Gene regulation results in differential gene expression, leading to cell specialization. **PROKARYOTIC GENE REGULATION**
Regulatory elements
There are multiple regulatory elements in the genome that play a role in controlling gene expression.

Some regulatory DNA sequences:
Promoter: sequenced in front of a transcribed gene recognized by RNA polymerase and transcription factors.

Enhancers: sequences further “upstream” of a gene that increase transcription.
A “gene” is not just a transcript

DNA

Promoter

Enhancers

Transcription

pre-mRNA

Exon

Exon

Exon

Introns

Splicing

mRNA

5' UTR

Open reading frame

3' UTR

Translation

protein
Prokaryotic Control of Gene Expression

Prokaryotes control gene expression almost entirely by controlling transcription.
Operons

- Groups of metabolically related genes with a single promoter.
- Common in prokaryotes.
- 2 Major Types:
  - Inducible & Repressible
Operon Operation
The presence or absence of a molecule controls the transcription of operon genes by controlling the access of RNA polymerase by controlling the binding of a repressor protein.
Inducible Operons

Default state: **OFF**.
Involves in metabolic pathways that are only occasionally used.

Ex. The lac operon
Lac Operon

- Lactose Absent
- Repressor Active
- Operon OFF

(a) Lactose absent, repressor active, operon off

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Lac Operon

- Lactose Present
- Repressor Inactive
  - Lactose = inducer
- Operon ON
Repressible Operons

**Default state:** **ON.**

Involved in metabolic pathways that are frequently used

Ex. The trp operon
Trp Operon

- Tryptophan Absent
- Repressor Inactive
- Operon ON
Trp Operon

- Tryptophan Present
- Repressor Active
  - Tryptophan = Corepressor
- Operon OFF

(b) Tryptophan present, repressor active, operon off

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Upregulation

Refers to increasing the baseline amount of transcription through the binding of an **upregulator**.

Ex. The CAP/cAMP Complex

cAMP – Cyclic AMP
CAP/cAMP Complex

- Lactose present
- Glucose scarce (cAMP level HIGH)
- Abundant Lac mRNA synthesized
**CAP/cAMP Complex**

- Lactose present
- Glucose present (cAMP level **LOW**)
- Little Lac mRNA synthesized