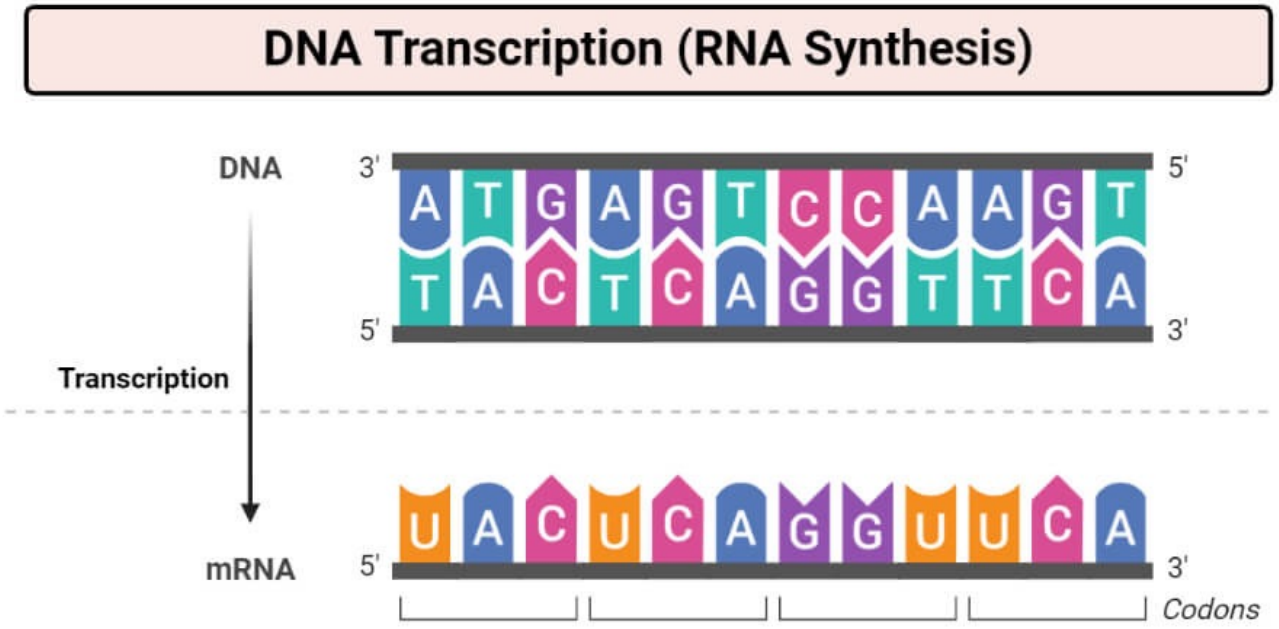
Lesson 11
DNA transcription



DNA transcription

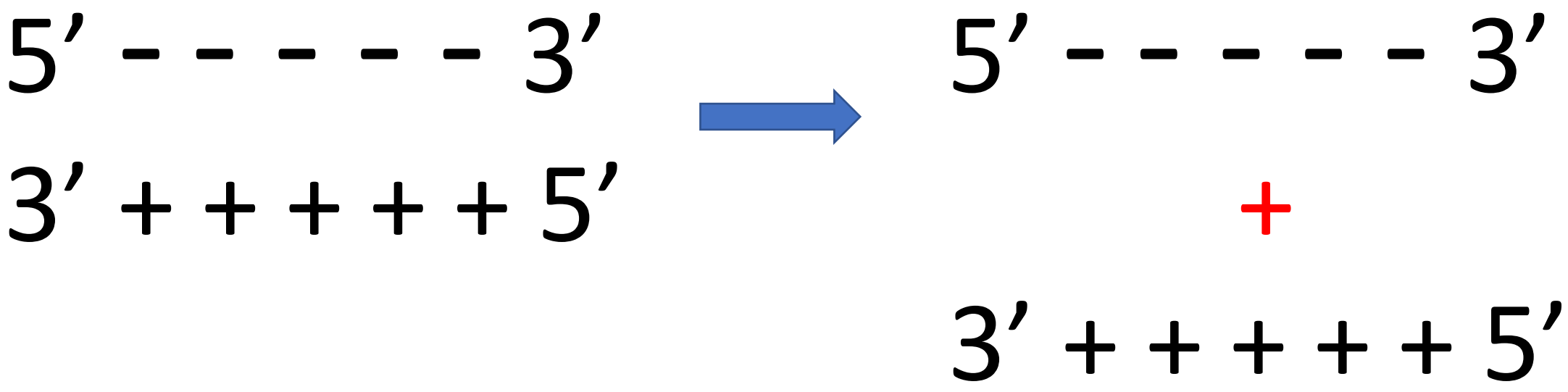
- **DNA (gene) transcription** is a process that produces an **mRNA** from a DNA template
- The process takes place in the cell nucleus
- Two major difference with DNA replication
  - RNA uses U instead of T
  - **Only 1 DNA template strand is used: the BOTTOM strand**

5’ - - - - - 3’→ non-template strand

3’ + + + + + 5’→ **template strand**

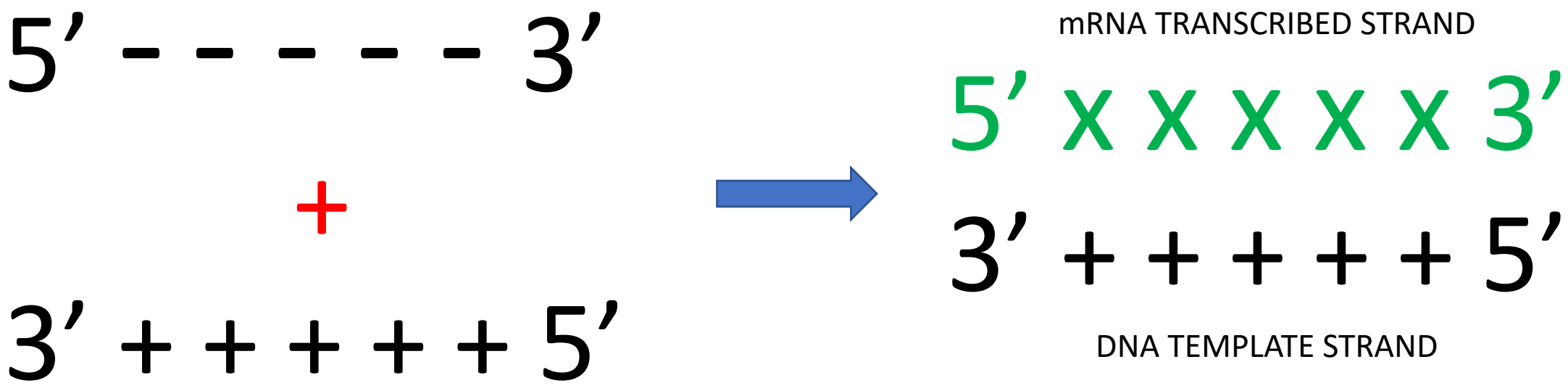
DNA transcription

1. DNA strands separate



DNA transcription

2. mRNA is transcribed (copied) from the DNA template strand



DNA transcription

3. mRNA transcribed strand leaves the DNA template strand
4. DNA template and non-template strands base-pair again

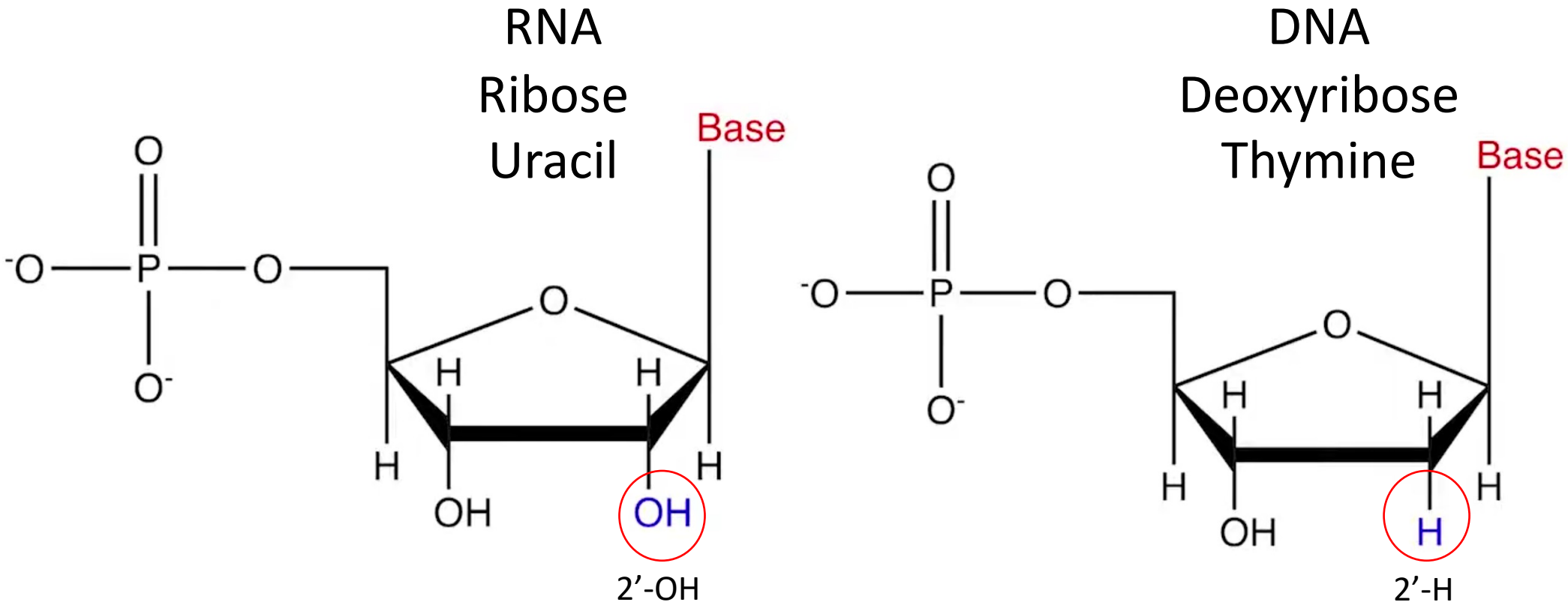
5’ x x x x x 3’ 5’ – – – – – 3’

+

3’ + + + + + 5’

DNA transcription

- The transcribed 5’xxxxx3’ mRNA strand = same as DNA non-template strand (with U in place of T)



DNA transcription

- The transcribed 5’xxxxx3’ mRNA strand = same as DNA non-template strand (with U in place of T)
- The 2’-OH on ribose is a reactive group
  - Makes RNA substantially more reactive (hydrolysis) = less stable than DNA
- This is why DNA (a double stranded nucleic acid) is a better genetic storage material than RNA (usually a single stranded nucleic acid)

Locating the file to be transcribed

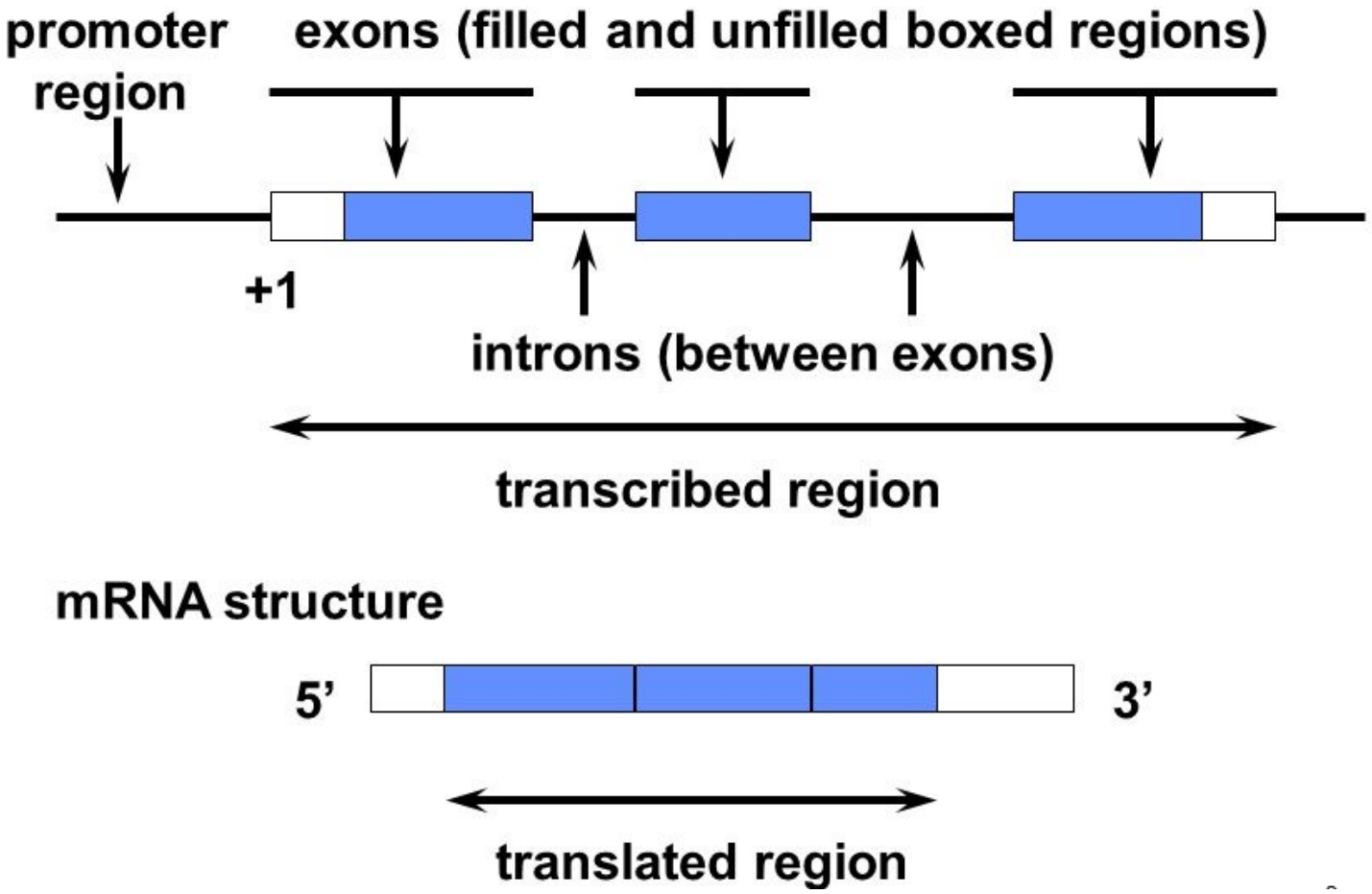
- Only 2% of DNA contains the codes for proteins
  - We are still figuring our what are the functions of the other 98%
    - Much of it seems to be involved in regulating how the informaion in DNA is used
- When a cell needs to build a protein, it must recognize the gene for that protein among all other genes
- Cells recognize a specific gene by its **PROMOTER**
  - A unique sequence on DNA that is located at the beginning of the gene to be expressed

Promoters

- In eukaryotes, promoters have variable sequences
- Yet, 20% eukaryotic promoters contain a common sequence:

  TATAAA

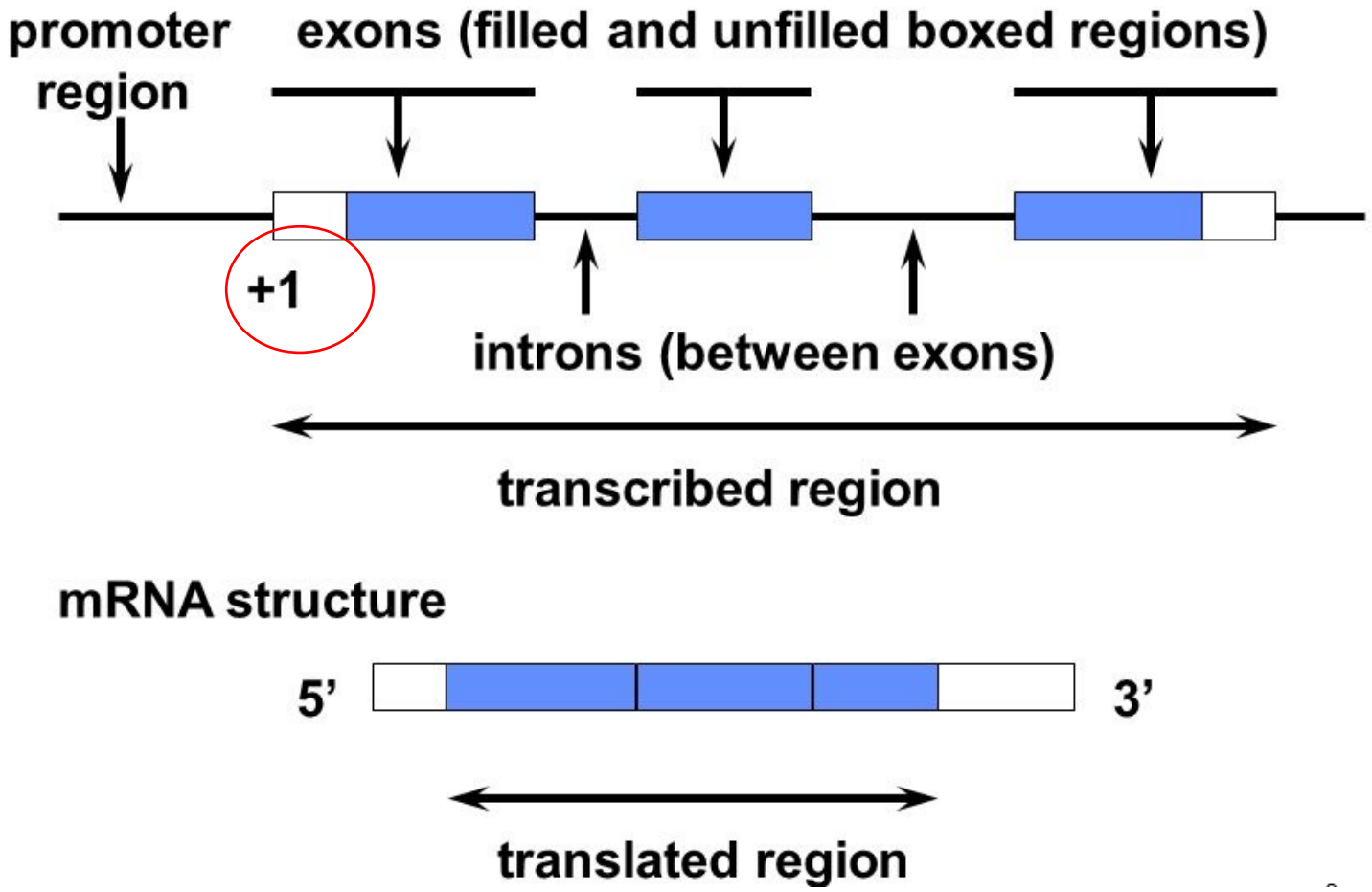
- This is called a **TATA box**



Promoters

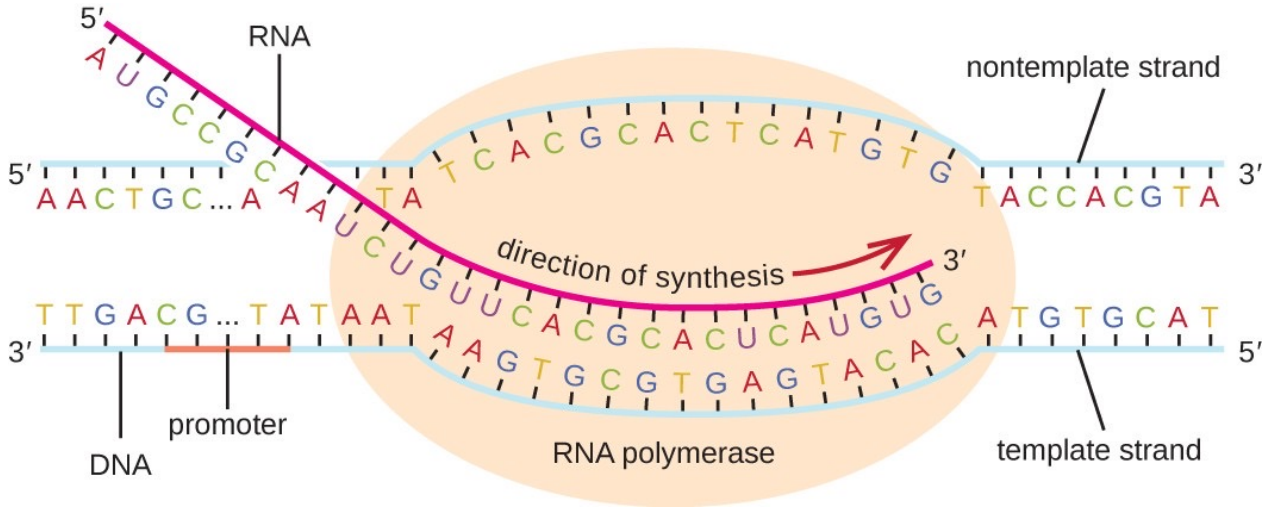
- In eukaryotes, promoters have variable sequences
- Yet, 20% eukaryotic promoters contain a common sequence:

  TATAAA
- This is called a **TATA box**
- The TATA box is located near the site where transcription begins
  - called +1 site



RNA polymerase – the transcription master

- The enzymes that reads and copies the DNA info onto RNA is called **RNA polymerase**
- The RNA POL
  - Binds at the promoter
  - Unwinds the DNA DH
  - Uses the template strand (3'-5') to build the RNA molecules based on the complementarity principle



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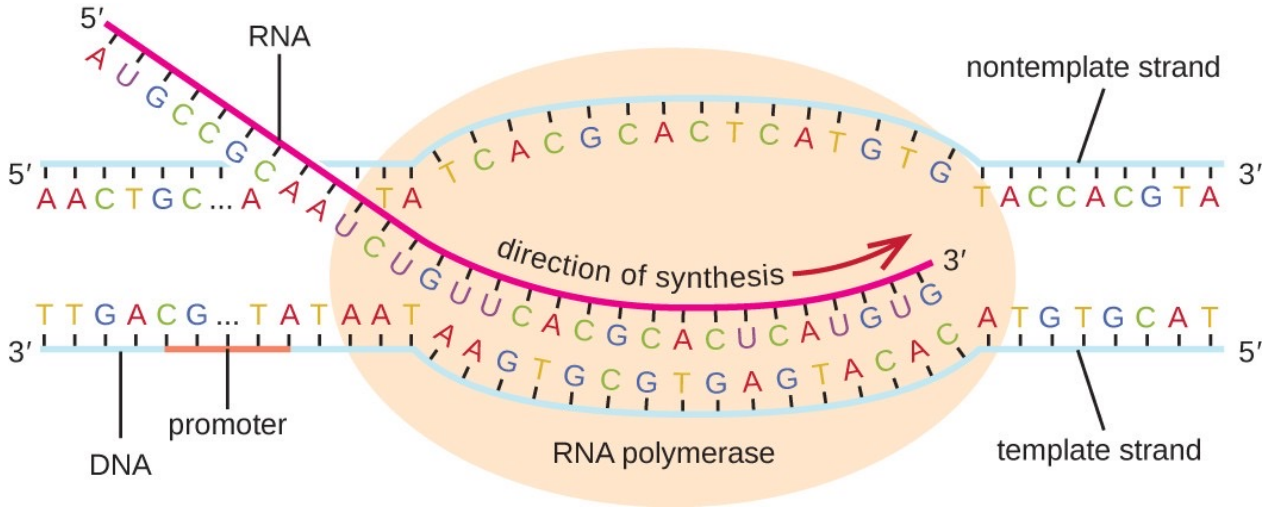
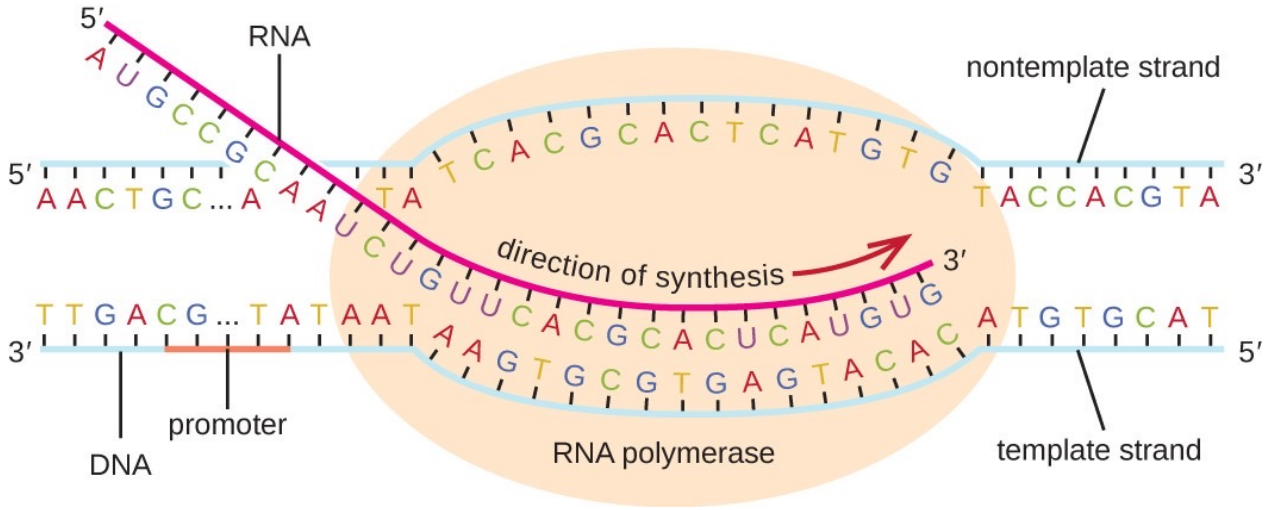
- The DNA strand that is not read is called non-template strand
  - it is often called coding strand
- This might seem confusing
  - **The reason is that, ultimately, the sequence of the non-template strand is the same of the newly synthesized RNA (only with U in place of T)**



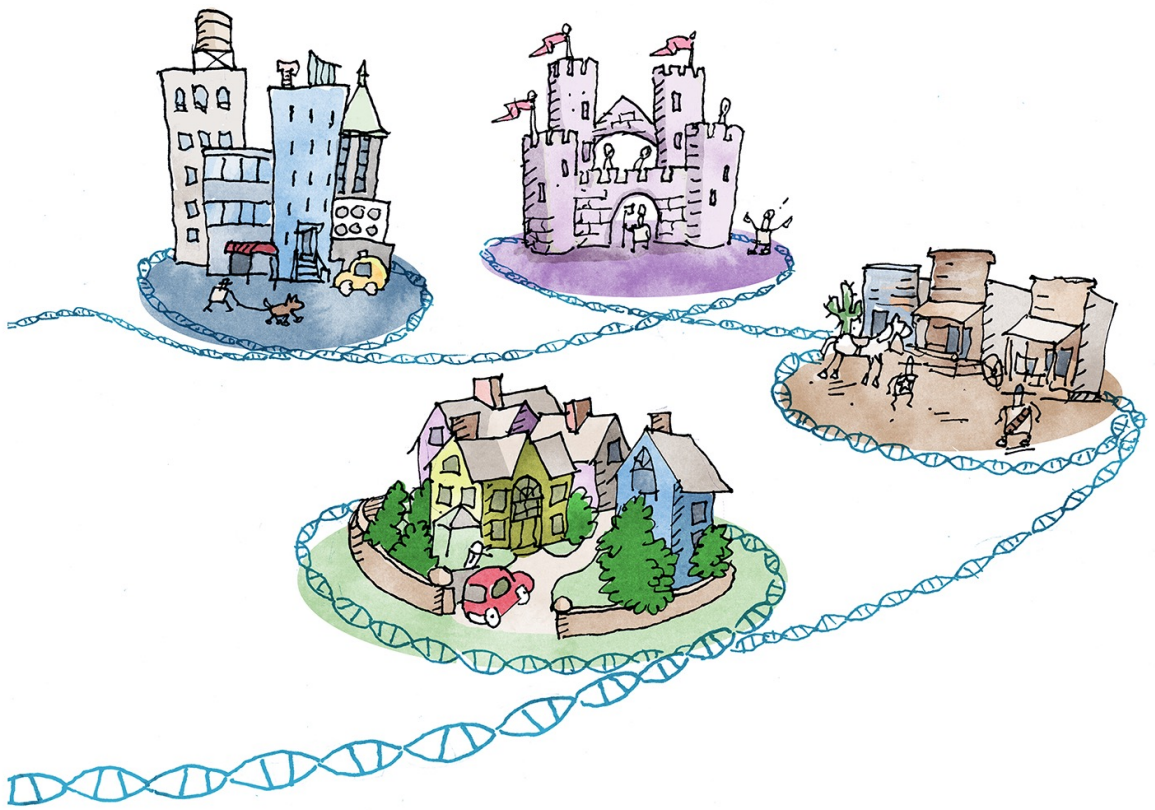
RNA polymerase – the transcription master

- RNA POL reads the template strand of DNA in the 3’ to 5’ direction in order to build the new RNA molecule in the 5’ to 3’ direction
- *i.e.*, the 5’ end of the incoming nucleotide is added to the 3’ end of the growing RNA chain



The RNA POL helpers – transcription factors

- RNA POL needs helpers to recognize promoters
  - Regulatory proteins that control the transcription process
- In eukaryotes, these proteins are called **transcription factors**
  - They help RNA POL in locating and binding to promoters



Transcription terminators

- Just like promoter sequences mark the beginning of genes, transcription **terminators** mark the end of genes
- Once the RNA POL reads in a terminator sequence, it
    - unbinds from the DNA template strand and
    - releases the newly synthesized RNA

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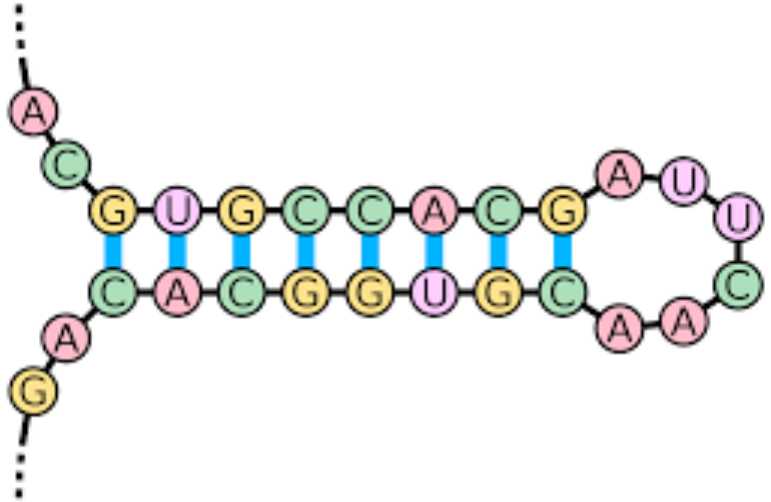
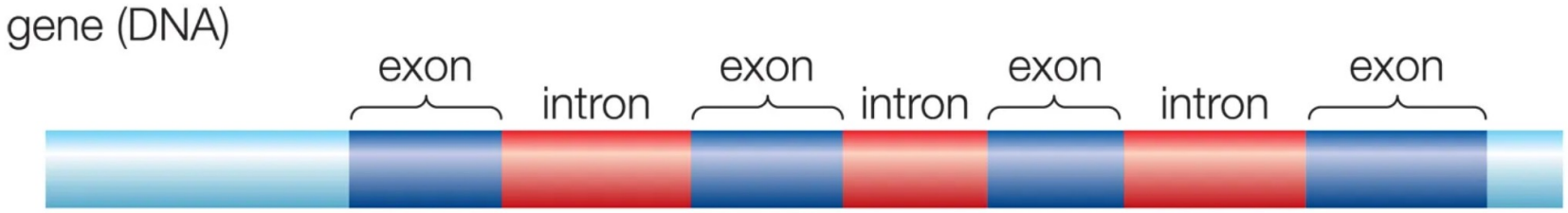
- A transcription terminator often contains a code that induces the corresponding synthesized RNA to fold back onto itself to form a hairpin loop (or stem-loop)
  - This structure knocks off the RNA POL from DNA, ending transcription



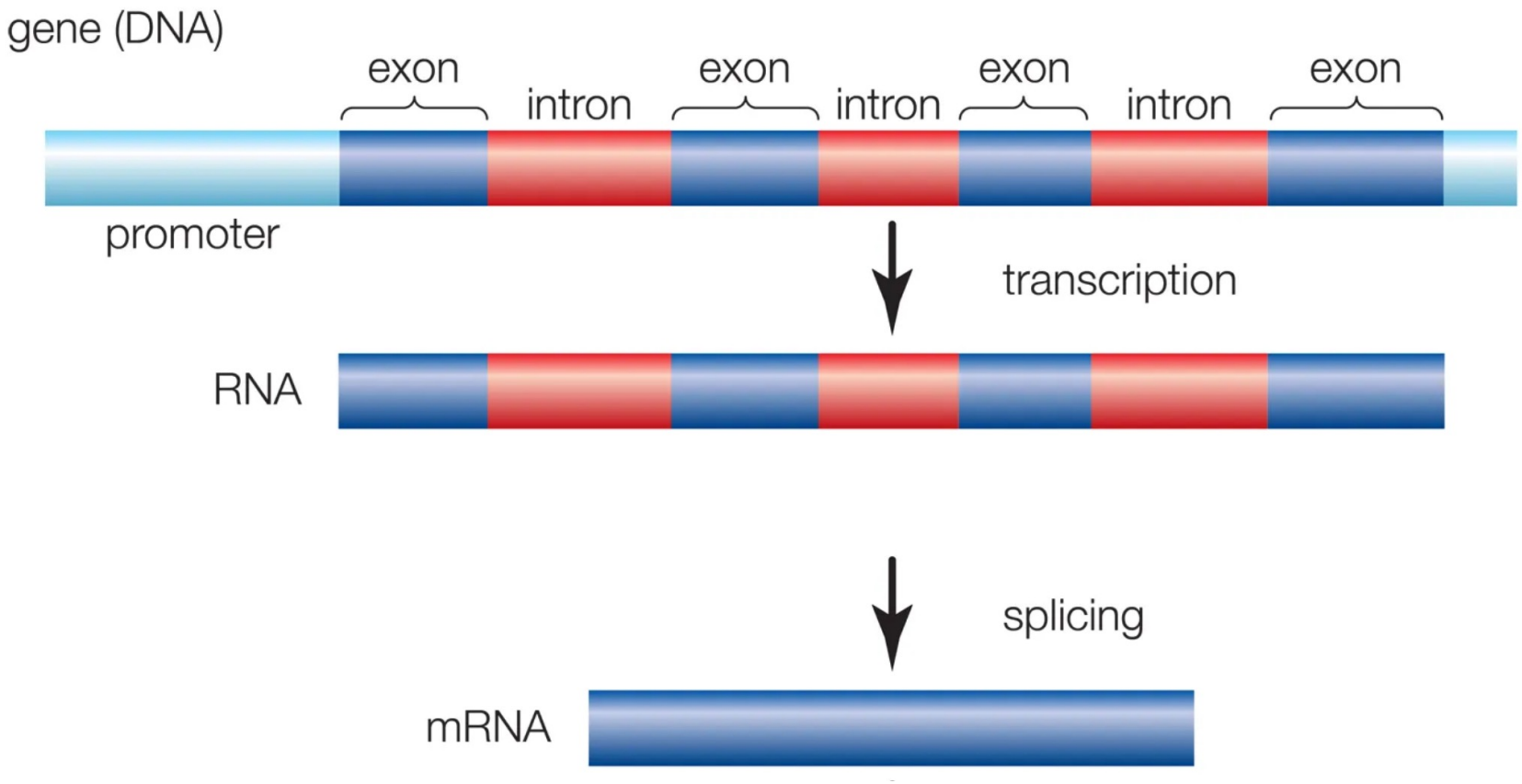
RNA processing in eukaryotes – a finishing touch

- The RNA just transcribed is not quite ready to be translated → it is not yet a true mRNA = messenger RNA
  - It is called pre-mRNA or primary RNA transcript
- To become an mRNA, the pre-mRNA must get read of all those gene sequences that do not codify for the corresponding protein = **introns**

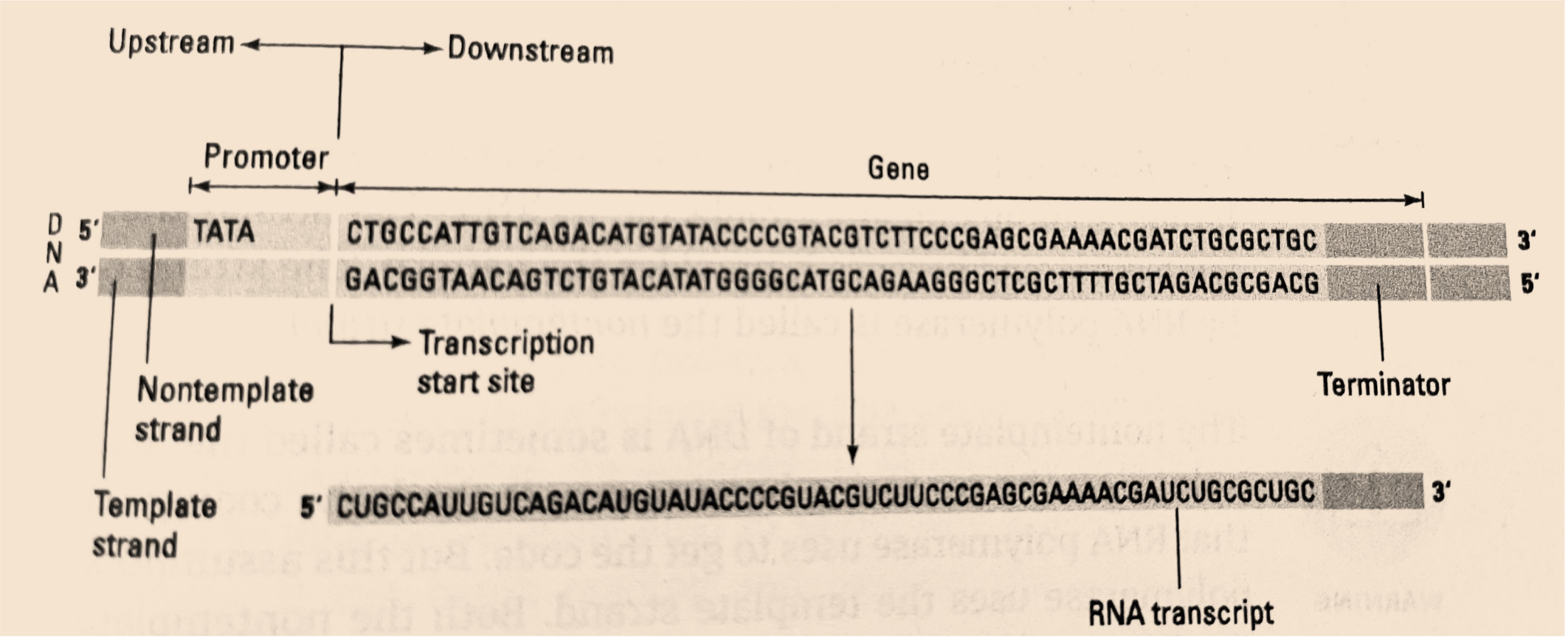


- The final mRNA must be devoid of non-coding information (introns)

RNA splicing – from RNA to mRNA

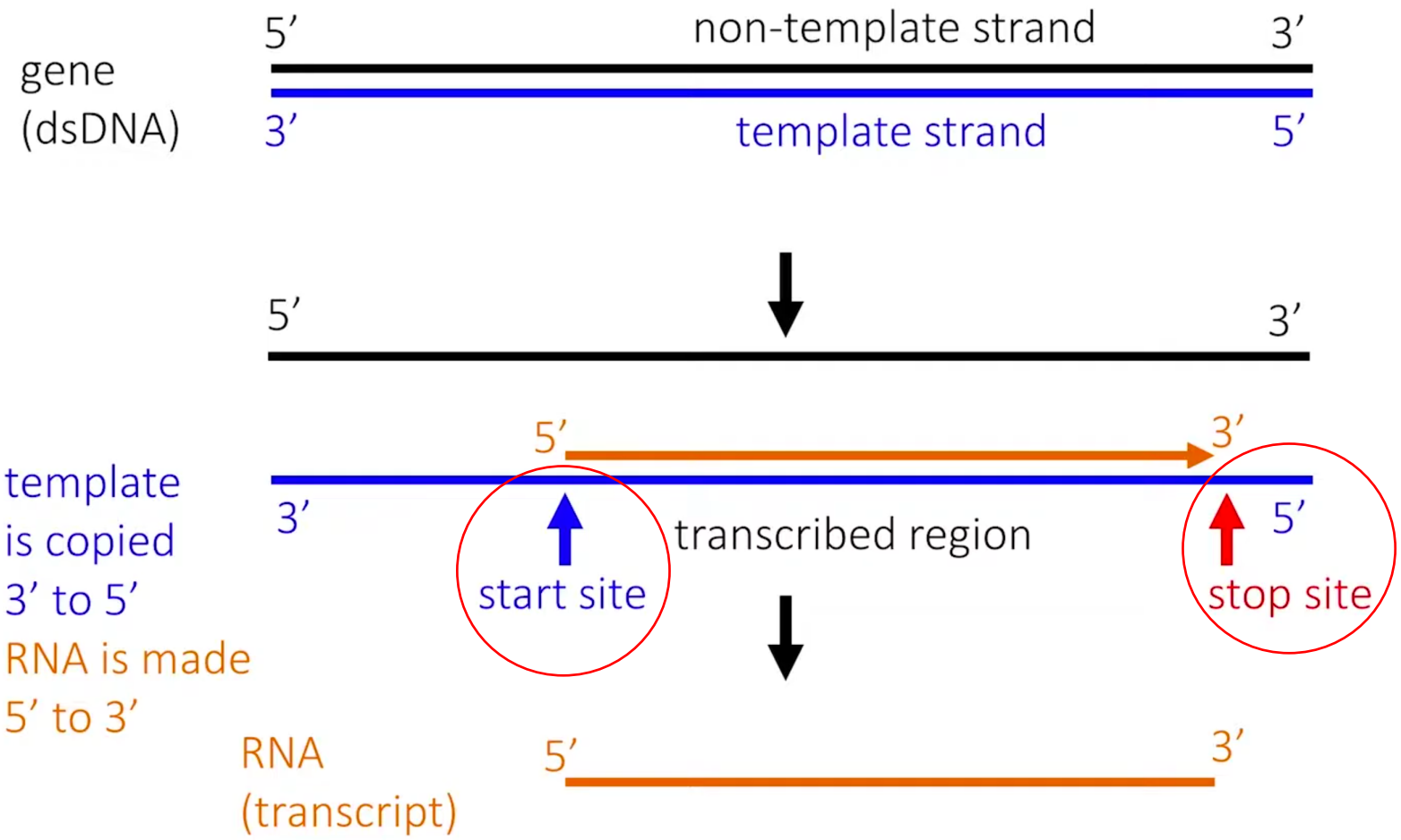


Transcription – the basic recap



DNA transcription

Transcription from specific strand/position



DNA transcription – ONLY THE BOTTOM STRAND

- Complementary DNA strands are transcribed into different mRNAs