KEY CONCEPT
Gene expression is carefully regulated in both prokaryotic and eukaryotic cells.
Prokaryotic cells turn genes on and off by controlling transcription.

- A promoter is a DNA segment that allows a gene to be transcribed.
- An operator is a part of DNA that turns a gene “on” or “off.”
- An operon includes a promoter, an operator, and one or more structural genes that code for all the proteins needed to do a job.
  - Operons are most common in prokaryotes.
  - The *lac* operon was one of the first examples of gene regulation to be discovered.
  - The *lac* operon has three genes that code for enzymes that break down lactose.
The *lac* operon acts like a switch.

- The *lac* operon is “off” when lactose is not present.
- The *lac* operon is “on” when lactose is present.

**Without lactose** (switched off)

- DNA
- RNA polymerase blocked
- promoter
- operator
- genes for enzymes that digest lactose

**With lactose** (switched on)

- lactose
- growing RNA
- RNA polymerase transcribes
- promoter
- operator
- genes for enzymes that digest lactose
Eukaryotes regulate gene expression at many points.

- Different sets of genes are expressed in different types of cells.
- Transcription is controlled by regulatory DNA sequences and protein transcription factors.
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- Most eukaryotes have a TATA box promoter.
- Enhancers and silencers speed up or slow down the rate of transcription.
- Each gene has a unique combination of regulatory sequences.
RNA processing is also an important part of gene regulation in eukaryotes.

mRNA processing includes three major steps.
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- Introns are removed and exons are spliced together.
- A cap is added.
- A tail is added.