RNA：a polymer composed of alternating units of ribonucleotides connected through a 3’ to 5’ phosphodiester bond

Type of RNA

1. Ribosomal RNA(85%): the RNA structural component pf the ribosome
2. in eukaryotes there are 4 major forms: 28s, 18s, 5.8s, 5s
3. In prokaryotes there are 3 forms: 23s, 16s, 5s
4. Messenger RNA(2%): the RNA that transfers genetic information stored in DNA into a form usable for protein synthesis
5. Transfer RNA(12%): assists in decoding the information contained within mRNA during translation by recruiting the correct amino acid to the growing peptide chain
6. Other forms: snRNA, snoRNA(1%): small nuclear RNAs that participate in RNA processing

General properties of DNA-dependent RNA polymerases

1. Polarity: RNA polymerase reads the DNA template in the 3’ to 5’ direction while synthesizing RNA in the 5’ to 3’ direction
2. DNA template: either strand of a DNA double helix can serve as a template for RNA synthesis
3. Fidelity: RNA polymerases do not possess 3’ to 5’ proofreading activities
4. Mechanical features of RNA synthesis
5. Role of topoisomerases
6. coli RNA polymerase=ααββ’+ω+σ

α：RNA聚合酶的四聚体核心形成有关

β：核苷三磷酸结合位点

β’：DNA模板结合位点

δ/σ：RNA转录起始有关，识别转录的起始位置（promoters），并使RNA聚合酶结合在启动子部位

四聚体核心酶（core enzyme）：链的延伸

Promoters: DNA sequnences that indicate where transcription should start

Promoter region including: ①Upstream promoter element ②Core promoter

Transcription by RNA polymerase proceeds in a series of step

1. Intiation
2. RNA polymerase bind to ds-DNA
3. Slide down DNA until σ finds promoter sequence
4. RNA polymerase unwinds and opens ~12bp section of DNA (open promoter: nts -9 to +3, transcript start site =nt +1)
5. An rNTP binds to RNA pol site β (nt 1 is usually a purine: A or G)
6. 2nd rNTP binds at 2nd site on RNA pol, 1st rNTP attacks 2nd. Up to 9 more nts are added in a similar way

▲opening efficiency depends on TM of Pribnow box(P盒)

* 35 nts upstream of transcription start
* AT-rich (lower melting point)
* Another element of control

1. Elongation

Function: ①synthesis RNA②unwinds the DNA in frant③re-anneals DNA behind④dissociates the growing RNA chain

1. Termination

Two type of mechanisms of RNA chain termination

* RNA pol reads the termination signal [poly (A) sequence on DNA and poly (U) sequence on RNA]
* An additional protein called the ρ factor binds to RNA pol or DNA

Eukaryotic RNA polymerases

Pol Ⅰ——rRNAs; 28s, 18, 5.8s

Pol Ⅱ——mRNA, some small RNAs

Pol Ⅲ——tRNAs; 5s; small RNAs

RNA processing in eukaryotic

1. Cappong of the 5’ end of the RNA: a methylated guanine joined to the RNA transcript by a 5’ to 5’ linkage

Function:

1. Protection from degradation
2. Increased translational efficiency
3. Transport to cytoplasm
4. Splicing of first intron
5. Splicing of the introns

Function: joining the protein coding sequences

# CTD tail plays a role in recruiting the polyadenylation enzymes and regulating transcriptional activation and repression

1. Poly adenylation of the 3’ end

Triggers the reactions:

1. Cleavage of the message
2. Addition of poly (A)
3. Termination of transcription

* CPSF(cleavage and polyadenylation specificity factor) and CstF(cleavage stimulation factor) bind to the poly-A signal, leading to the RNA cleavage
* PAP(Poly-A polymerase) adds ~200 As at the 3’ end of the RNA, using ATP as a substrate

Function of poly(A) tail:

1. Increased mRNA stability
2. Increased translational efficiency
3. Splicing of last intron

Why is transcription necessary?

Transcription makes messenger RNA to carry the code for proteins out the nucleus to the ribosomes in the cytoplasm

Describe transcription mechanism.

RNA pol binds to DNA, separates the strands, then uses one strand as a template to assemble mRNA

What are the main differences between DNA and RNA?

1. DNA has deoxyribose, RNA has ribose
2. DNA has 2 strands, RNA has one strand
3. DNA has thymine, RNA has uracil

|  |  |  |
| --- | --- | --- |
|  | prokaryotic | eukaryotic |
| DNA pol | Pol Ⅰ:repair  Pol Ⅱ:repair  Pol Ⅲ:mainly duplicate DNA | αβγδε  δis the main pol |
| RNA pol | α2ββ’δ | Pol Ⅰ:rRNA  Pol Ⅱ:mRNA  Pol Ⅲ:tRNA |