

### 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

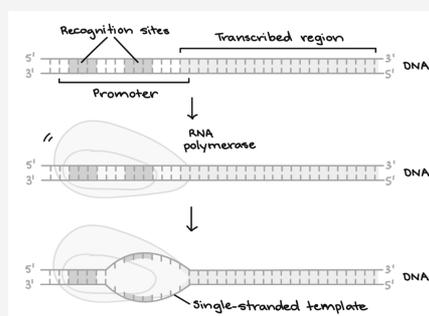
### RNA Transcription

**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.

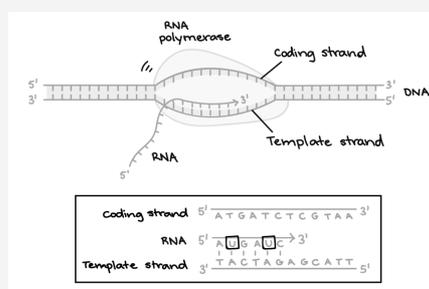
**Elongation** RNA polymerase reads template strand and builds RNA molecule out of complementary nucleotides. RNA transcript carries the same information as the non-template (coding) strand of DNA, but it contains the base uracil (U) instead of thymine (T)

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

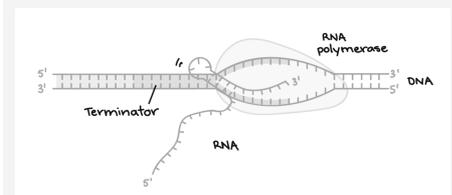
### Initiation



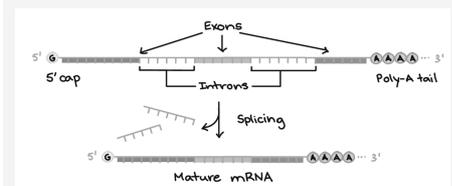
### Elongation



### Termination

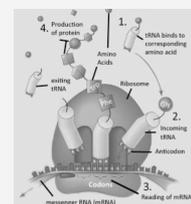


### Eukaryotic Modifications



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

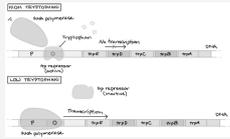
**Chromatin access-ibility** More "relaxed" chromatin makes a gene more available for transcription

**Transcription** Sets of transcription factor proteins bind to specific DNA sequences in or near a gene and promote or repress its transcription into an RNA

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

**RNA stability/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 trans-formation** Introduces DNA into bacterial cells (via plasmid)

**DNA sequencing** Determines order of nucleotides in DNA molecule



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