

# Highlights Gene Expression 2

1. The lactose operon consists of three linked structural genes that encode enzymes of lactose utilization, plus adjacent regulatory sites. The three enzymes --z, y, and a--encode beta-galactosidase, beta-galactoside permease (a transport protein), and thiogalactoside transacetylase (an enzyme of still unknown metabolic function), respectively.
2. X-Gal is a synthetic substance used to study lac operon expression. X-Gal has the useful property that it turns blue when acted on by beta-galactosidase, giving a measure of how much the operon has been induced by the amount of blue color produced.
3. Negative transcriptional regulation of the lac operon is accomplished by a protein known as the lac repressor. It binds the operon's operator region and inhibits transcription.
4. In the absence of inducer molecules, the lac repressor tightly binds to the operator and inhibits transcription of the operon. When inducer molecules are present, they bind to the lac repressor and change its shape and reduce its ability to bind the operator, thus allowing the RNA polymerase to bind the promoter and start transcription.
5. The promoter sequence of the lac operon differs somewhat from the ideal consensus sequence of an *E. coli* promoter. Consequently, in the absence of positive acting elements, the lac promoter does not function well on its own. A protein that acts positively to help activate the lac operon is the CAP (cAMP Receptor Protein). It is also called CRP.
6. CAP must bind to cAMP in order to function. When CRP binds cAMP, its affinity increases for the lac operon adjacent to the RNA polymerase binding site (-68 to -55). This binding facilitates transcription of the lac operon by stimulating the binding of RNA polymerase to begin transcription.
7. When both CAP and the lac repressor are bound to the lac operon, the repressor 'wins', shutting down transcription of the operon.
8. In eukaryotic cells, DNA is wrapped up (coiled up) with basic proteins called histones. Histone sequences are strongly conserved from yeast to humans.
9. Four histones form a core around which DNA is wrapped. This core contains two copies each of histones H2A, H2B, H3, and H4. This core of proteins is called an octamer.
10. The appearance of chromatin DNA is that of beads on a string, with the octamer wrapped with DNA composing the beads and the DNA strand coated with histone H1 (and H5) composing the string.
11. Histones of the octamer have strong structural similarity to each other.
12. Wrapping of DNA around the histone octamer provides only partial compression of the length of a DNA molecule. Additional compression occurs as a result of coiling of octamer/DNA complexes as well, forming higher order structures.
13. Enhancer sequences are bound by enhancer proteins and are found only in eukaryotes. Multiple enhance sequences may be present before the start site of a particular gene. Binding of enhancer proteins to enhancer sequences allows for tissue specific expression of genes if the enhancer proteins themselves are expressed

tissue specifically. Enhancer proteins help to "clear" out the histones from a region of a chromosome to allow transcription to occur.