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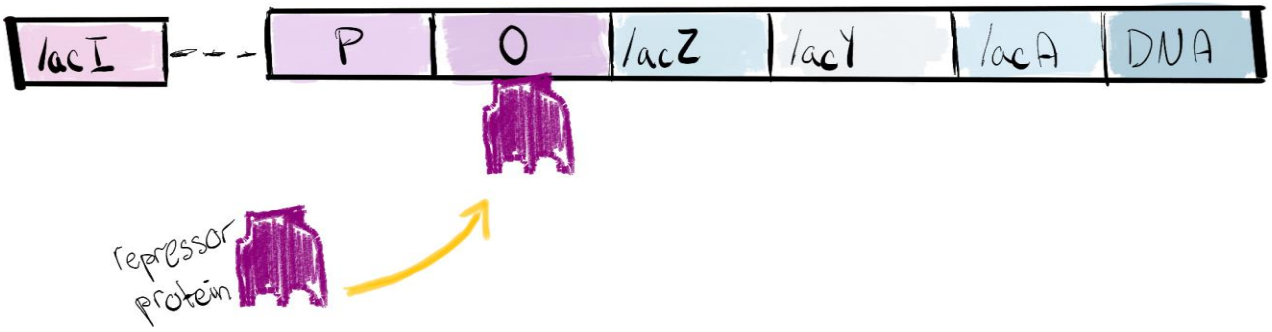
11/8/2021

BIOL 294

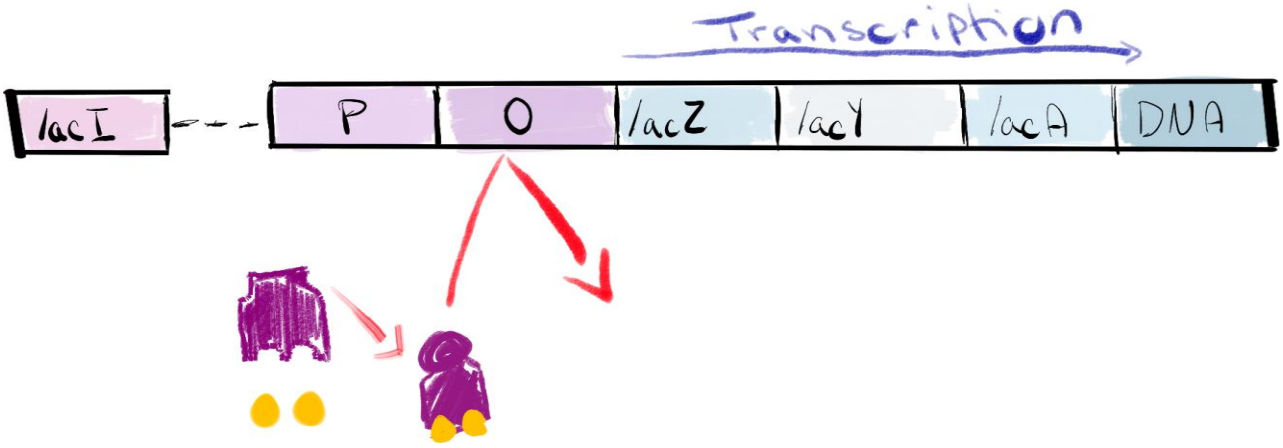
Lac Operon

1. In the absence of lactose (disregard presence or absence of glucose).



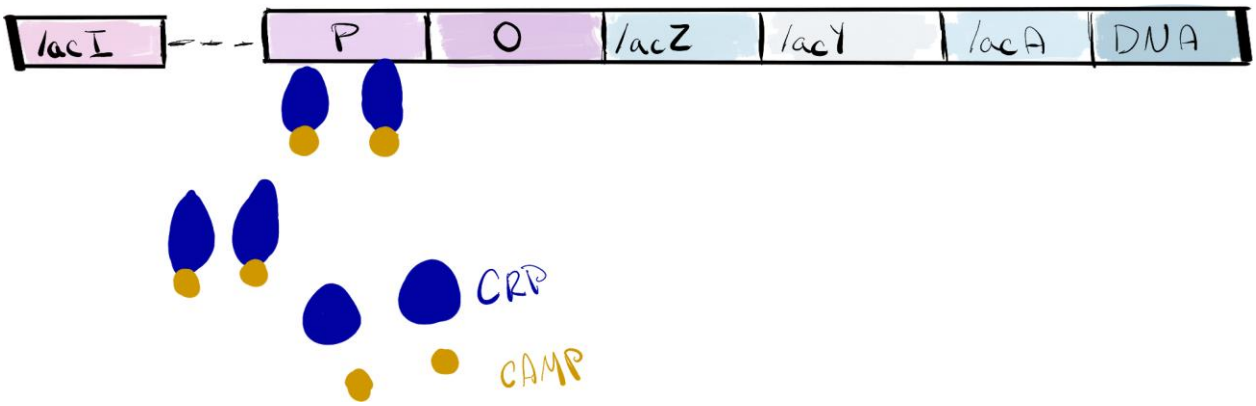
In the absence of lactose, the repressor protein will bind to the operator section of the DNA, halting transcription of the following operon. This does not halt regular transcription of the normal DNA strand, just the operon and its specific genes because the promoter for this gene is unavailable for RNA polymerase.

2. In the presence of lactose (disregard presence or absence of glucose).



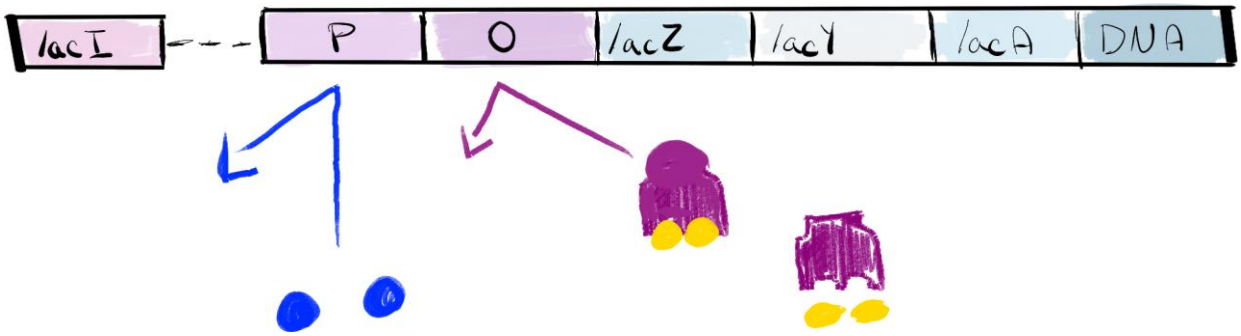
In the presence of lactose, transcription of the DNA strand will occur. Lactose will bind to the repressor protein, causing a conformational change that will impede its ability to bind to the operon. Because the repressor cannot bind to the operator, both the promoter and operator are accessible to RNA polymerase, which will bind at the promoter and proceed with the transcription of the genes. This then allows them to be expressed, which then allows the cell to process the lactose for energy.

3. In the absence of glucose (disregard the presence or absence of lactose).



In the absence of glucose, the amount of adenyl cyclase increases, increasing the availability of cAMP (cyclic adenosine monophosphate) in the cell. The cAMP is then available to bind to CRP, which is necessary to enhance the activity of the RNA polymerase at the promoter of the operon. This then helps promote the expression of the *lac* genes: Z, Y, and sometimes A.

4. In the presence of glucose **AND** the presence of lactose.



In the presence of both glucose and lactose, the operon does not run as readily. Because there is glucose available, the adenyl cyclase and cAMP availability is low, and so the CRP does not bind to the *lac* operon's promoter. The lactose available will still cause a conformational shift in the repressor protein, which will not attach to the operon. Though the repressor protein does not attach, with the lack of CRP on the promoter, the expression of the *lac* operon genes will be slow, so the use of glucose will take precedence over the use of the lactose in the cell.

5. Where does this regulation of gene expression take place?

The regulation of the *lac* operon takes place during the process of transcription before the RNA polymerase has a chance to attach to the DNA. These regulatory proteins, the repressor and CRP, will bind or not bind directly to the base DNA strand, and will either then block or interact with the available RNA polymerase.