1E Concept Development: Gene Expression: The *lac* Operon
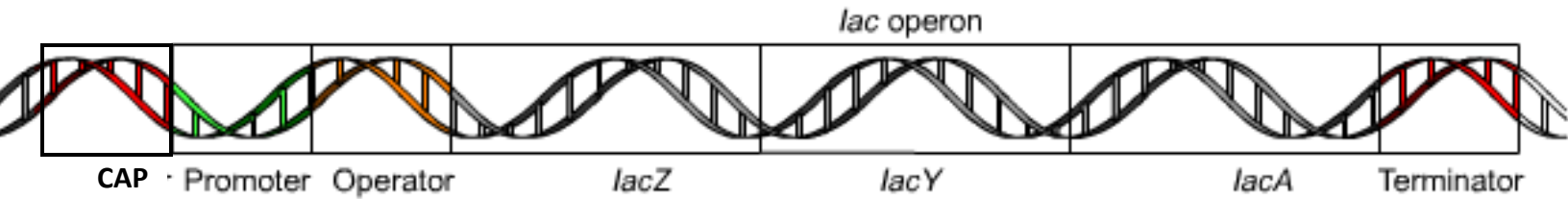
lac operon

CAP · Promoter Operator   lacZ   lacY   lacA   Terminator

Select : Combination of Switches - the Lac Operon (684.0K)

Genes are not expressed all the time. This means that the proteins your body uses are not being made 24/7. Just like in business, the expression and construction of certain proteins are made on a supply and demand basis. It is only when the protein is needed that the gene is transcribed.

The expression of certain genes, and therefore the synthesis of proteins, is dependent on its environment. Gene expression/regulation can be seen in operons (a segment of DNA containing a cluster of genes that are transcribed as a unit).

The *lac* operon is a collection of genes that produce an enzyme that breaks down lactose to obtain energy. However, the cell would rather use any existing glucose for energy production, but if there is none, the cell will break down any lactose present.

First, let's look at two regulatory proteins that play a major role in gene expression/regulation of the *lac* operon.

ACTIVATOR

What is the activator for the *lac* operon?

Where does the activator bind the DNA?

If cAMP level is _____, then

the activator _____ DNA.

If cAMP level is _____, then

the activator _____ DNA.

How does glucose affect cAMP?

REPRESSOR

Where does the repressor bind on the DNA?

What inactivates the repressor?

If _____ is present, then the repressor is _____.

If _____ is not present, then the repressor is _____.

Where does the RNA polymerase bind to the DNA?

❖ Fill in the following table using your notes and the information above.

❖ Use the space beneath the table to draw out the *lac* operon with the lactose, glucose, repressor, and/or activator for each of the four conditions in the table. Use the symbols in the box!

Condition	Lactose	Glucose	Repressor (active/inactive)	Activator (active/inactive)	Does RNA polymerase attach?	Are the genes transcribed?
1	Present	Absent				
2	Absent	Present				
3	Absent	Absent				
4	Present	Present				

= Repressor   = Lactose   = Inactive repressor   = CAP   = RNA polymerase

Condition 1:

Promoter p	Operator o	Gene z	Gene y	Gene a

Condition 2:

Promoter p	Operator o	Gene z	Gene y	Gene a

Condition 3:

Promoter p	Operator o	Gene z	Gene y	Gene a

Condition 4:

Promoter p	Operator o	Gene z	Gene y	Gene a