

### Genetic Material

- DNA primary source of heritable information (sometimes RNA)
- Info stored and passed through subsequent generations (mostly DNA sometimes RNA)
- Base Pairing: A-T(U) and G-C
- Purines: G and A; have a double ring structure
- Pyrimidines: C, T, and U; have a single ring structure
- Retroviruses: info flows from RNA to DNA, made possible by reverse transcriptase

### DNA Replication

DNA is synthesized in the 5' to 3' direction

**Semiconservative** One strand of DNA serves as the template for a new strand of complementary DNA

**Helicase** Unwinds the DNA strands

**Topoisomerase** Relaxes supercoiling in front of the replication fork

**DNA polymerase** Requires RNA primers to initiate DNA synthesis

**Leading Strand** DNA polymerase synthesizes new strands of DNA continuously in 5'-3' direction

**Lagging Strand** DNA polymerase synthesizes new strands of DNA DISCONTINUOUSLY (runs 3'-5')

**Ligase** Joins the fragments on the lagging strand

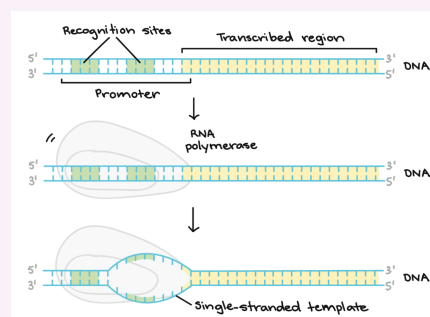
### RNA Transcription

**Initiation** RNA polymerase binds to a sequence of DNA called the promoter. Once bound, RNA polymerase separates the DNA strands, providing the single-stranded template needed for transcription.

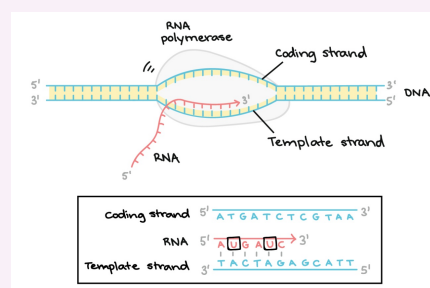
**Elongation** RNA polymerase reads template strand and builds RNA molecule out of complementary nucleotides. RNA transcript carries the same information as the non-template (coding) strand of DNA, but it contains the base uracil (U) instead of thymine (T)

**Termination** When termination sequence is transcribed, they cause the transcript to be released from the RNA polymerase

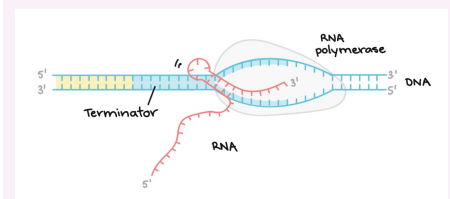
### Initiation



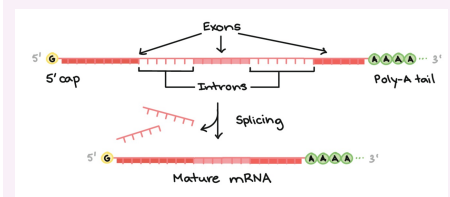
### Elongation



### Termination

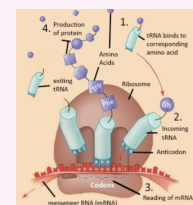


### Eukaryotic Modifications



1. Addition of a poly-A tail.
  2. Addition of a GTP cap.
  3. Excision of introns and splicing and retention of exons.
- Generates different versions of resulting mRNA molecule (alternative splicing)

### RNA Translation



### Prokaryotic Gene Regulation

**Inducible** Turned on by the presence of a particular small molecule (inducer)

**Repressible** On by default but can be turned off by a small molecule (corepressor)



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### Eukaryotic Gene Regulation

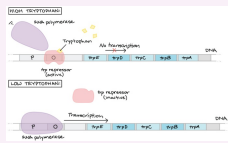
Chromatin access-ibility More "relaxed" chromatin makes a gene more available for transcrip-tion

Transc-ription Sets of transcription factor proteins bind to specific DNA sequences in or near a gene and promote or repress its transcrip-tion into an RNA

RNA processing Splicing, capping, and addition of a poly-A tail, alternative splicing

RNA stabil-ity/Trans-lation Protein yield determines lifetime of RNA molecule in cytosol. Small regulatory RNAs called miRNAs bind to target mRNAs - chop them up

### Trp Operon



Repressible Operon

### Lac Operon

Glucose	Lactose	CAP binds	Repressor binds	Level of transcription
+	-	-	+	No transcription
+	+	-	-	Low-level transcription
-	-	+	+	No transcription
-	+	+	-	Strong transcription

Inducible Operon

### Histones

Acetylation Makes DNA more accessible

Methylation Makes DNA less accessible

### Mutations



Mutations are the main source of genetic variation

### Biotechnology

Electrophoresis Separates molecules according to size and charge

Polymerase chain reaction (PCR) Amplifies DNA fragments (makes more)

Bacterial transformation Introduces DNA into bacterial cells (via plasmid)

DNA sequencing Determines order of nucleotides in DNA molecule



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