

## Chapter 3 – DNA Structure & Transcription (Production of RNA)

DNA structure, Transcription, Processing of eukaryotic transcripts

### Part 1: DNA Structure

#### I. DNA

##### A. General

1. "Information molecule": must
  - a. contain necessary information
  - b. be passed to offspring
  - c. be variable, but still accurate (*ex.* binary)
2. Reminder: DNA is a **polymer of nucleotides**

##### B. Terminology

1. Nucleotide vs. Nucleoside
  - a. Nucleoside = sugar + base
  - b. Nucleotide = sugar + base + at least 1 phosphate
    - i. Can be identified as "nucleoside *mono, di, tri,* phosphate"

#### II. Structure

2 nucleotides are linked by series of covalent bonds called a **phosphodiester bond (C-O-P-O-C)**

##### A. The Backbone

1. Linear strand of alternating phosphate & sugar groups
2. Nonvariable
3. Negatively charged
4. Tail-end phosphate (not connected to a sugar) will be  $\text{HPO}_4$  (H attached to top O), instead of  $\text{PO}_4$  (*see diagram*)
5. All sugars in strand are oriented in same direction ( $5' \rightarrow 3'$  or  $3' \rightarrow 5'$ )
6. Strand has polarity or direction

##### B. Base Sequence

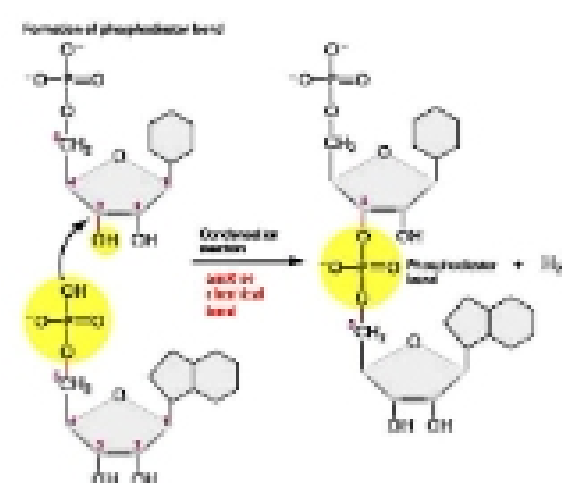
1. Variable part of DNA – holds info
2. Absolutely no constraints on what bases are in what order

##### C. **Double-helix** (for BDNA – only DNA we talk about)

1. 2 antiparallel strands in a double helix
2. 2 strands stay together by H-bonds that form between **complimentary bases** (1 purine—1 pyrimidine)
  - a. A-T, G-C
    - i. This specificity is what keep width of DNA constant
  - b. Bases also interact noncovalently with the ones above & below and "stack" (tightly group), which stabilizes helix
    - i. **\*\*clicker question (unrelated): Make sure the Oxygen on the 3' carbon isn't there if you're working in DNA.**

##### D. **IN the cell**, DNA is coiled & packaged with proteins. The 2 together are called **chromatin**

1. *\*Don't worry about H2A, H2B, etc. in the book*

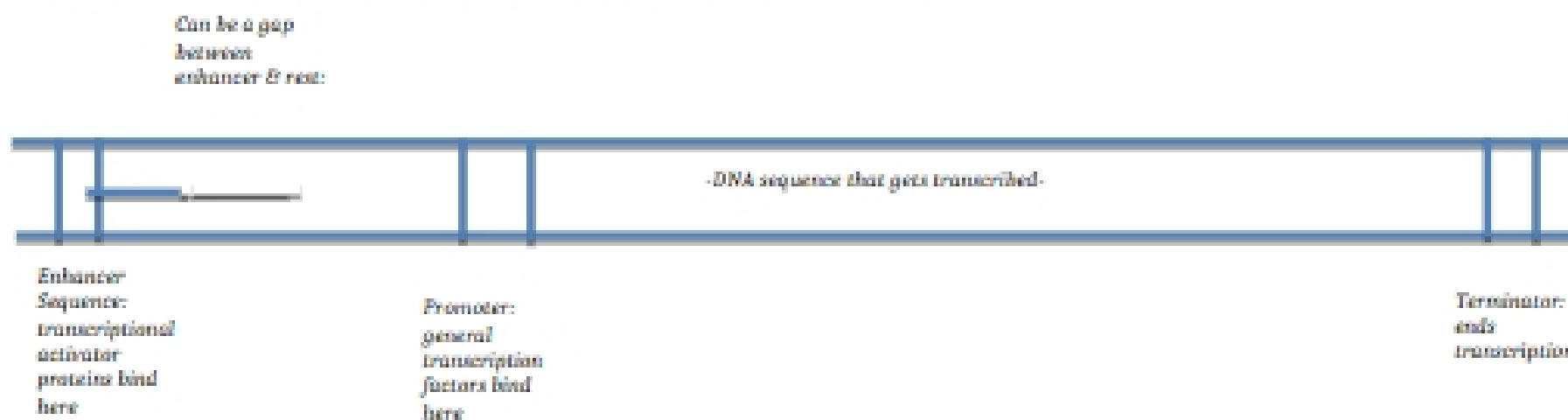


## Part 2: Transcription – Making an RNA Product From a Gene

### I. General

A. “Gene” – sequence of DNA that codes for a product, and its associated control regions

### II. 1 scenario of gene structure (eukaryote):



### III. Process of Transcription

A. **Specific proteins** associate with the control regions of a gene (ex. start/stop) (fig. 3.17)

B. **RNA polymerase complex** separates the DNA strands to form the “transcription bubble” (fig. 3.18)

C. **1 DNA strand (half-strand) used to build RNA**

1. RNA built from its 5’ to 3’ end (so, from 3’ to 5’ on the half-strand of the DNA)

D. **RNA polymerase** checks for correct base pairing & catalyzes pyrophosphate release & phosphodiester bond formation (3.19)

E. **If the transcript** contains information to build a protein, it’s mRNA (messenger RNA)

1. Prokaryotes can immediately use mRNA to build proteins

2. Eukaryotes first **process** mRNA because some of the transcript isn’t useful (*introns/exons splicing*)

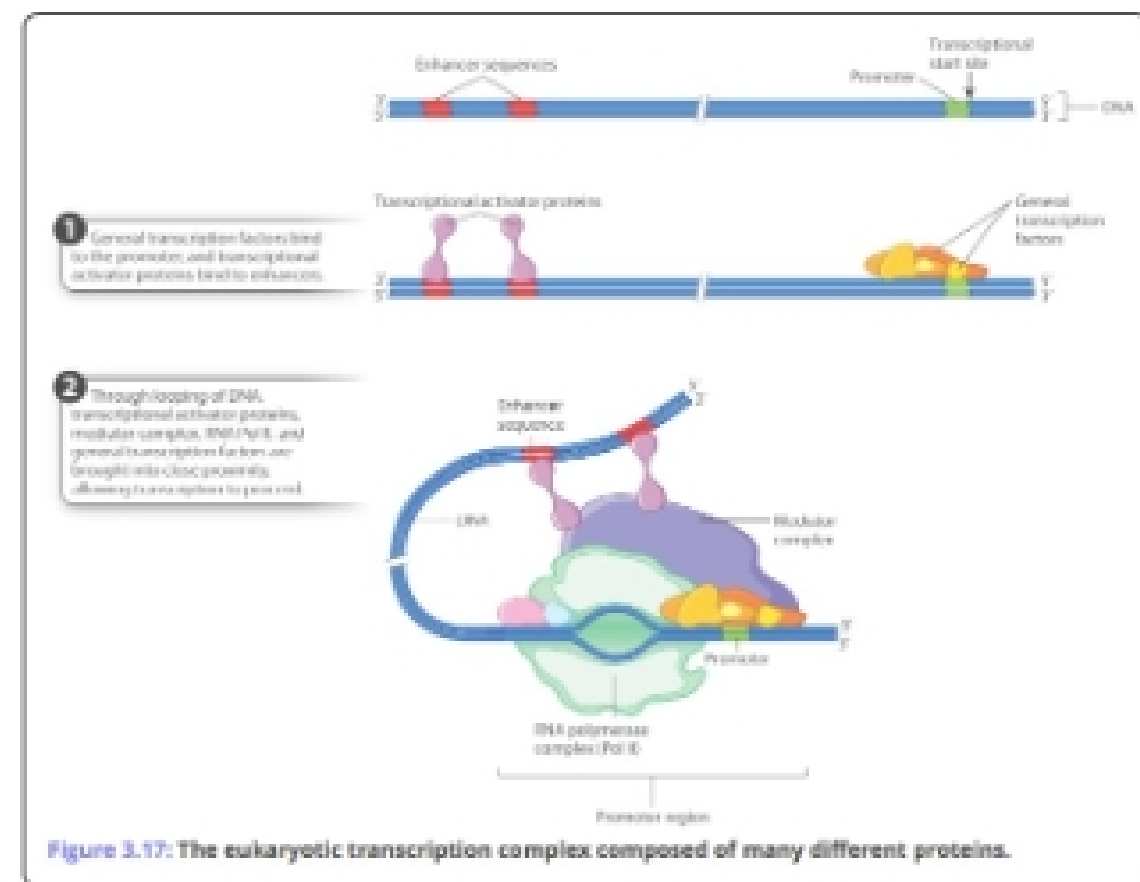


Figure 3.17: The eukaryotic transcription complex composed of many different proteins.

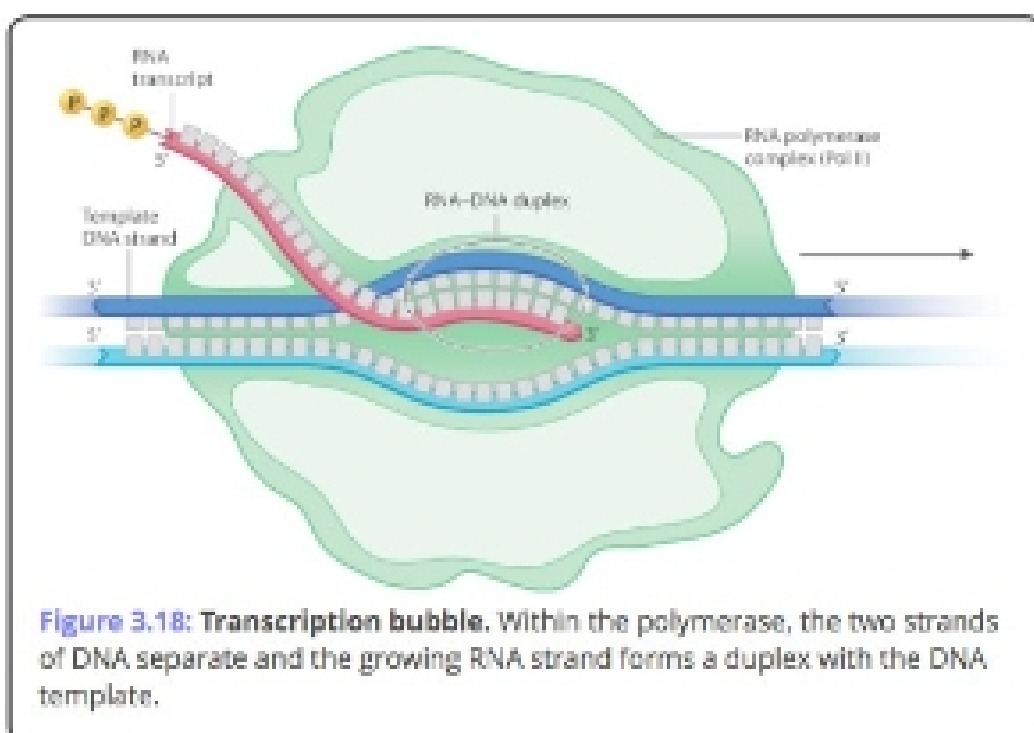


Figure 3.18: Transcription bubble. Within the polymerase, the two strands of DNA separate and the growing RNA strand forms a duplex with the DNA template.

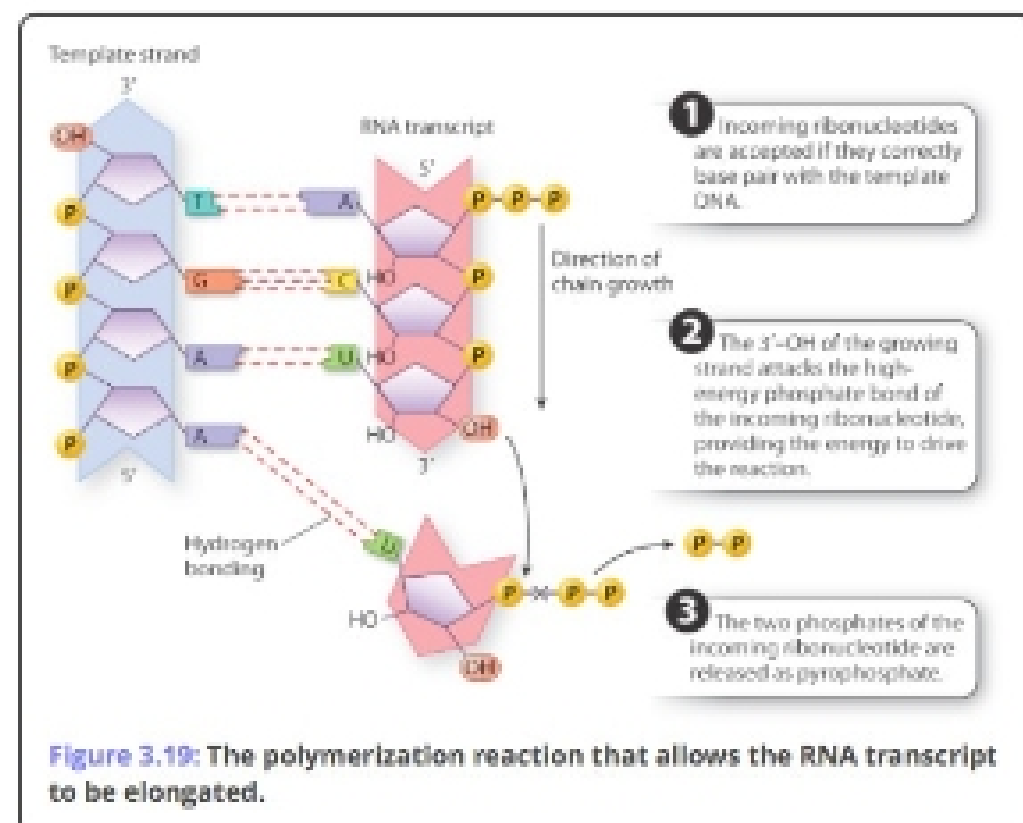


Figure 3.19: The polymerization reaction that allows the RNA transcript to be elongated.

The polymerization reaction releases a phosphate-phosphate group (pyrophosphate), shown at the lower right in Fig. 3.19, which also has a high-energy phosphate bond that is cleaved by another enzyme. Cleavage of the pyrophosphate molecule makes the polymerization reaction irreversible, and the next ribonucleoside triphosphate that complements the template is brought into line.

#### IV. Splicing (Introns/Exons)

- A. The *-DNA sequence that gets transcribed-* above contains introns (useless) and exons (useful)
- B. mRNA processing
  1. Adds special nucleotide to the 5' end (5' cap)
  2. Adds poly-A (adenine) tail to 3' end
  3. **Removes introns & covalently bond exons together**
    - a. One eukaryotic transcript can be processed different ways (*fig. 3.25*)
    - b. Spliceosomes (snRNP's) – RNA & protein machines used to remove introns
  4. Remember, not all transcripts are mRNA.
    - a. rRNA (ribosomal)
    - b. tRNA (transfer)
    - c. small nuclear (snRNA)
    - d. micro RNA (miRNA)

