

Controlling Gene Expression

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All Genes Can't be Expressed At The Same Time

- Some genes are needed for the function of all cells all the time. These genes are called constitutive genes and are expressed by all cells.
- Other genes are only needed by certain cells or at specific times. The expression of these inducible genes is tightly controlled in most cells.
- For example, beta cells in the pancreas make the protein insulin by expressing the insulin gene. If neurons expressed insulin, problems would result.

Operons Are Groups Of Genes Expressed By Prokaryotes

- The genes grouped in an operon are all needed to complete a given task
- Each operon is controlled by a single control sequence in the DNA
- Because the genes are grouped together, they can be transcribed together then translated together

The *Lac* Operon

- Genes in the *lac* operon allow *E. coli* bacteria to metabolize lactose
- Lactose is a sugar that *E. coli* is unlikely to encounter, so it would be wasteful to produce the proteins needed to metabolize it unless necessary
- Metabolizing lactose for energy only makes sense when two criteria are met:
 - Other more readily metabolized sugar (glucose) is unavailable
 - Lactose is available

The *Lac* Operon - Parts

- The *lac* operon is made up of a control region and four genes
- The four genes are:
 - *LacZ* - β -galactosidase - An enzyme that hydrolyzes the bond between galactose and glucose
 - *LacY* - Codes for a permease that lets lactose across the cell membrane
 - *LacA* - Transacetylase - An enzyme whose function in lactose metabolism is uncertain
 - Repressor - A protein that works with the control region to control expression of the operon

The *Lac* Operon - Control

- The control region is made up of two parts:
- Promoter
 - These are specific DNA sequences to which RNA Polymerase binds so that transcription can occur
 - The lac operon promoter also has a binding site for another protein called CAP
- Operator
 - The binding site of the repressor protein
 - The operator is located down stream (in the 3' direction) from the promoter so that if repressor is bound RNA Polymerase can't transcribe

