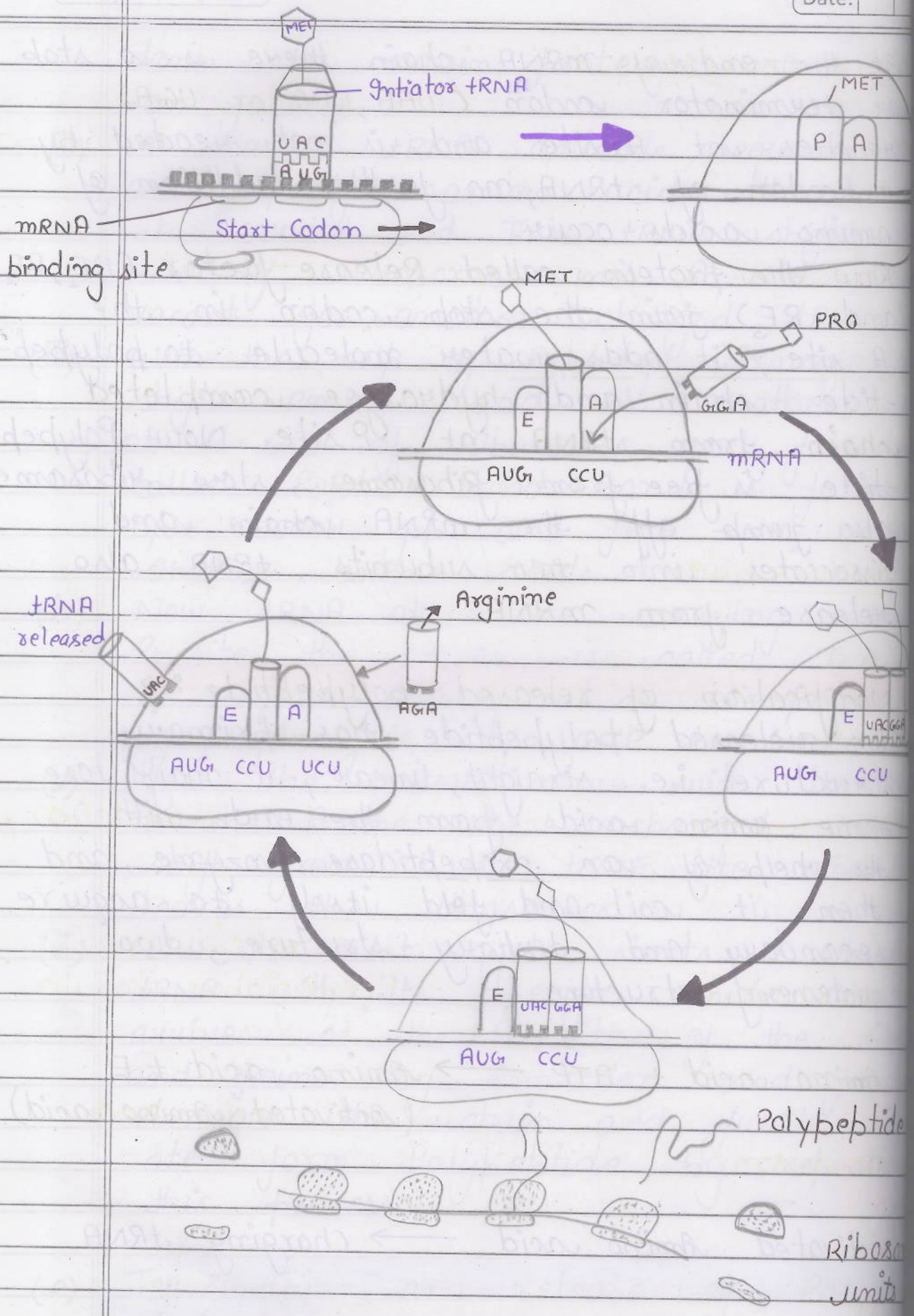
(i) At the end of mRNA chain there is a stop or terminator codon (UAA, UAG or UGA) reaches at A site and is not readed by anticodon of tRNA, no further addition of amino acids occur.

(ii) Now the protein called Release factor (RF_1, RF_2 and RF_3) join the stop codon in the A site, it adds water molecule to polypep-tide chain and hydrolyse completed chain from tRNA at P site. Now Polype-tide is free from Ribasomes, slow ribasom also jump off the mRNA chain and dissociates into two subunits, tRNA also release from mRNA.

(d) Modification of released polypeptide :→
The released polypeptide has primary structure i.e. straight, linear, it may lose some amino acids from the end with the help of an exopeptidase enzyme, and then it coil and fold itself to acquire secondary and tertiary structure, two quaternery structure

Amino acid + ATP ⟶ Amino acid + E
(activated amino acid)

Activated amino acid ⟶ Charging tRNA


MET
Initiator tRNA
UAC
AUG
mRNA
binding site
Start Codon
MET
P
A
MET
PRO
E
A
GGA
AUG CCU
mRNA
tRNA
released
UAC
Arginine
AGA
E
A
AUG CCU UCU
E
UACGGA
AUG CCU
E
UAC GGA
AUG CCU
Polypeptide
Ribosomal
units

Page No.
Date:

Gene expression :→

It is a molecular mechanism by which gen can shows its potential in the phenoty of an organism.

Mechanism of gene expression :→

(i) A gene contains code for a particular polypep -de in the form of a specific sequence of its base pairs. It transfers its code to mRNA transcribi from it. Only the sense strand of DNA is capable of transcription. Others genes transcribi rRNA and tRNAs.

(ii) The ribosomes bind with mRNA, and with the help of tRNAs select the required amino acid and links them in proper sequence received from gene to form polypeptide process is called Translation

(iii) The polypeptide chain formed may act as a structural protein and form some organelles as form Proteinaceous biochemical such as Haemoglobin, Insulin etc. or enzyme.

(iv) The polypeptide may form morphogical as functional trait of the cell and organism. So the molecular structure of a gene is expressed in a phenotype.

eg:→ One gene —Transcription→ rRNA, mRNA, tRNA —Trans-lation→ One Polype

Polypeptide —EXPRESSION→ Organelle, Enzyme, Proteinaceous

A change in the gene would Biochemic change the code & give rise to differen Polypeptide.

★ Central Dogma or Flow of Information

"It is the flow of information from D to mRNA and hence to a polypepti is called central Dogma."

(i) The chromosomal DNA is the 1° - informat centre. It contains complete information about all the specific proteins, to b synthesized in the cells for their n

(ii) The information coded in the DNA the particular sequence of bases cal genetic code.

(iii) The one of the two strands of DNA the sense strand, contain information to guide the synthesis of Polypepti and a single stranded nucleic aci molecule can carry information from to the site of Protein synthesis.

66 mould - Fungus 99

white Fungus - Rhizopus

Page No.
Date:

(iv) The information passed on by the DNA to mRNA and then it direct the synthesis of required polypeptide chain.

★ Relationship b/w Genes and enzymes :→

The relationship was found in 1902 by Archibald Garrod. He told that the genes operate by producing enzymes. He suggest that each of the disease inherited by offspring from the parents is caused by the lack of an enzyme which change one metabolic substance to another. He called such diseases Inborn errors of metabolism.

Lack of enzyme is due to the absence of normal form of gene which control the synthesis of that enzyme.

☆ One gene - One enzyme Hypothesis :→

(Beadle and Tatum's Hypothesis)

This hypothesis was given by Beadle & Tatum in 1948, with the help of their experiment on the pink bread mould, "Neurospora crassa."

(i) They grow this mould in simple medium containing salt, sugar, amino acids, Purines and Pyrimidines with the help of enzymes. Such to normal or wind type of individual are called Prototroph.

Mellanocyte cells – Melanin

Page No.
Date:

(ii) They expose this mould to X-ray, which cause the mutation by changing the sequence of DNA. They found that mutants were unable to grown in minimal medium unless additional -ients were added to the medium. Such mutants are called Auxotrophs.

(iii) The different mutants need the amino ornithine to citruline to arginine for growth.

(iv) It is known that a cell can sequentially change ornithine to citruline and then arginine, for their growth, they lack enz due to mutation in gene, which code this enzyme. Similarly another gene wa lack of enzyme which change ornit to citruline. This mutant need citru for growth.

(v) This led them to thought that each g had the information for producing single enzyme, so they proposed their famous One-gene One-enzyme hyp -sis in 1948.

This hypothesis states that each gene controls the synthesis of specific enzyme or Particular protein.

This hypothesis got them Nobel Prize in 1958.

Page No.
Date:

★ Modification of Beadle and Tatum's Hypothesis :→

It has been now found that

(i) All genes do not produce enzymes, certain proteins contain more than one polypeptide chain. For eg: Haemoglobin molecule consists of two α and β polypeptide chain. This shows that more than one gene may control the synthesis of a Protein.

Now it is stated that one gene is responsible for the formation of one polypeptide chain.

Now one gene - One enzyme hypothesis has been replaced by one gene-one enzyme polypeptide chain principles.

★ Genetic code :→ The information exist as the particular sequences of bases in the DNA strand is called genetic code.

★ 2nd definition: The sequence of base triplets in DNA molecule, each triplet representing one amino acid of a Polypeptide also called genetic code.

★ Characteristics of genetic code :→

(i) The genetic code is a triplet code Three adjacent bases termed as codon.

(ii) The adjacent codon's do not overlap, th
do not share any base each single ba
a part of only one codon.

AUG UAA C C U C A U AUG
CCU CUC UCA

(iii) The genetic code is commonless. There is
Punctuation maks b/w coding triplets.

(iv) The genetic code is universal i.e. a
codon in the DNA and mRNA specif
the same amino acids in the prot
synthesizing systems of all organisms
from bacteria to man.

(v) The genetic code is "degenerate" it lack
specificity and one amino acid o
has more than one code triplet.
methionine and tryptophan have sing
triplet codons. All other amino aci
are specified by 2-6 base triplets.

eg: Phenylamine has two codons UUU &
Arginine has six codons - CGU, CGC, C
CGG, AGA and AGG.

(vi) Each codon codes for only one amino
none for more than one.

(vii) Nonsense or Terminator codons Three
the 64 codons are terminator codons.
UAA, UAG and UGA. (1) UAA is called

(2) UAG is called Amber (3) UGA is called OPAL.

(viii) The codon's AUG and GUG are k/a start codon or Initiation codon.

(ix) DNA is a linear polynucleotide chain & a protein is a linear polypeptide chain.

(x) A specific gene transcribes a specific mRNA which produces a specific polypep-tide.