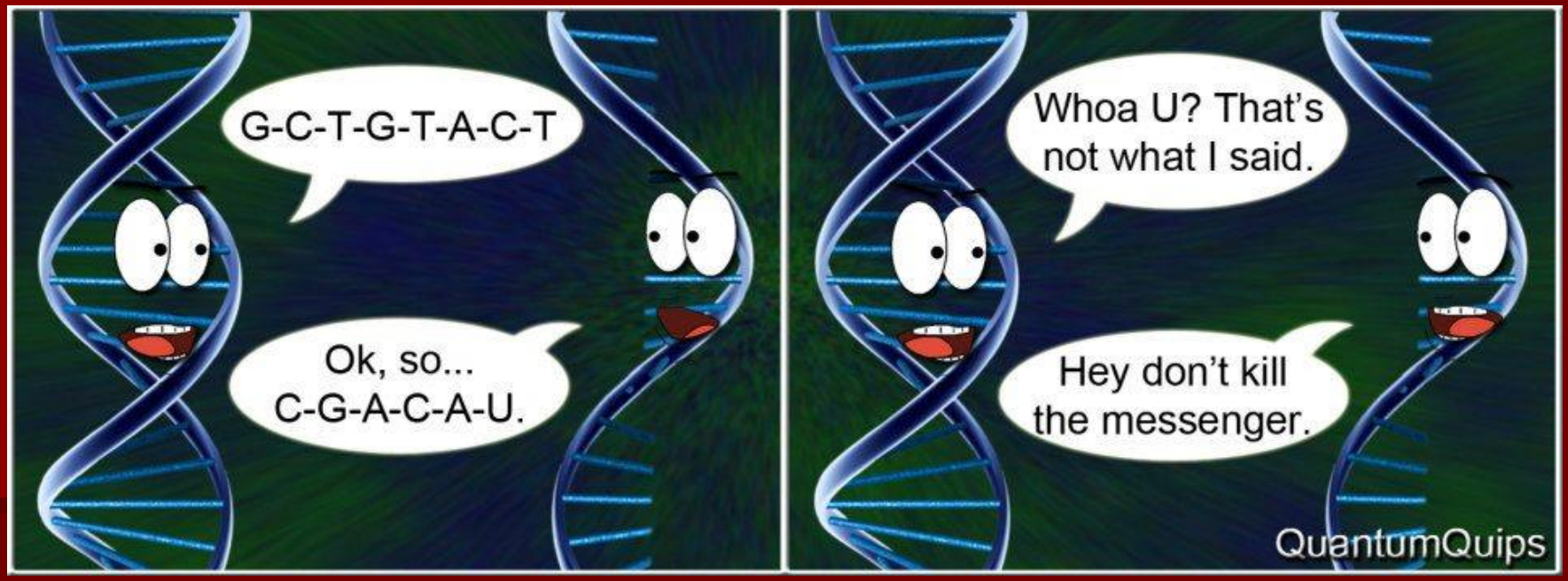
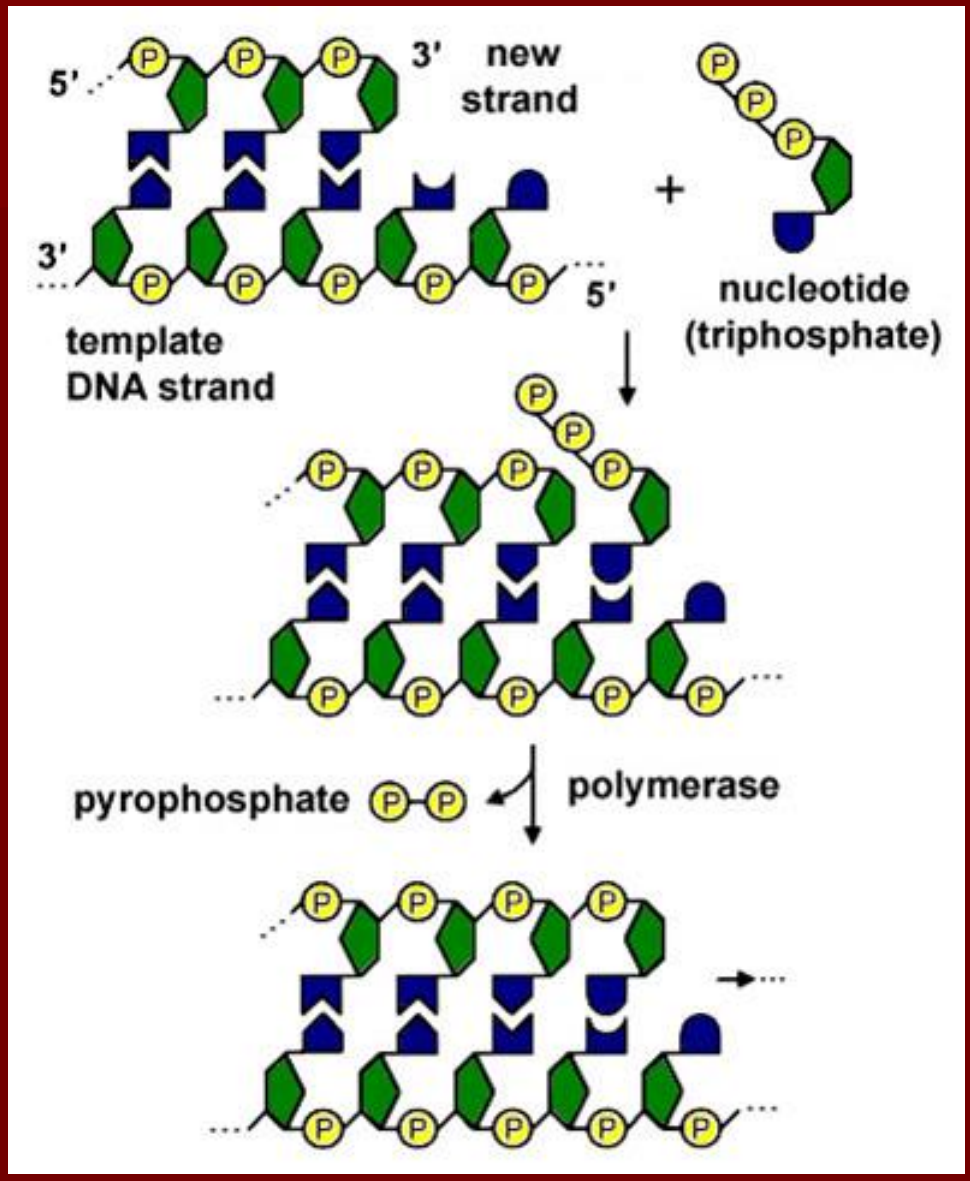
Transcription

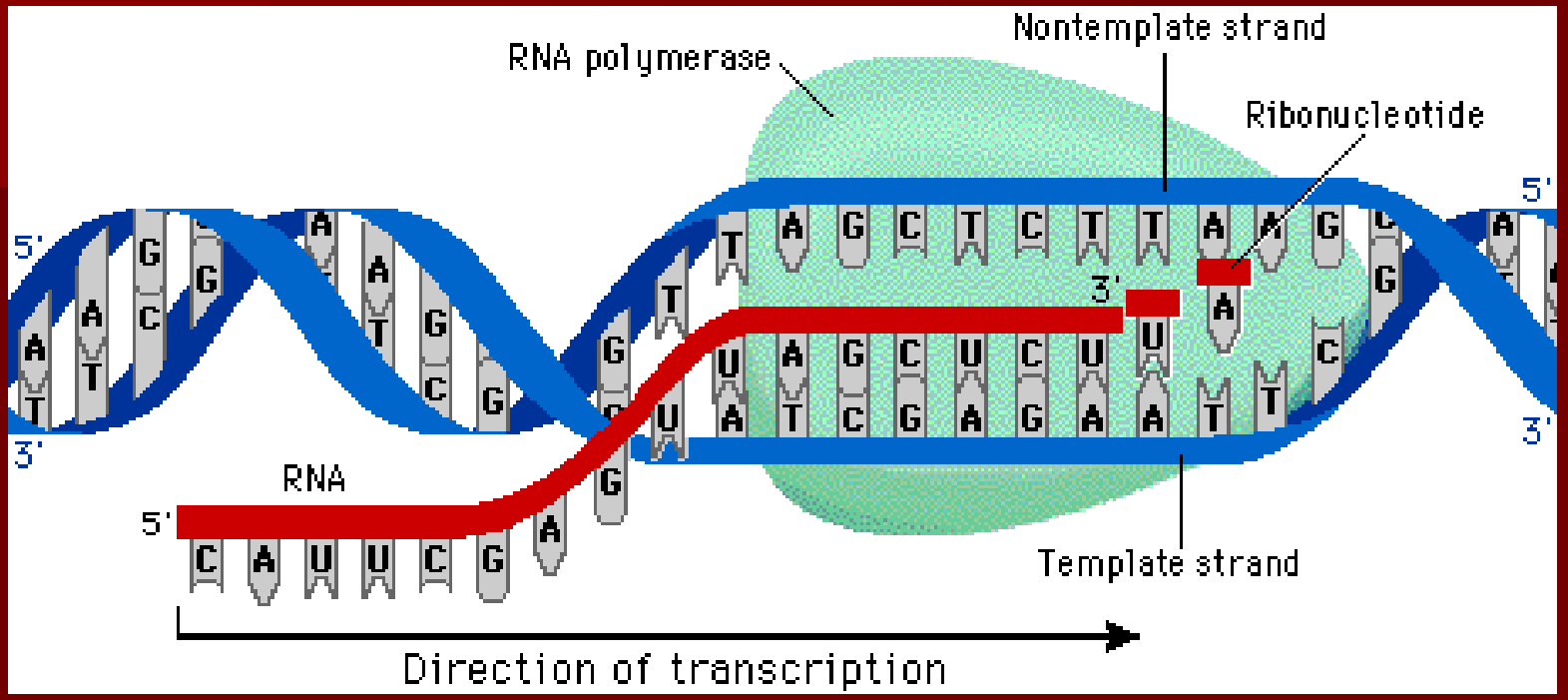
Department of Biology, Medical Faculty,
Medical University of Sofia



Template synthesis of nucleic acids

The recovery of information stored in DNA begins with the process of transferring it to RNA. RNA synthesis is called transcription because it is performed on a template (DNA) and the product is very similar to the template - like a transcript of an original. Because they are a copy of only a portion of DNA, RNA molecules are much smaller, more mobile, and can pass through the entire cell. Once done, they can be removed without affecting the genotype. In addition, RNAs have a more diverse and variable conformation because they are single-stranded.

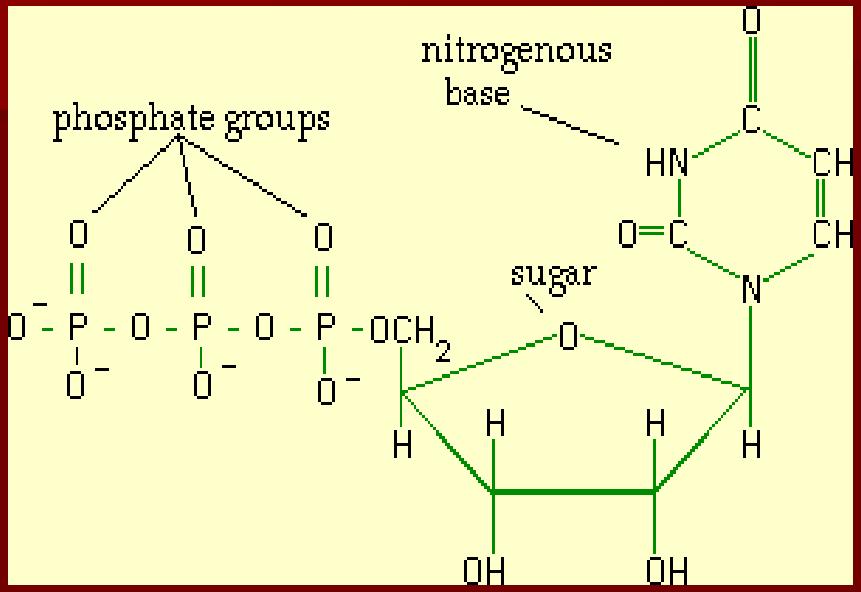


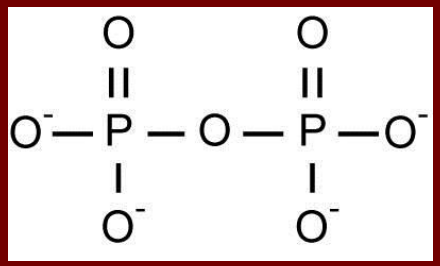


www.phschool.com

Transcription involves the conversion of covalent bonds, so the involvement of an enzyme is required. It is called RNA polymerase. By binding to DNA, the enzyme causes the two strands to separate. Only one of the two DNA strands serve as a template for transcription.

Energy





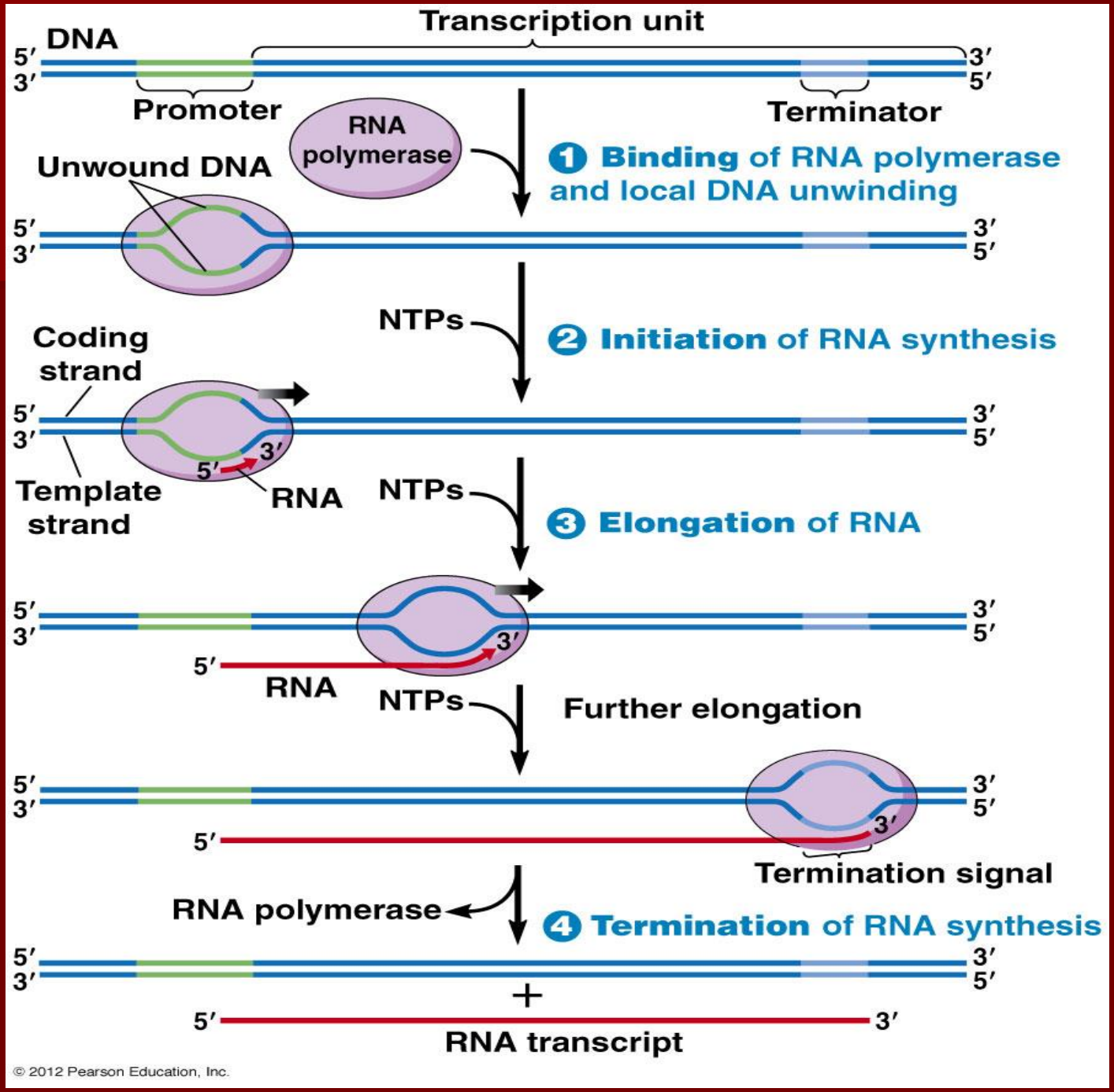
www.biologylessons.sdsu.edu

The energy for the transcription is derived from splitting the high-energy triphosphate into the monophosphate and releasing the inorganic diphosphates.

The enzyme

During transcription, a DNA sequence is read by an RNA polymerase, which produces a complementary, antiparallel RNA strand called a primary transcript.

http://www.biochemistry.uab.edu


Transcription unit
DNA
5′
3′
3′
5′
Promoter
Terminator
RNA polymerase
Unwound DNA
1 Binding of RNA polymerase and local DNA unwinding
NTPs
2 Initiation of RNA synthesis
Coding strand
Template strand
RNA
NTPs
3 Elongation of RNA
NTPs
Further elongation
Termination signal
RNA polymerase
4 Termination of RNA synthesis
+
RNA transcript
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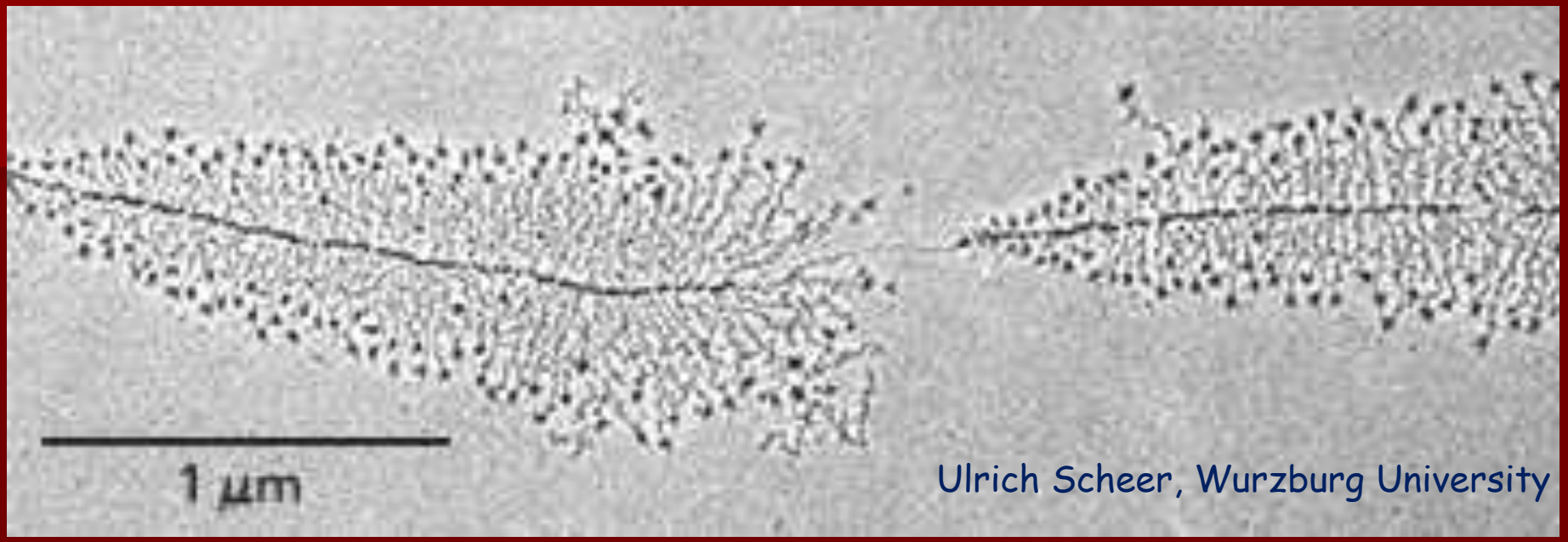
Transcription involves three stages. In the first, called initiation, RNA polymerase must understand where a gene is, where it originated and where it continues, ie. which is the template strand. The enzyme obtains this information from the primary structure (nucleotide sequence) of DNA. The region of DNA that is recognized as a transcription signal is called a promoter. Once bound to it, the enzyme causes the strands to separate and initiates future RNA, forming a phosphodiester bond between the first two nucleotides.

The second stage is called elongation. It consists in the monotonic attachment of nucleotides to the RNA strand.

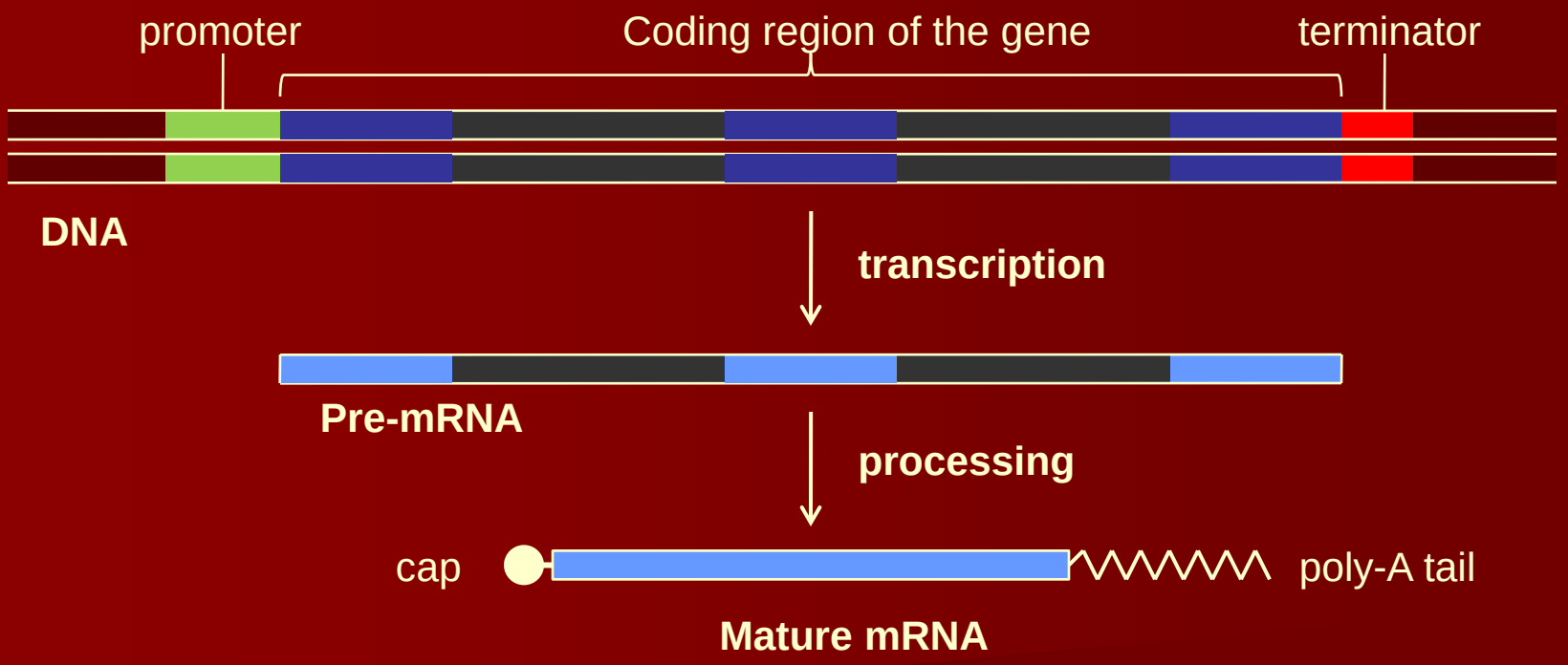
A DNA termination site is provided for each promoter. When RNA polymerase reaches it, it recognizes it and transcription enters its final stage - termination. The DNA region where transcription is terminated is called a terminator. The enzyme stops crawling on DNA and is released from it. RNA is also released and begins independent existence.

Transcribed rRNA genes under an electron microscope.



The picture of transcribed rRNA genes often resembles a Christmas tree. The growing transcripts are the "branches of the Christmas tree." Extending them indicates the direction of transcription. The black dots on DNA are RNA polymerase molecules. It is clear where the transcription unit extends: the top of the tree is the starting point, and the place where the "branches" suddenly end - the terminator.

Eukaryotic mRNA processing



mRNA transcribed from the DNA template is called primary transcript or pre-RNA. Most mRNAs cannot work in this form.

The conversion of the primary transcript into functionally suitable RNA is called processing.

It consists mainly in cutting out the excess parts, splicing of the other parts and adding of the so-called cap and tail, which we will not discuss here.

Thus a mature and functional RNA is obtained.