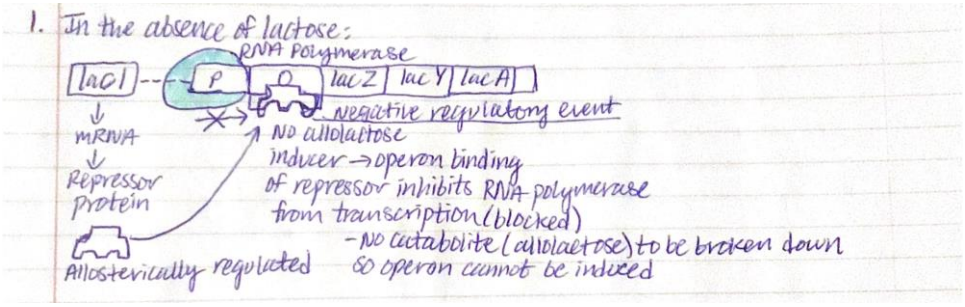
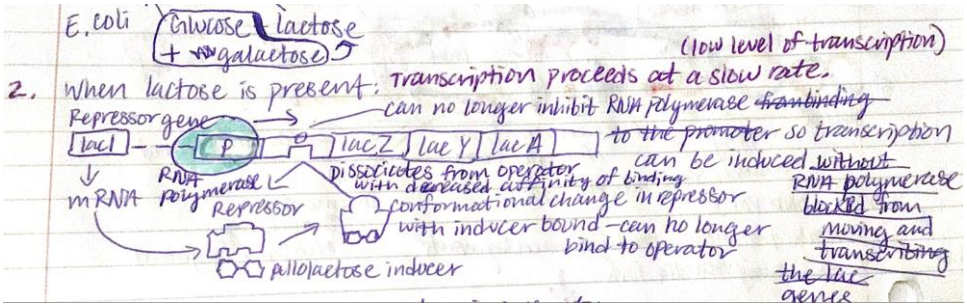
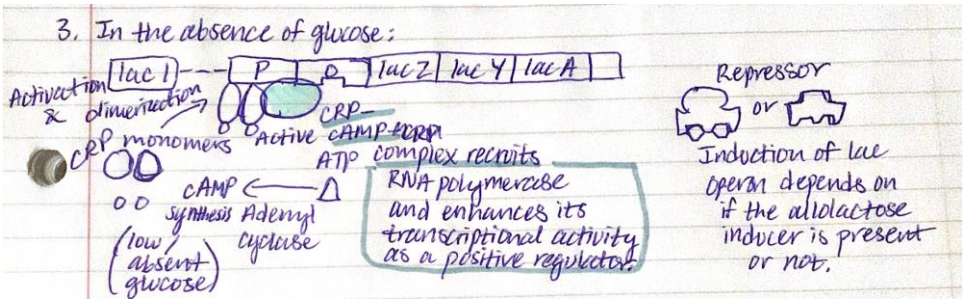
Inducible Lac Operon Regulation in *Escherichia coli*

1. 

The absence of lactose as an inducer could not prevent the repressor binding to the operator. Without lactose, it could not bind to the repressor and change the conformation of the allosteric protein. Thus, the repressor was able to bind to the operator and block RNA polymerase from transcribing the lac genes. The catabolite lactose to be broken down in this catabolic pathway was not present, so the repressor as a negative regulator is bound to the operator to conserve the lac genes from being transcribed and wasted.

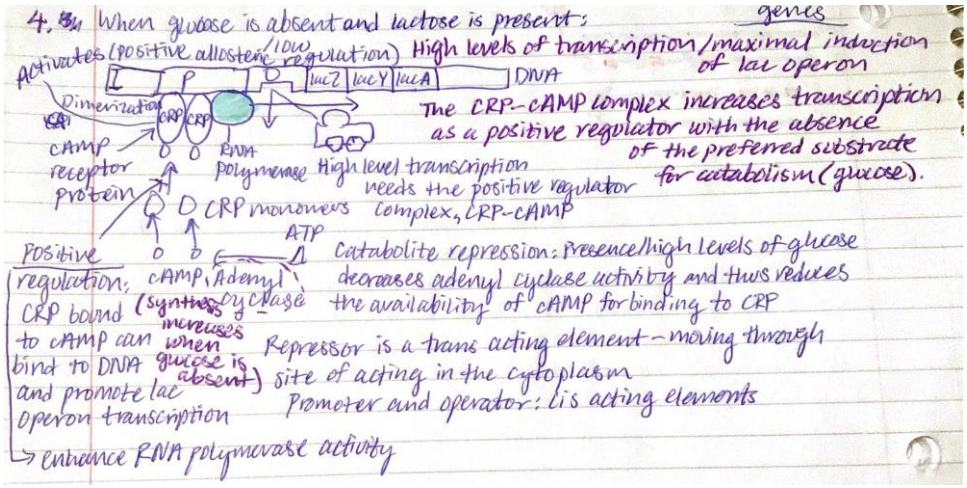
2. 

The presence of lactose as an inducer prevents the repressor from binding to the operator. Allolactose binds to the repressor and changes the conformation of the allosteric protein, thereby decreasing the repressor's affinity to the operator and the repressor then dissociates from the operator. RNA polymerase can move past the operator and transcribe the lac genes in this catabolic pathway that is induced by lactose. Some lactose can now be broken down with low transcription of the lac genes due to the absence of the CRP-cAMP complex.

3. 

The absence of glucose prompts adenylyl cyclase to convert ATP to cAMP. This increase in cAMP synthesis allows for cAMP to bind to CRP as two monomers that form a dimer and the CRP-cAMP complex. The CRP-cAMP complex is a positive regulator that recruits RNA polymerase to the promoter with physical contact enhancing high level transcription of the lac operon. However, induction of the lac

operon depends on the presence or absence of lactose. If allolactose binds to the repressor, the repressor can be released from the operator upon a conformational change and allows transcription by RNA polymerase. If lactose is absent, the repressor is bound to the operator and blocks transcription by RNA polymerase.

4. 

In the presence of lactose and absence of glucose that brings about the presence of the CRP-cAMP complex, transcription is enhanced by the positive regulator and maximal induction of the lac operon ensues. The binding of allolactose to the repressor changes its conformation to be released from the operator, and RNA polymerase can move past the operator and transcribe the lac genes at a high rate.

Gene expression activity of lac operon regulation: Lac operon regulation takes place during the process of transcription in which DNA is transcribed into an mRNA transcript of the lac genes. In *E. coli*, the process of transcription is coupled with translation in the cytoplasm where the transcribed lac genes are translated into proteins to enter the catabolic pathway of breaking down lactose.