

## GENE REGULATION - JACOB & MONOD OPERON CONCEPT 1965

- Function of gene is always controlled and regulated
- Gene regulation is a mechanism through which any specific gene can be switched off or switched on according to requirement of the cell.
- Any operon is the unit associated with gene regulation.

An operon consists of Regulator gene(s), Promotor gene (P), Operator gene (O) and Structural genes ( $S_1, S_2, S_3$  etc)

Regulator gene (z) - is that which regulates the function of structural genes or genes by producing a Repressor protein. Regulator gene is present just before Promotor gene (P)

- Promotor gene (P) is actually that site of DNA to which RNA Polymerase binds for transcription of structural gene. It is present between Regulator and Operator genes.

- Operator gene (O):- is that through which regulator gene is attached through repressor protein to switched off. It is present in between promotor and structural genes.

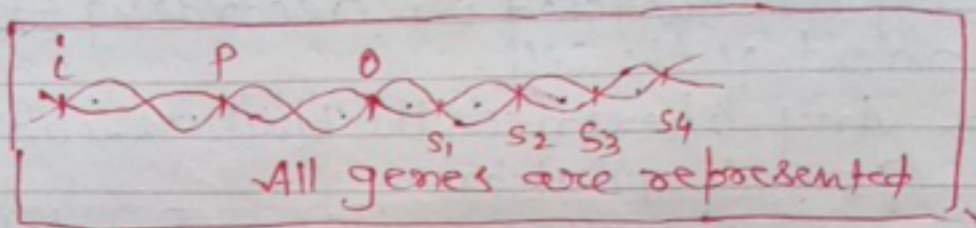


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- Structural genes ( $S_1, S_2, S_3$  etc): - are those which code mRNA to produce functional polypeptides which convert into enzyme and ultimately products are released. They are present at terminal end and part of cistron.



## OPERON

Model of gene regulation in Prokaryotes is called operon.

7

APRIL  
THURSDAY

It was for the first time discovered by Jacob and Monod in E. coli bacteria.

- They got Nobel Prize in 1965.

Types of Operon:-

### (I) Lac operon

Name lac operon is given because here lactose works as Inducer. So, also called Inducible operon. It is induced by presence of lactose.

### (II) His operon.

Name is given on the basis of Histidine. Histidine works as repressor to stop the synthesis of also called repressor operon. Another name is Toy operon.

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## 1. LAC OPERON = INDUCIBLE OPERON.

It is related with on and off mechanism means ~~either~~ either protein synthesis and organ formation will take place or not, depends upon presence (ON) or absence of Lactose (OFF).

Thus lac operon will be covered under two parts.

(A) ON Mechanism - In presence of Lactose.

(B) OFF Mechanism - In absence of Lactose.

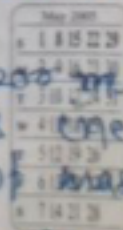
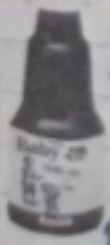
### ON Mechanism of LAC OPERON:

- Lactose will be present only when the protein synthesis is going on.
- Protein will be synthesized when genes are active that is they will participate in transcription, translation and formation of enzyme.
- It is possible only when RNA Polymerase will be freely ~~working~~ moving on DNA during transcription.
- Let, lactose are synthesized during gene action. This lactose completely stick with repressor which is synthesized by Regulator gene.

Thus, lactose and Repressor mixed together and this becomes inert.

This inert Repressor can not

RNA Polymerase, so that RNA Polymerase is free to move and to participate in transcription.





11

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and Protein Synthesis.

So, the mechanism is on and Protein Synthesis is carried out.

Note: - Reverse is condition during off mechanism.

Means. Lactose is absent because Protein Synthesis is not carried out.

Repressor is not covered by Lactose so, it completely masked RNA Polymerase to stop transcription and Protein Synthesis.

→ So, free Repressor is that which is not masked ~~by~~ by Lactose, so, it will mask RNA Polymerase to stop Protein Synthesis → OFF Mechanism

12

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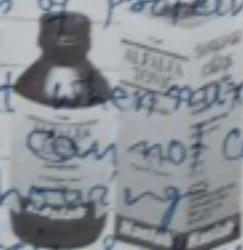
→ Masked Repressor is that which is covered by Lactose, so, it will be inert not masking RNA Polymerase, so Protein Synthesis is carried out → ON Mechanism

So, in nut cell - either Repressor is free or not depends upon presence or absence of Lactose.

→ Repressor means Lactose absent - means RNA Polymerase will be covered by Repressor to OFF Mechanism of Protein Synthesis.

Repressor becomes inert when mixed with Lactose, so, that they can not cover the RNA Polymerase & ON Mechanism for Protein Synthesis.

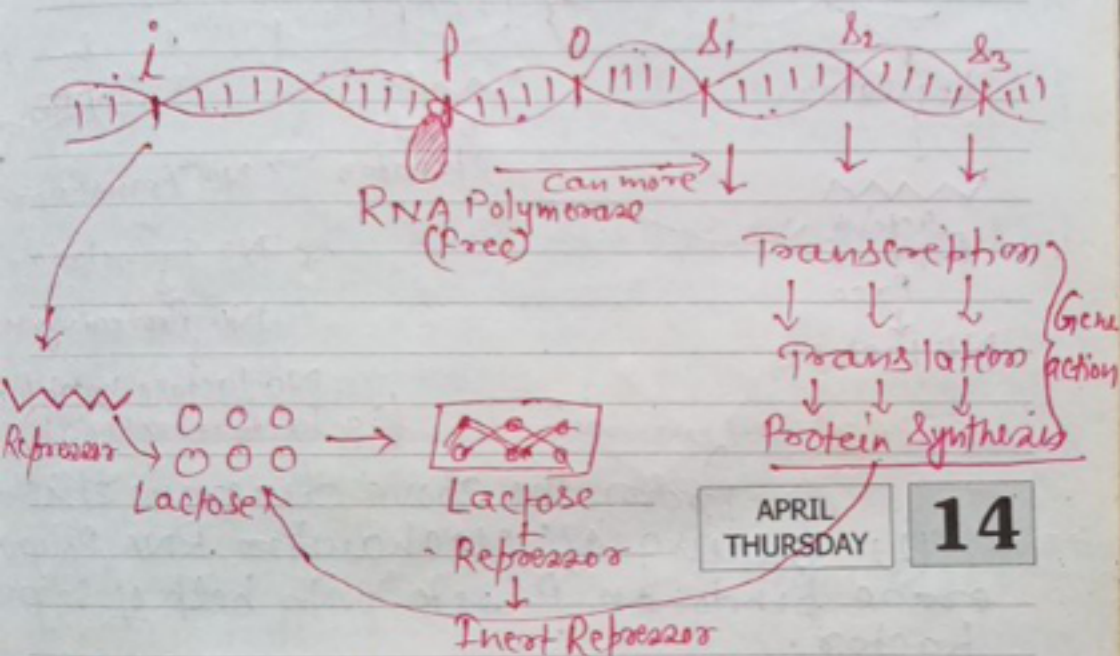
April 2005
S 30 17 24
M 4 11 18 25
T 5 12 19 26
W 6 13 20 27
Th 7 14 21 28
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AN HEALTH RESTORER



Diagram for ON Mechanism (Lactose present)



During ON Mechanism :-

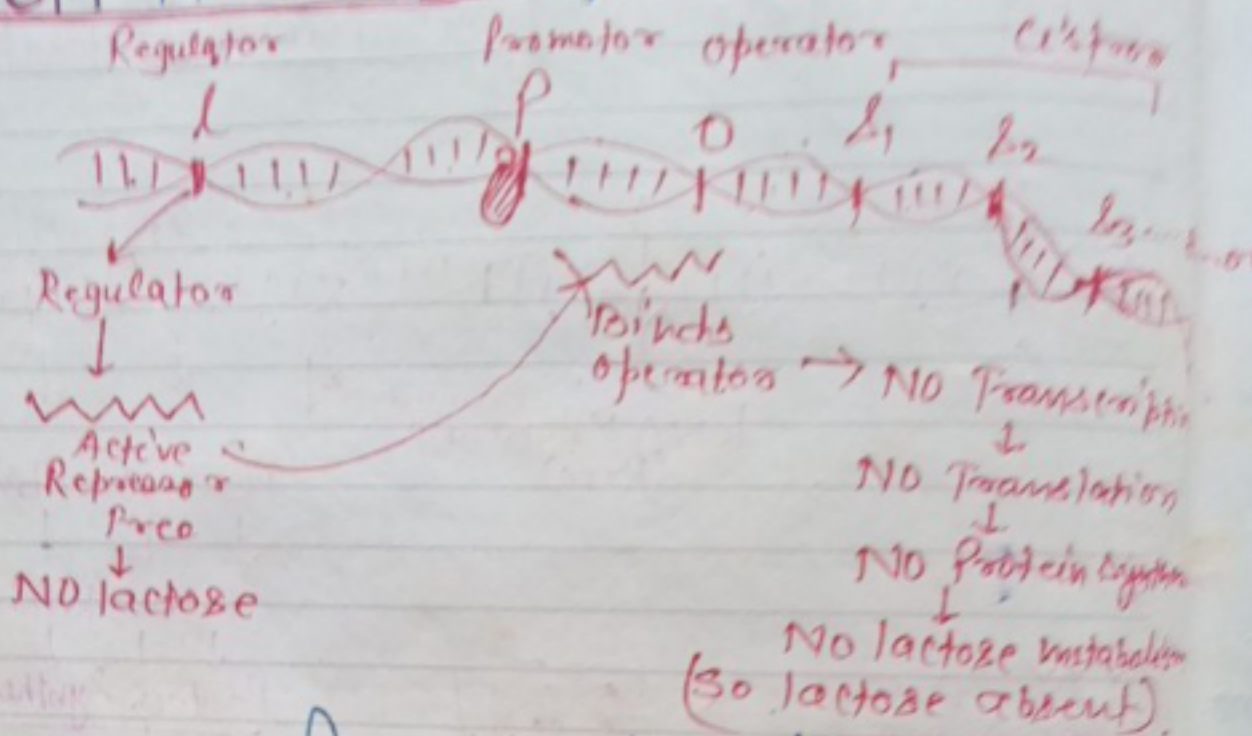
- (i) RNA polymerase binds to Promotor side (P)
- (ii) Regulator controls synthesis of Repressor
- (iii) In presence of Lactose, Repressor combines with lactose to produce Inert Repressor.
- (iv) Inert Repressor fails to mask RNA polymerase. Thus free operator gene allow RNA polymerase to move forward, initiating gene action.
- (v) Due to gene action, enzyme formation and protein synthesis will be carried out.
- (vi) Lac operon is inducible operon because the substrate in lactose is...

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OFF Mechanism of LAC OPERON:-

From the above diagram it is clear:-  
(i) Binding of RNA Polymerase binds on P-site with help of sigma factor.

(ii) Regulator gene (l) controls synthesis of Repressor (low mol. wt. Polypeptide)

(iii) In absence of Lactose, Repressor binds on operator to mask the function of RNA Polymerase.

(iv) RNA Polymerase can not move to post-  
17 SUNDAY  
site in transcription.

(v) Thus gene action is stopped acting like off mechanism.

In further step No translation and protein synthesis.

So, lactose metabolism is absent and

Lactose is not available to metabolize.

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## 2. HIS (Histidine) Operon

Histidine = Repressible Operon

It is the type of Amino Acid whose presence indicates the off mechanism and absence indicates on Mechanism.

In HIS operon Regulator gene (I) controls synthesis of APO REPRESSOR which is itself inert.

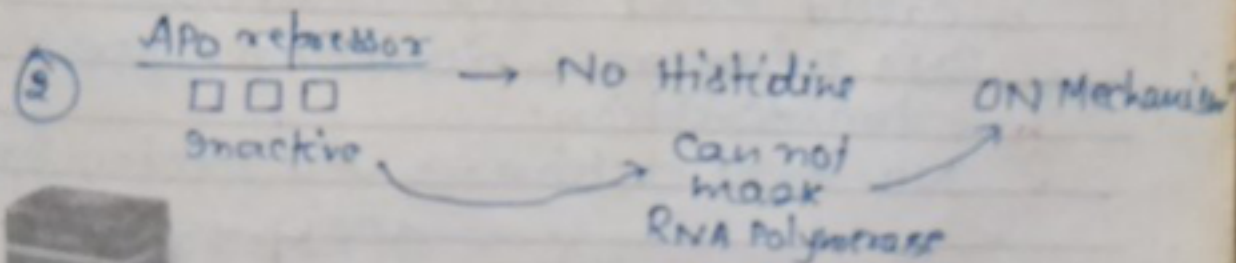
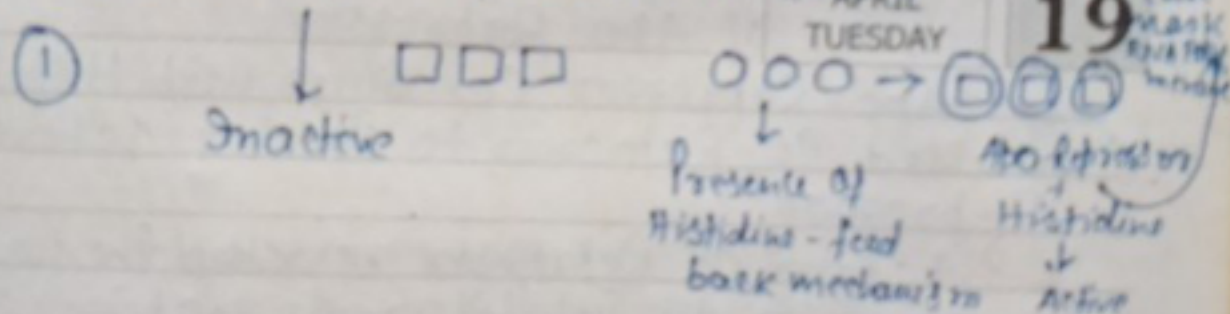
It will be active only when make contact with Histidine (+)-OFF Mechanism

APO Repressor in absence of Histidine (-) can not mark operator, so RNA Polymerase will active - ON Mechanism

OFF mechanism

Can mark RNA Pol. enzyme

Means: Apo Repressor + Histidine

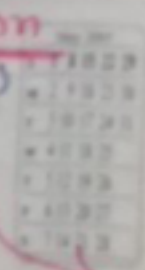


### OFF Mechanism of HIS Operon

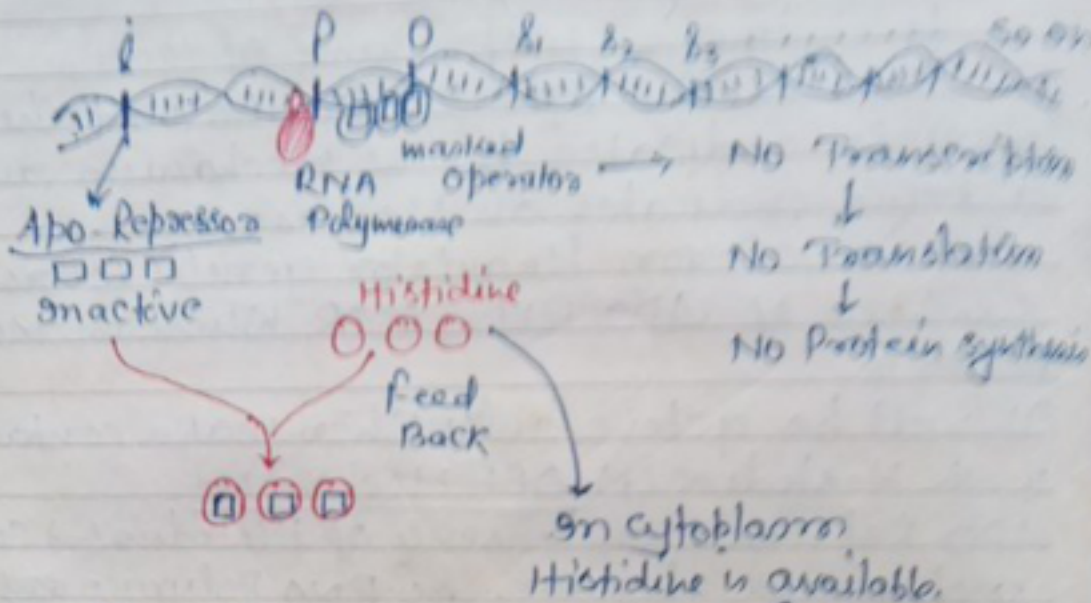
on presence of histidine (++++)

P.T.O

BIOCHEMIC COMPOUND TABLETS







→ RNA Polymerase binds on Promoter gene  
 → Regulator gene (R) controls the synthesis of Apo-Repressor.

21

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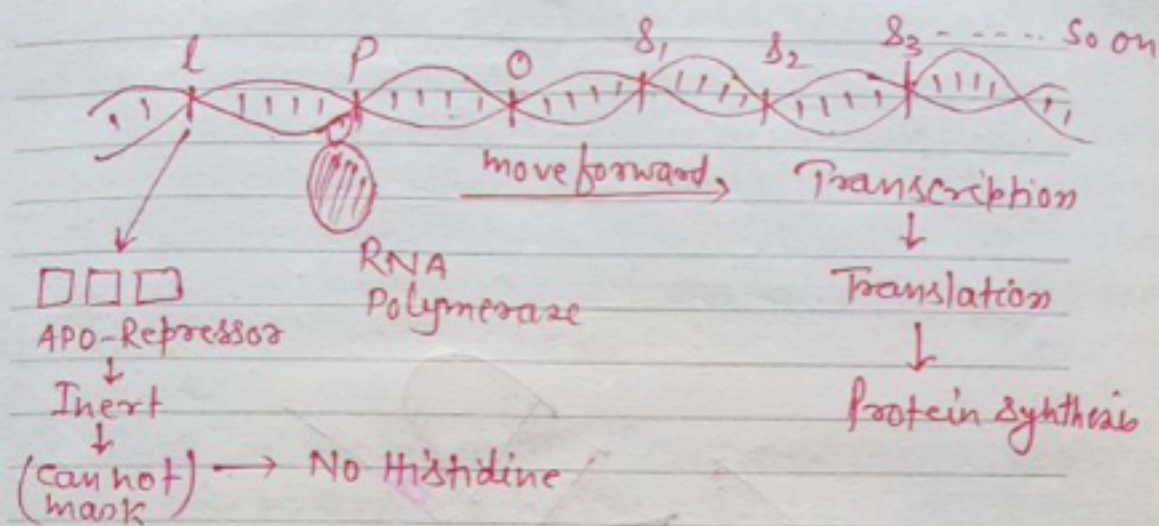
- Apo-Repressor combines with Histidine called Co-Repressor to produce Active Repressors.
  - Active Co-Repressor masks the surface of Operator to inhibit gene action. This is called Feed Back Inhibition.
  - RNA Polymerase don't move forward for transcription.
  - No Gene action → No protein synthesis
- OFF Mechanism

ON-Mechanism of HIS operon

on absence of Histidine

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- RNA Polymerase binds on Promotor.
- Regulator controls the synthesis of Apo-Repressor.
- In absence of Histidine the Apo-repressor ~~remains~~ remains inert.
- Inert Repressor fails to bind operator gene.

So RNA Polymerase is free to move and participate in Transcription. Every possibility for synthesis of protein and formation of organ-ON mechs



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