**Regulation of Gene Expression (Genetic Control)**

1. Define:

   **Operon** – An operon is a segment of DNA that includes a series of structural genes and the control elements regulating the transcription of those genes. The structural genes within a single operon are regulated together (by a single promoter), and transcribed as a single unit (transcription is polycistronic).

   **Promoter** – The promoter site is a portion of DNA and serves as one of several control elements within an operon. The promoter is the nucleotide sequence recognized and bound by the sigma factor of RNA polymerase to initiate transcription.

   **Operator** – The operator site is a portion of DNA serving as one of several control elements within an operon. The operator is the nucleotide sequence to which a functional repressor protein binds to stop (repress) transcription. The location of operator sites within operons is variable.

   **Catabolite repression** – Catabolite repression is a regulatory mechanism allowing bacteria to utilize metabolic pathways for which the enzymes are constitutive in favor of those for which the enzymes must be induced. It increases cellular efficiency and energy conservation. The most common catabolite involved is glucose, and when glucose is available to cells, the genes encoding enzymes required to utilize alternate carbon sources (lactose, arabinose, etc,), are repressed.

   **Cyclic-AMP** – Cyclic-AMP is a regulatory nucleotide involved in catabolite repression within bacteria. A complex made up of Cyclic-AMP and catabolite activating protein can enhance promoter sites of inducible operons (making them more attractive to sigma factor). If glucose is available to cells, the enzyme adenylate cyclase is inhibited, and cyclic-AMP is not produced. Under such circumstances, the promoter sites of inducible operons fail to bind much sigma factor, and transcription is very limited.

2. Feedback inhibition or end product inhibition

3. Allosteric inhibition/ This mechanism is less efficient than end product repression in terms of energy conservation. Cells expend considerable energy when they synthesize m-RNA molecules and protein molecules (form phosphodiester and peptide bonds). If the proteins synthesized are not used because they are being inhibited, then this energy is wasted.

4. Feedback inhibition or end-product inhibition

5. Structural gene/ When transcription is polycistronic, several genes are transcribed together, forming one, long m-RNA molecule. When this m-RNA is translated, a series of different polypeptides will be formed.

6. Operon/ polycistronic

7. The promoter is a nucleotide sequence (region of DNA) where the sigma factor of RNA polymerase binds to begin transcription. Without a promoter, transcription will not occur.

8. Operon/ promoter
9. Repressor protein/ operator
10. Repressor protein/ tryptophan (an amino acid)
11. Repressible operon/ corepressor/ operator
12. Inducible operon/ permease/ allolactose
13. Allolactose/ catabolite activating protein
14. β-galactosidase/ Allolactose binds to the repressor and inhibits the activity of this protein. The repressor then releases the operator site, and transcription is allowed to proceed. Transcription is thus induced (however, it will not proceed with high efficiency unless the promoter site is attractive to sigma factor).
15. It is active alone. It does not require a corepressor.
16. The β-galactoside permease is an enzyme that catalyzes the reactions necessary to bring lactose through the cell membrane and into the cell. In *E. coli*, β-galactoside permease is encoded by the *lac* Y gene of the lactose operon.
17. Lactose utilization operon (lac operon)/ allolactose
18. Catabolite repression/ cyclic-AMP
19. Glucose/ constitutive/ cyclic-AMP
20. Constitutive/ catabolite repression.
21. Adenylate cyclase/ catabolite repression