Concept 13.5

Control mechanisms switch genes on and off.

Regulation of Genes in Prokaryotes:

A Bacterium can change its functions in response to changes in its environment.

E. Coli (*Escherichia coli)* which lives in our intestines, a constantly changing chemical environment. Can switch on and off the production of enzymes needed to absorb and use the disaccharide lactose.

The three genes coding for the enzymes that process lactose are next to each other in the E. coli chromosome. Before the genes, there are two short stretches of DNA called control sequences. Such a cluster of genes, along with its control sequences, is called on **operon.** The operon discussed here is the lac operon, for "lactose".

Control Sequences:

1. **Promoter** - Site where RNA polymerase attaches to the DNA.

(recall RNA polymerase transcribes genes by making mRNA)

2. **Operator** - acts like a switch, determining whether of not RNA polymerase can attach to the promoter.

The operator is switched on or off by a **repressor**, a protein that functions by binding to the operator and blocking the attachment of RNA polymerase to the promoter.

- In the absence of lactose, the repressor is active and the lactose-processing genes are "turned off".

- When lactose molecules are present, they bind to the repressor protein and change its shape, the repressor cannot bind to the operator. RNA polymerase can now attach to the promoter and transcribe the DNA. The lactose-processing genes are "turned on".

Regulation of Genes in Eukaryotes:

Eukaryotic cells have a more elaborate mechanisms than bacteria for regulating genes, but some of the general principles are the same.

- Eukaryotic DNA includes promoter sequences located before the point where transcription begins.

- **Transcription factors** regulate transcription by binding to promoters or to RNA polymerases. These transcription factors are activated or deactivated by chemical signals in the cell. By attaching to transcription factors, some hormones signal cells in the body to express certain genes.

- **Gene expression** is the transcription and translation of genes into proteins.
  Gene Expression is regulated starting when an egg is fertilized.

1. Position promotes expression of particular genes
2. Individual cells undergo **cellular differentiation** - they become increasingly specialized in structure and function.

Stem Cells:

- Remain undifferentiated
- Have the potential to differentiate into various types of cells.

Homeotic Genes:

- Master control genes that direct development of body parts in specific locations.

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