Regulation of Gene Expression

Big Picture

In order to produce the specific proteins that cells need, cells must regulate DNA transcription so that only certain parts of DNA are transcribed and translated into proteins. Transcription is regulated by regulatory proteins, which control the behavior of RNA polymerase. Regulation in prokaryotic cells involves operons, while regulation in eukaryotic cells involves different types of regulatory elements such as TATA boxes.

Key Terms

Gene Expression: Activating a particular gene to make a protein.

Regulatory Protein: Proteins that regulate DNA transcription.

Activators: Regulatory proteins that promote transcription.

Repressors: Regulatory proteins that prevent transcription.

Regulatory Elements: Regions of DNA where regulatory proteins can bind.

Promoter: Region of a gene where a RNA polymerase binds to initiate transcription of the gene.

RNA Polymerase: An enzyme that helps produce RNA during transcription.

Operon: Region of DNA containing genes that code for proteins with a particular function (usually for prokaryotic cells).

Operator: Part of the operon where regulatory proteins bind.

TATA Box: Regulatory element in the promoter of most cells.

Homeobox Genes: Genes that regulate development.

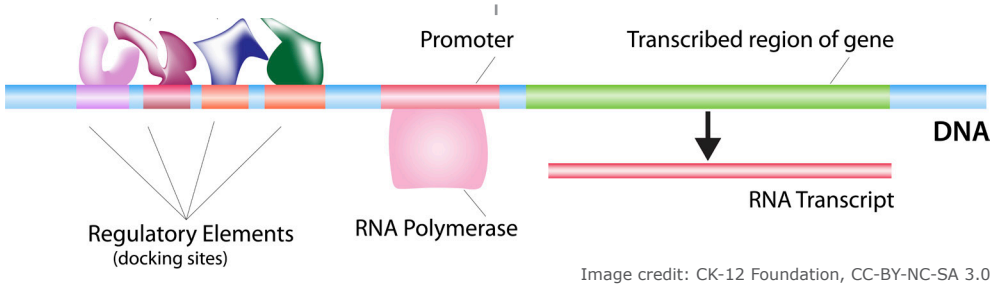
How Genes are Regulated

Gene expression is regulated, meaning that specific proteins are made when and where they are needed. This can be done by regulating transcription.

- Transcription is regulated by r**egulatory proteins.**
- Regulatory proteins bind to **regulatory elements** located near **promoters** and interact with **RNA polymerase**.

Types of regulatory proteins:

- **Activators**: promote transcription by helping RNA polymerase interact with promoter.
- **Repressors**: prevent transcription by preventing RNA polymerase from transcribing.



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Gene Expression

Prokaryotes

Regulation in prokaryotes involve **operons** and **operators**.

- When a group of proteins is not needed, a repressor binds to the operator and prevents RNA polymerase from transcribing the operon.
- When proteins are needed, the repressor is removed so that the operon can be transcribed and the proteins can be made.

Eukaryotes

Eukaryotic cells are specialized, meaning that they have different functions, so different types of cells use different regulatory elements.

- Some regulatory elements are used by all types of cells, such as the **TATA box**
  - Many regulatory proteins can bind to the TATA box
  - The gene is only expressed after all the necessary regulatory proteins bind to the TATA box
- Regulation while an organism is growing is important because it allows the organism to have specialized cells
  - **Homeobox genes** in particular need to be regulated since they code for proteins that will turn on many development genes
- Regulator gene mutations can cause cancer
  - Mutations that cause cancer usually occur in tumor-suppressor genes and proto-oncegenes, which cause cells to keep dividing rapidly without stopping