GENE GALA

DAY 2
GENETICS OF THE MICRO-WORLD

This session is meant to give you an overview of what happens inside a bacterial cell that expresses proteins. Bacteria are special in their expression and let's find out how!

TOPICS COVERED :

BACTERIAL GENETICS
THE OPERON CONCEPT
LAC OPERON

PROTEIN EXPRESSION (TERMS AND CONDITIONS APPLIED)

- Some proteins (or enzymes) are always required by a bacterium, genes coding for such proteins are constitutively expressed. These genes are usually needed for the cell to survive. These genes are "constitutive" in nature

- Other genes that may not be needed at all times, hence are regulated to conserve energy and cellular materials.

- Some proteins (or enzymes) are produced only when the need arises or when stimulated by certain environmental conditions. Such genes are normally repressed and are induced whenever required.

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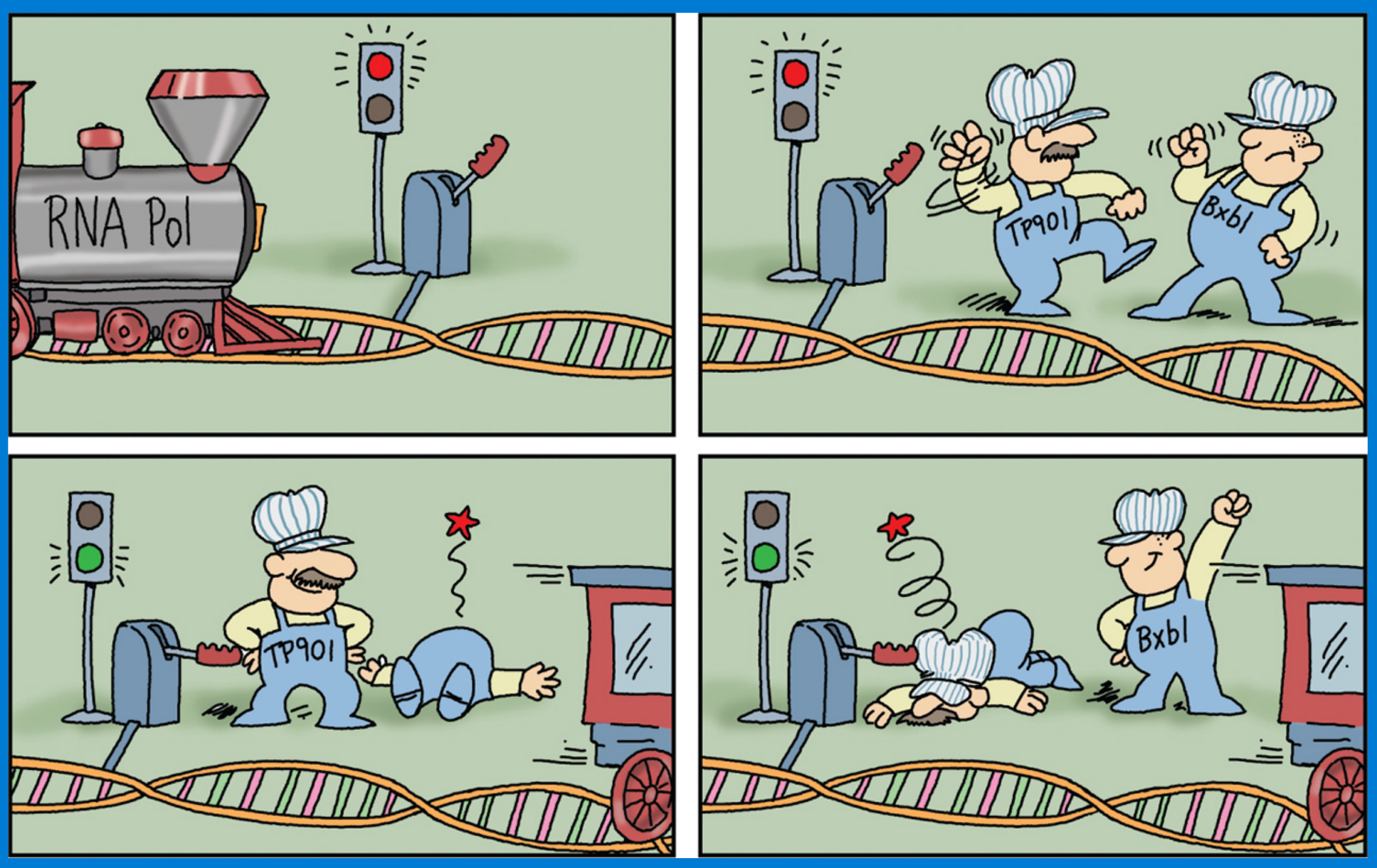
- **Repression of genes** is a method of inhibiting or decreasing the expression of specific genetic products. This inhibition is controlled by proteins called **repressors**, which usually block the binding of RNA polymerase to the template DNA.

- The **induction of genes** is the opposite of repression; **inducers** act to "turn on" genes that are not constitutive.



Repressor- TP901

Inducer - Bxbl

THINK AND REFLECT

1.Think about some proteins in your own body that are constitutively produced and some that are occasionally produced?

2.Think about what could be the inducers of the genes produced in our body.

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THE OPERON CONCEPT

- The operon concept was first demonstrated by **Jacob and Monad.**
- Bacteria utilize a special energy-saving system of genetic control called operons.
- The operon is a sequence of DNA that contains multiple genes used to produce multiple proteins for a single purpose.
- An example of an operon is the **lac operon** in E. coli.

LAC OPERON

- In order to break down lactose, E. coli must use a series of enzymes (**beta-galactosidase, galactoside permease and transacetylase**). The genes for these three enzymes are located in a row on the DNA and share a single promoter.
- Genes determining the structure of a particular protein are called structural genes and the activity of structural genes are controlled by regulator genes, which lie adjacent to them.
- The genes lacZ, lacY, and lacA which code for the three enzymes are the structural genes.
- **lacZ** encodes **β-galactosidase (LacZ)**, an intracellular enzyme that cleaves the disaccharide lactose into glucose and galactose.
- **lacY** encodes **Beta-galactoside permease (LacY)**,Permease increases the permeability of the cell to β-galactosides.

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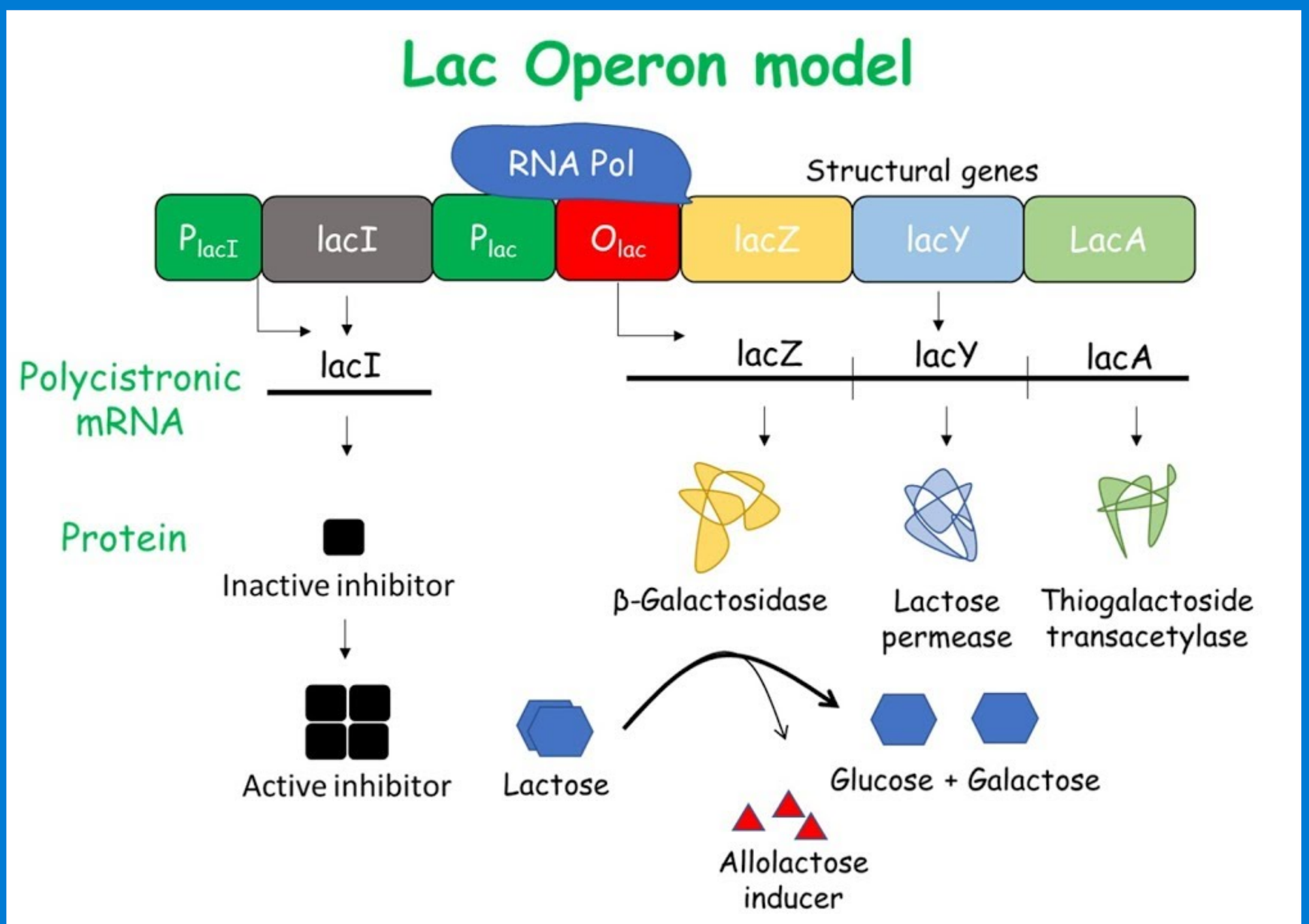
LAC OPERON

- **lacA** encodes β-galactoside transacetylase (LacA), an enzyme that transfers an acetyl group from acetyl-CoA to β-galactosides.
- The operator region lies in between the promoter and structural genes and the RNA polymerase has to go through the operator region.



- Under normal circumstances, when the structural genes are not transcribed, the repressor protein is bound to the operator region thus preventing the passage of RNA polymerase from the operator region towards the operon.

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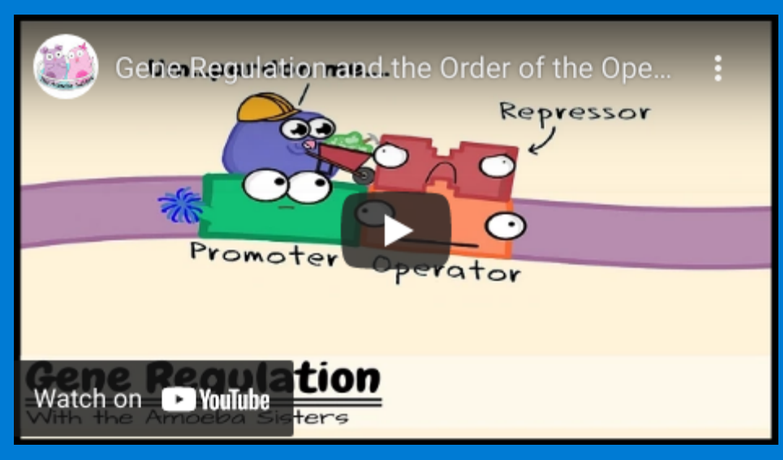
LAC OPERON

- When lactose is available in the environment, the repressor protein leaves the operator region and binds to lactose because it has high affinity for lactose. This frees the operator region and the RNA polymerase enzyme moves towards the operon and transcribes the structural genes. The products of structural genes result in the metabolism of lactose.
- When lactose is no more available, the repressor protein goes back and binds to the operator region, thus stopping further transcription of structural genes. This way lactose acts both as an inducer as well as a substrate for beta galactosidase.

THINK AND REFLECT

If lacY codes for permease, then how does lactose enter the cells in the first place?

REFERENCE



FIND OUT

We know that the presence of lactose switches on the lac operon, but can the absence of a molecule also turn on an operon ?

Hint : The absentee is the largest amino acid