OPERONS-REPRESSIBLE AND INDUCEIBLE

An operon is a region in prokaryotic DNA that codes for several genes at the same time. The operon is composed of a promoter region that contains the operator and several genes lined up next to each other. Each gene has a start and stop codon, but since they are so close, the enzymes form one after another. The mRNA will be transcribed if the RNA Polymerase can get past the operator. If there is a repressor protein in the operator than the enzymes are not synthesized. If the repressor protein is NOT in the operator, then the mRNA will be transcribed. The repressor protein is coded upstream from the operon, so it is there if it needs to be.

In the above example, will the RNA Polymerase transcribe the genes? Explain.

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We will learn about 2 operons but there are several others we will not talk about.

The first is called the TRP Operon-REPRESSIBLE.

Prokaryotes need the amino acid tryptophan (Trp) in order to build proteins and enzymes. If the Trp is obtainable, the prokaryotes will uptake it and build all of the necessary proteins and enzymes.

If Trp is not present, the prokaryotes need to synthesize it themselves. They can achieve this through a series of enzymatic reactions. RNA Polymerase will bind to the promoter region and transcribe the mRNA needed for the necessary enzymes. They will continue to synthesize the Trp until they have enough. Once that amount is reached, all of the genes that code for the enzymes are turned off together. This happens when Trp binds allosterically to the repressor protein and alter the active site. The repressor protein will now fit in the operator blocking the RNA Polymerase from transcribing mRNA. This is called “REPRESSING THE GENES”

If there is no Trp in the cell, the repressor protein is produced but WILL NOT FIT in the operator site. The RNA Polymerase will move down and transcribe mRNA that will code for the 5 enzymes needed to synthesize more Trp.

If Trp is present, it will allosterically bind to the repressor protein and change its shape. The repressor protein will NOW FIT INTO the operator and block the RNA Polymerase.
The second is called the Lac Operon-INDUCEIBLE

Lactose is a disaccharide composed of glucose and galactose. Prokaryotes like E coli live in our gut and are exposed to lactose when we eat things like cheese. These bacteria need glucose. In order to get the glucose from the lactose, they need a series of enzymes that can break down the lactose. Interestingly, the E coli will only produce these enzymes when lactose, or its isomer allolactose are present. Very economical.

If there is NOT lactose or allolactose around, a repressor protein is in the operator site blocking the RNA Polymerase from making enzymes needed to break down lactose.

If allolactose is around, it will allosterically bind to the repressor protein and change the active site. It can NO LONGER FIT into the operator region. If the repressor protein is not there, the RNA Polymerase can transcribe the enzymes needed to break down the allolactose into the glucose it needs. This is called “INDUCING THE GENES”
Tryptophan Synthesis Repressible

Lactose Digestion Inducible

(b) Lactose present, repressor inactive, operon on