

Gene Induction in Prokaryotes (page 202)

- Operon:** Consists of at least one structural gene coding for the primary enzyme structure, and two regulatory elements: the operator and the promoter.
 - Regulator gene:** (repressor gene) produces a repressor substance that binds to the operator, preventing transcription of the structural genes.
 - Operator:** This is a non-coding sequence of DNA that is the binding site for the repressor molecule.
 - Promoter:** Site of RNA polymerase binding to start the transcription process.
 - Structural genes:** Genes responsible for producing enzymes that control the metabolic pathway.
- In an inducible enzyme system, the enzymes required for the metabolism of a particular substrate are produced only when the substrate is present. This saves the cell valuable energy in not producing enzymes that have no immediate use.
 - Inducible enzyme systems are not adaptive when

the substrate is present all (or most) of the time.

- Regulation of a non-inducible system is achieved (in prokaryotes) through **gene repression**. Genes that are normally switched on are switched off.
- The operon model explains diauxic growth because it links the growth phase to utilization of different substrates. The initial growth is associated with the preferred substrate, glucose, which does not require induction, there is a lag when glucose is depleted and the genes for lactose utilization are induced, and a second phase of growth on lactose.

Gene Repression in Prokaryotes (page 204)

- The gene for tryptophan synthetase is normally transcribed constantly. A repressor is required to switch it off. The repressor is activated by an effector. The effector binds to the repressor which binds to the operator to stop gene expression. In the case of the tryptophan synthetase gene, the effector is the end product of the pathway tryptophan.
 - The effector that binds to the repressor is tryptophan (the end product of the pathway). When the gene is switched on, tryptophan synthetase is produced and catalyzes the synthesis of the amino acid tryptophan. Excess tryptophan acts as an effector for the repressor molecule, which binds to the operator sequence and stops transcription of the tryptophan synthetase gene. Levels of tryptophan synthetase decrease, tryptophan synthesis stops, the repressor is released from the operator, and the gene is transcribed.
- The operator must be downstream of the promoter so that when the repressor binds, it blocks the action of the RNA polymerase which binds at the promoter and thus the gene cannot be transcribed.
- In the inducible system (gene induction), the genes for metabolizing the substrate are usually switched off, but are switched on when the substrate is present. In the gene repression model, the genes (for metabolizing the substrate) are normally switched on and are only switched off when the substrate is present in excess.