CONCEPT: DNA TRANSCRIPTION

- **Transcription** is the process that changes DNA into RNA
  - □ **RNA polymerase** is the class of enzymes that _____ DNA

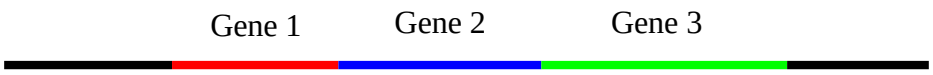
RNA polymerase	Prokaryotes	All RNA
RNA polymerase I	Eukaryotes	Ribosomal RNA (rRNA) – forms ribosomes
RNA polymerase II	Eukaryotes	Messenger RNA (mRNA) – formed proteins
RNA polymerase III	Eukaryotes	Transfer RNA (tRNA) – assist in protein creation

  - □ Transcription uses _____ strand of DNA as a template to produce a single stranded RNA
    - Prokaryotes are **polycistronic**, meaning a single RNA can encode for many genes
    - Eukaryotes are **monocistronic**, meaning, a single RNA usually encodes for only one gene
  - □ RNA polymerase (1 mistake every 10^4 nucleotides) is not as accurate as DNA polymerase (10^7 nucleotides)

EXAMPLE: Model of monocistronic and polycistronic transcripts

Monocistronic

Polycistronic



Transcription Initiation

● The **transcription start site** tells _____ where to start transcribing

□ A **promoter sequence** is a specific set of nucleotides that RNA polymerase binds to in order to start transcription

- Can lie upstream (*TATA promoter*) or downstream (*DPE-driven promoter*) of the gene start

- Other sequences, upstream of the promoter also control gene transcription

- *Proximal Control Elements:* Located 100-200 nucleotides upstream

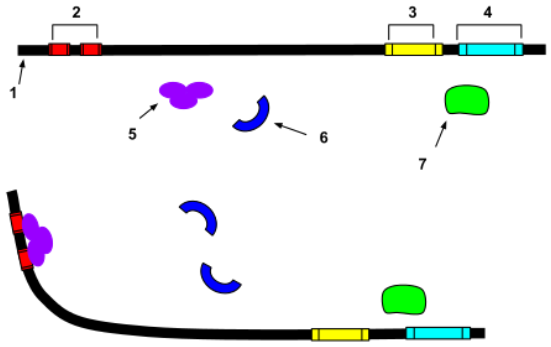
- *Enhancers:* Can be located 1000s nucleotides away – upstream or downstream

- Composed of a **consensus sequence** or common version of a conserved sequence that has variation

□ The polymerase finds the promoter because the promoter gives the helical _____ unique features

- Promoter has *polarity*, meaning it positions the RNA on only *one* strand in one direction

EXAMPLE: Model of a promoter (3) and enhancer (2) recruiting proteins for the transcription of the gene (4)



□ The **sigma factor** region of prokaryotic RNA polymerase recognizes the promoter RNA

□ **Transcription factors** bind the promoter and _____ RNA polymerase II in eukaryotes

- There are two main sequences that control promoter initiation

- The **TATA** box (contains T and A nucleotides) is bound by TFIID

- The **Inr initiation sequence** can be used in a promoter with or without a TATA box

- The **transcription initiation complex** is the collection of proteins at the promoter – recruited by TFIID

- The collection of proteins differs for each gene (and can contain over 100 protein subunits)

- *TFIIH* contains protein kinase, which adds a phosphate to RNA polymerase and activates transcription

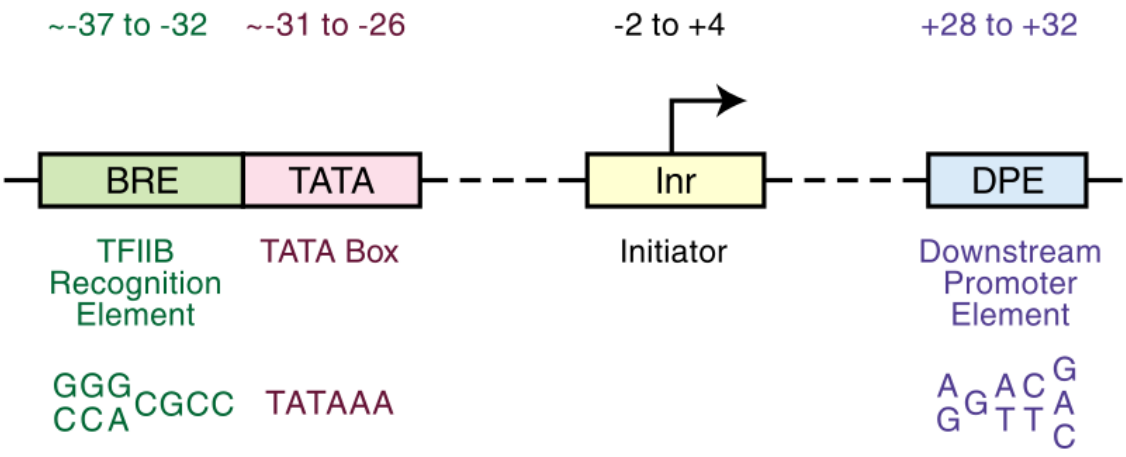
- After transcription begins the transcription factors _____ the promoter

- **Mediators** are proteins that help communication between RNA polymerase and transcription

□ Transcription initiation by RNA polymerase I and III differs from that of II

- Have additional types of promoters and transcription factors

EXAMPLE: The main promoter element's location and consensus sequence on a DNA region



Transcription Elongation

● Once initiated, RNA polymerase works to _____ the RNA transcript

□ Proteins traveling with RNA polymerase (*TFIIH)*, open up the DNA strand for transcription

- 12-14 base pairs are open at one time

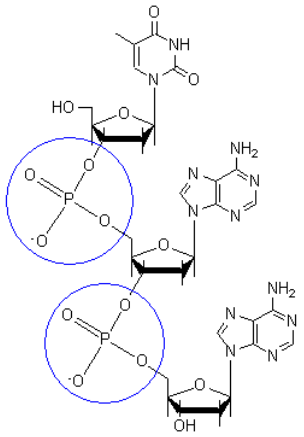
□ RNA polymerase _____ **phosphodiester bonds** between ribonucleotides during transcription

- Energetically favorable, because it releases two phosphates

- One nucleotide is added at a time (~1000 nucleotides a minute)

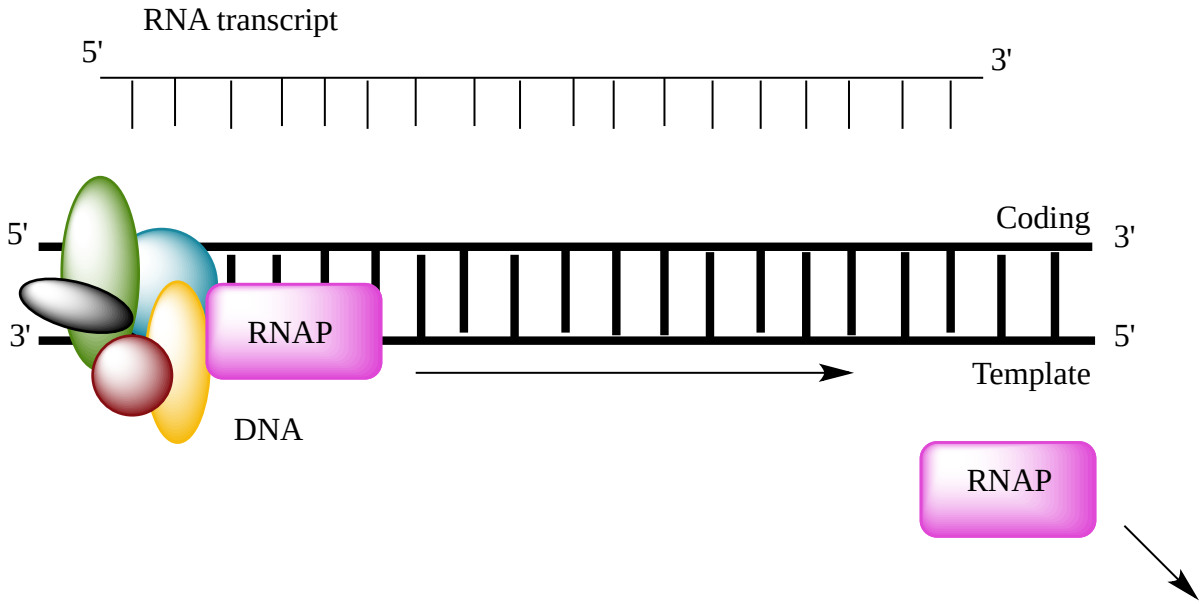
□ **Elongation factors** are proteins that travel with RNA polymerase to keep it attached to the DNA while it's moving

EXAMPLE: Phosphodiester bonds between nucleotides



□ RNA polymerase _____ RNA transcription in a **5' to 3' direction** (binds to a 3' template and moves 5')

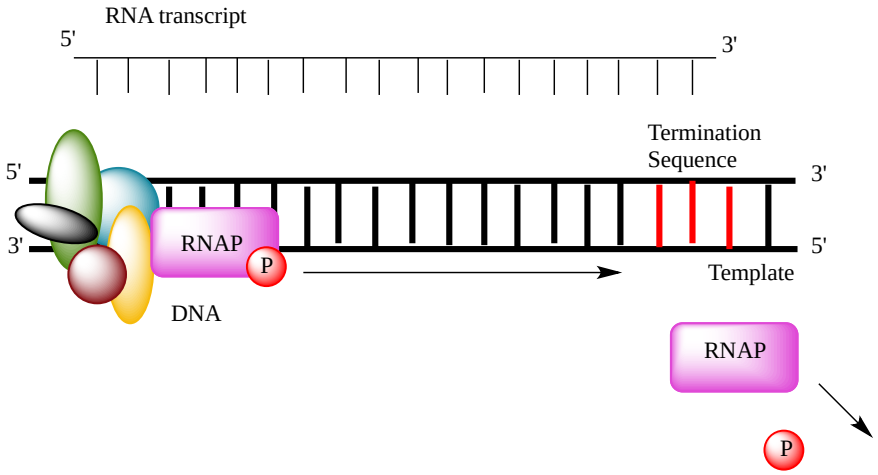
EXAMPLE: RNA polymerase transcribing 5' to 3' transcript



Transcription Termination

- Once RNA polymerases stops when it reaches a **terminator**, which is a stop site for transcription
  - □ The phosphates on its tail are _____ by protein phosphatases
  - □ The newly de-phosphorylated (with phosphates removed) polymerase is free to start transcription again

EXAMPLE: RNA polymerase ends transcription once reaching the terminator sequence



PRACTICE

1. Transcription initiation requires many factors, which of the following is not one of them?
    a. RNA polymerase
    b. Mediator
    c. Inr initiation sequence
    d. Elongation factors

2. Is polycistronic mRNA found in prokaryotic transcription or eukaryotic transcription?
    a. Prokaryotic
    b. Eukaryotic

3. Transcription occurs in which of the following directions?
    a. 5’ to 3’
    b. 3’ to 5’
    c. 3’ to 3’
    d. 5’ to 5’

4. When RNA polymerase reaches a terminator, what happens?
    a. It immediately falls off the DNA sequence
    b. It is marked by a protein that removes it from the DNA
    c. Phosphates are removed from the polymerase tail, which cause it to remove from the DNA
    d. It remains on the DNA strand, but does not transcribe

5. True or False: Both strands of the DNA are transcribed to create a protein.
    a. True
    b. False