Operons

An operon is a set of genes that work together to form a set of proteins. Typically, these genes are close together. All of the genes in an operon are controlled together. In many cases, when one gene in an operon is transcribed, other genes are as well.

There are many examples of operons, but common examples covered in genetics courses include lactose and tryptophan operons. Different operons contain different genes and thus make different proteins. The regulation of gene expression also depends on what the operon is. Despite these differences, all operons have at least three parts; a promoter, an operator, and structural genes.

A promoter is a part of the DNA that will initiate the process of transcription. Without a functional promoter, transcription will not occur and thus there will never be a transcript made for which to guide translation. An operator is a section of DNA where a repressor can bind to block transcription. An operator and repressor relationship is like a lock and key relationship. Only a very specific shaped repressor can bind to a given operator. The transcription of structural genes is regulated by the operator. Structural genes code for the protein(s) that are made.

The names of the structural genes, how many structural genes there are, and what the repressor is can differ between the types of operons. In a lactose operon, there are three structural genes called Z, Y, and A. The repressor in a lac operon is a protein produced from the lac gene. This repressor protein can be removed by lactose. In a tryptophan operon, there are five functional genes (trpE, trpD, trpC, trpB, and trpA) that produce a protein that acts in a biochemical pathway. The repressor in a trp operon is a protein produced by trpR and it should only be removed when tryptophan levels are low.

Effector molecules are molecules that can regulate transcription. These molecules often have a specific location where they bind to the DNA or the repressor to upregulate or downregulate transcription. In lac operons, lactose is an effector molecule. Lactose can bind to the repressor protein to remove it from the operator. The presence of lactose results in transcription occurring. In a trp operon, tryptophan is the effector molecule. Tryptophan can bind to a repressor protein. A complex with two tryptophan molecules and a repressor protein can bind to the operator to halt transcription.

It is important to understand, in general, how operons work as well as how specific operons such as lac and trp operons work. To complement your review on operons, you should draw the general structure of an operon and then a lac operon and a trp operon before reviewing lac and trp operons in depth.