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1. In the absence of lactose: - the lac repressor binds tightly to the operator, and this will prevent transcription by RNA polymerase. This is because there is no lactose that can bind with the repressor and free the operator for transcription.

2. In the presence of lactose: - the lac repressor gets released from the operator which will then allow transcription to occur at a slow rate. This is because the lactose will bind with the repressor and free up the operator for transcription to continue as normal.

3. In the absence of glucose: the lac operon can be activated, and transcription will still occur. In *E. coli* the use of lactose instead of glucose is dependent on the presence of cAMP and a catabolic activator protein. Once these bind to the operator then RNA polymer can begin transcription.

4. In the absence of glucose but presence of lactose: - there will be a high level of transcription of the lac operon. Since lactose is present, the repressor is released from the operator and bound to lactose, it will allow transcription to occur. The cAMP levels will also be high since glucose is absent and CAP is active, it will bind to the DNA.