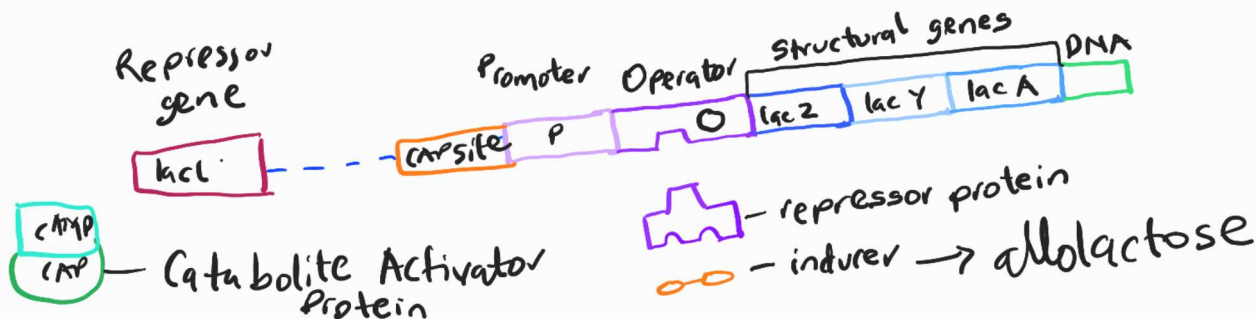
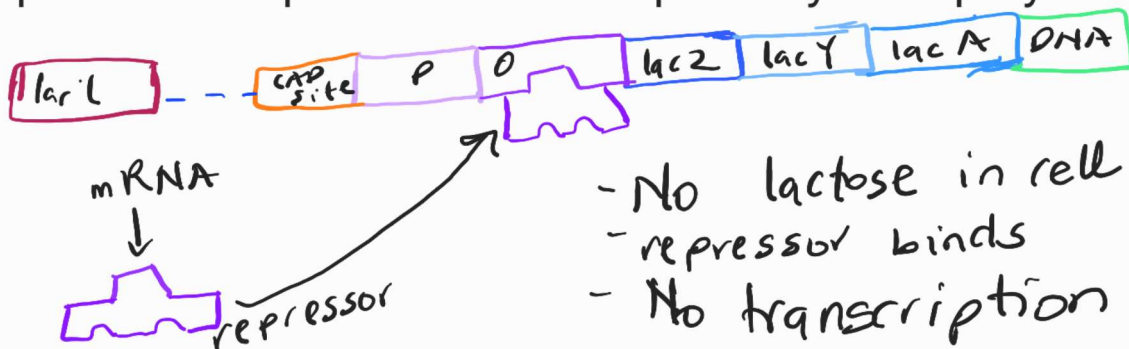


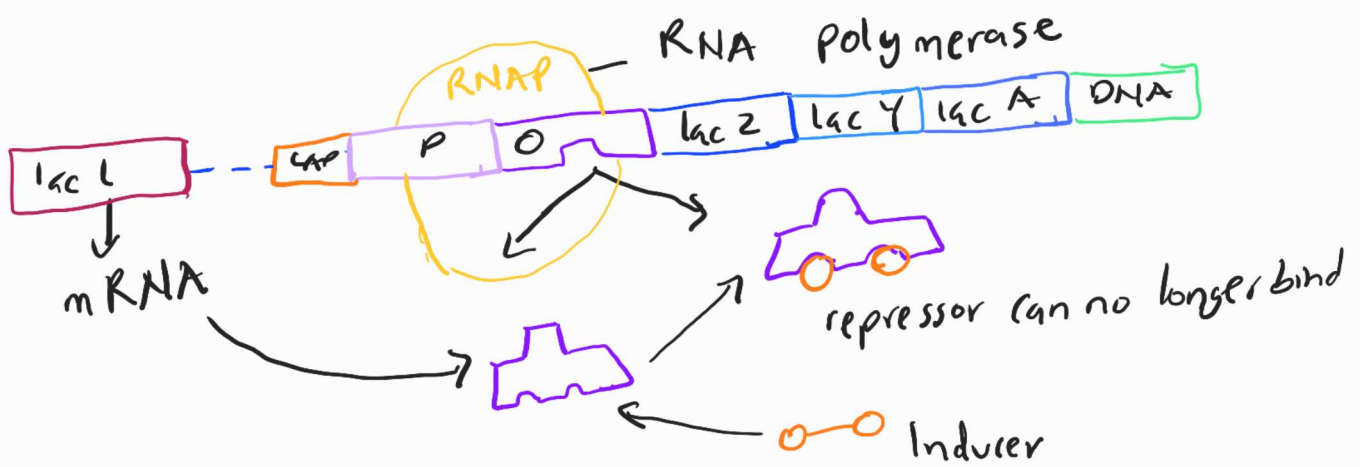
The lac operon is a single DNA unit in *E. coli*, composed of the lacZ, lacY, and lacA genes together with the promoter (P) and operator (O), that enables the simultaneous regulation of the three structural genes in response to environmental changes. The genes help to metabolize lactose and is only expressed in the presence of lactose and the absence of glucose.



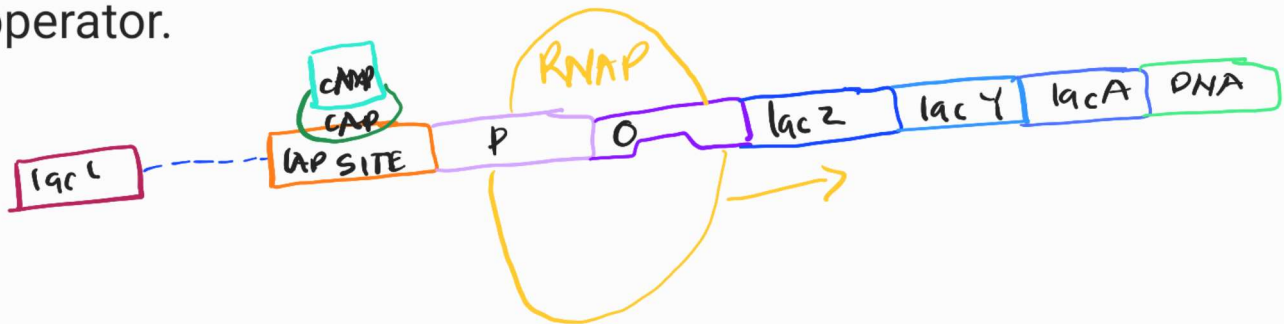
- Regulation of the lac operon in the absence of lactose. In the absence of lactose, the repressor binds to the operator and prevents transcription by RNA polymerase.



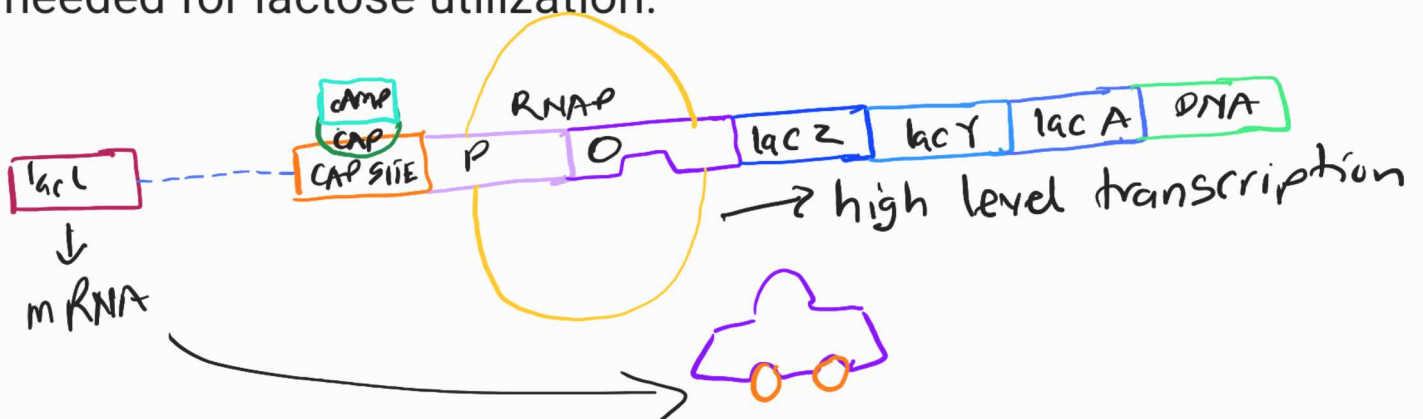
- Regulation of the lac operon in the presence of lactose. In the presence of lactose, the inducer allolactose binds to the repressor and causes a conformation change in the repressor making it unable to bind to the operator. RNA polymerase can then initiate transcription of the the genes into a single polycistronic mRNA. The mRNA is then translated into the proteins beta-galactosidase, permease, and transacetylase which help to metabolize lactose.



- Regulation of the lac operon in the absence of glucose. In the absence of glucose, cAMP binds to the catabolism activator protein (CAP) making CAP able to bind to DNA. This helps RNA polymerase to bind to the lac operon operator.



- Regulation of the lac operon in the absence of glucose and presence of lactose. In the absence of glucose and the presence of lactose, the binding of the activator and the release of the repressor allow RNA polymerase to bind strongly to the promoter and give it a clear path for transcription. This leads to strong transcription of the lac operon and production of enzymes needed for lactose utilization.



- Describe the part of gene expression(transcription, translation, post-translation) where this regulation takes place.

The regulation takes place before gene expression. When lactose is present and glucose is absent, the cell is made to undergo transcription of the genes needed to make use of lactose to provide energy. However in the situation where lactose is absent and glucose is present, no transcription occurs.