

4. Transkripcia a úlohy RNA v bunke.

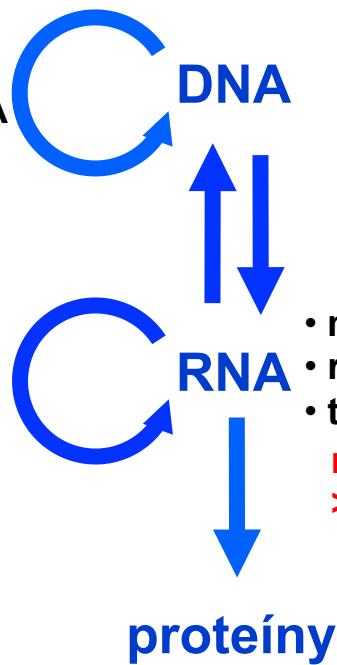
- Katalyticke vlastnosti RNA. Svet RNA a evolúcia živých systémov.
- Úloha RNA v interpretácii genetickej informácie.
- Typy RNA (mRNA, rRNA, tRNA, malé RNA).
- Transkripcia. Iniciácia, elongácia a terminácia transkripcie.
- RNA polymerázy. Transkripčné faktory.
- Porovnanie transkripcie v prokaryotoch a eukaryotoch.



Typy a úlohy RNA v bunkách

- RNA primery
- telomerázová RNA

- genómová RNA
(RNA vírusy)



- mediátorová RNA (mRNA)
 - ribozomálna RNA (rRNA)
 - transferová RNA (tRNA)
- ncRNA (*non-coding RNA*)**
> 80% genómu sa transkribuje

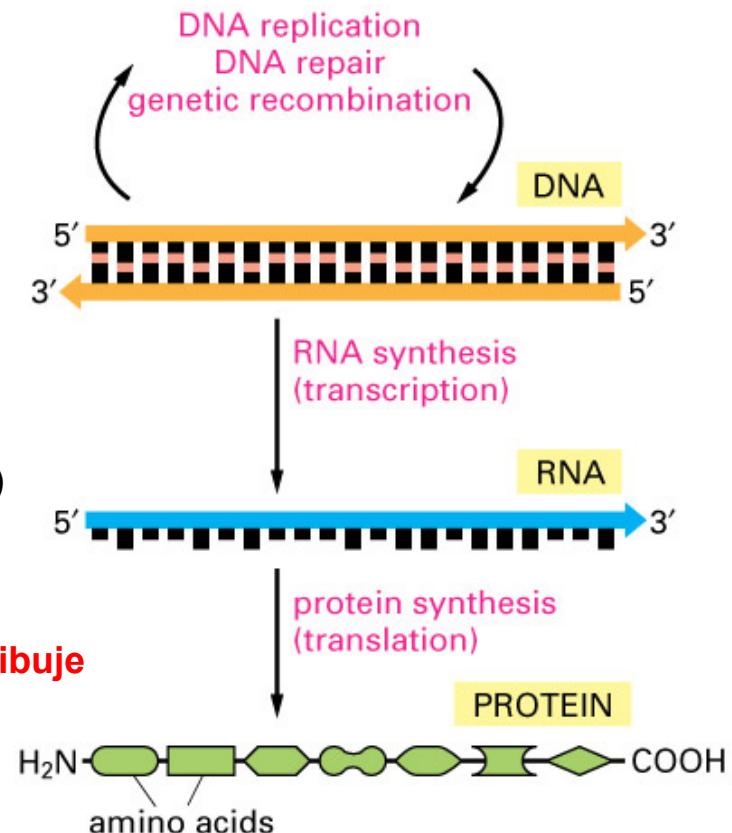
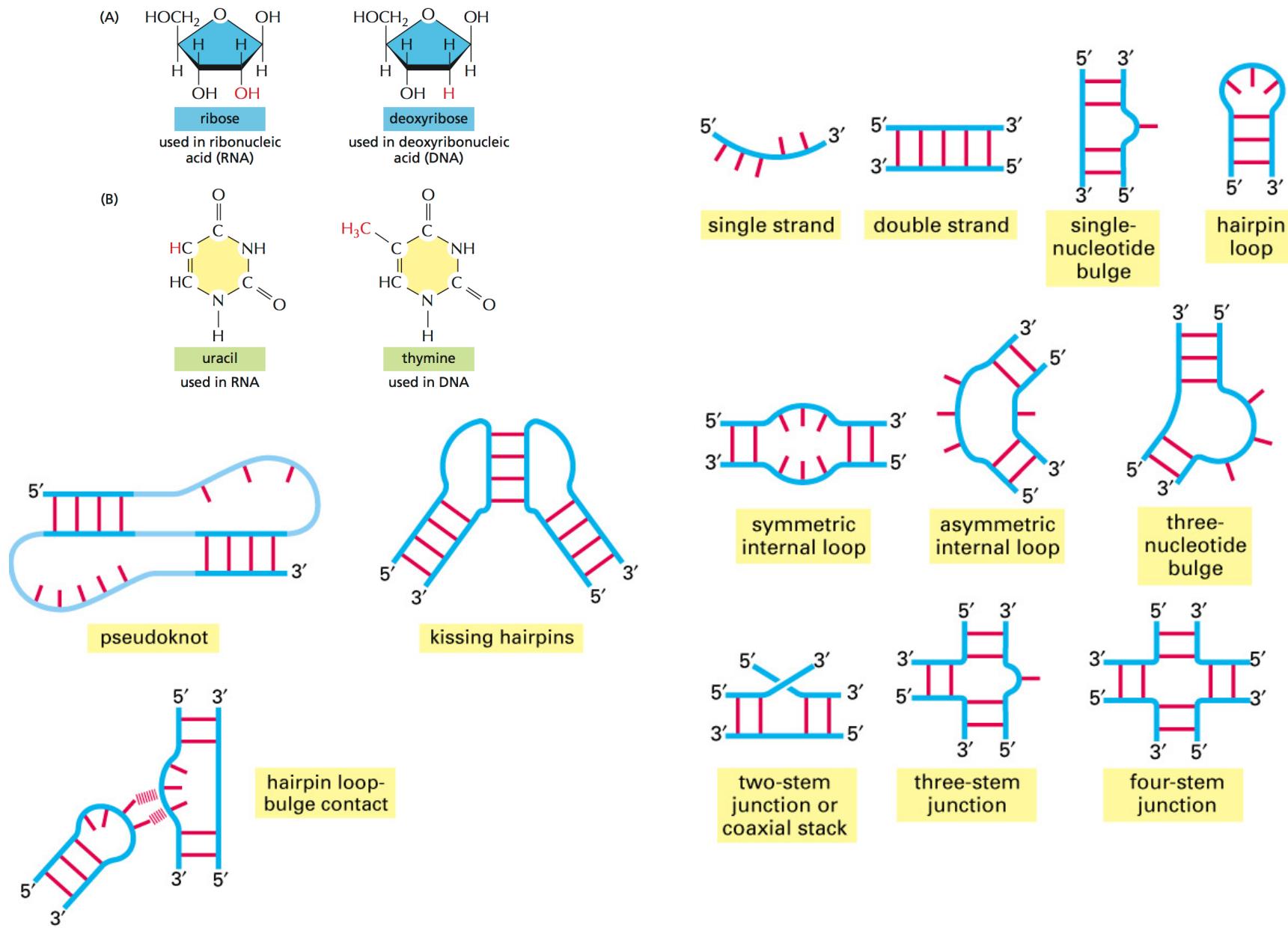


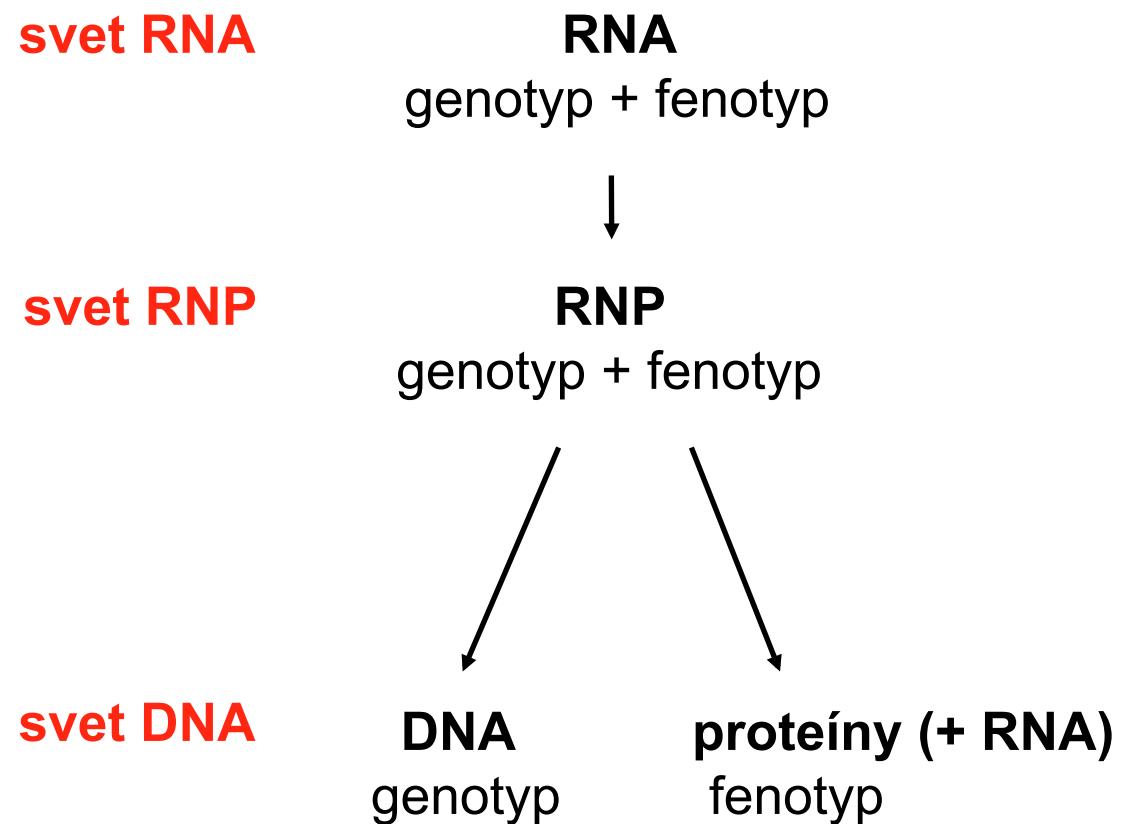
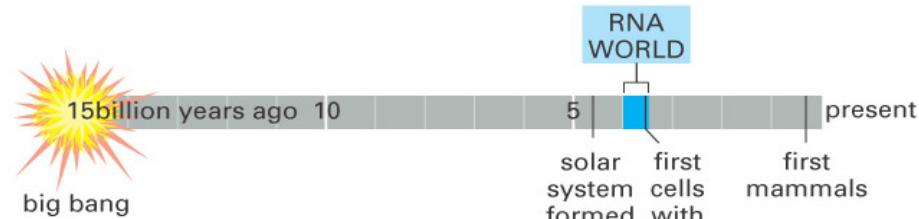
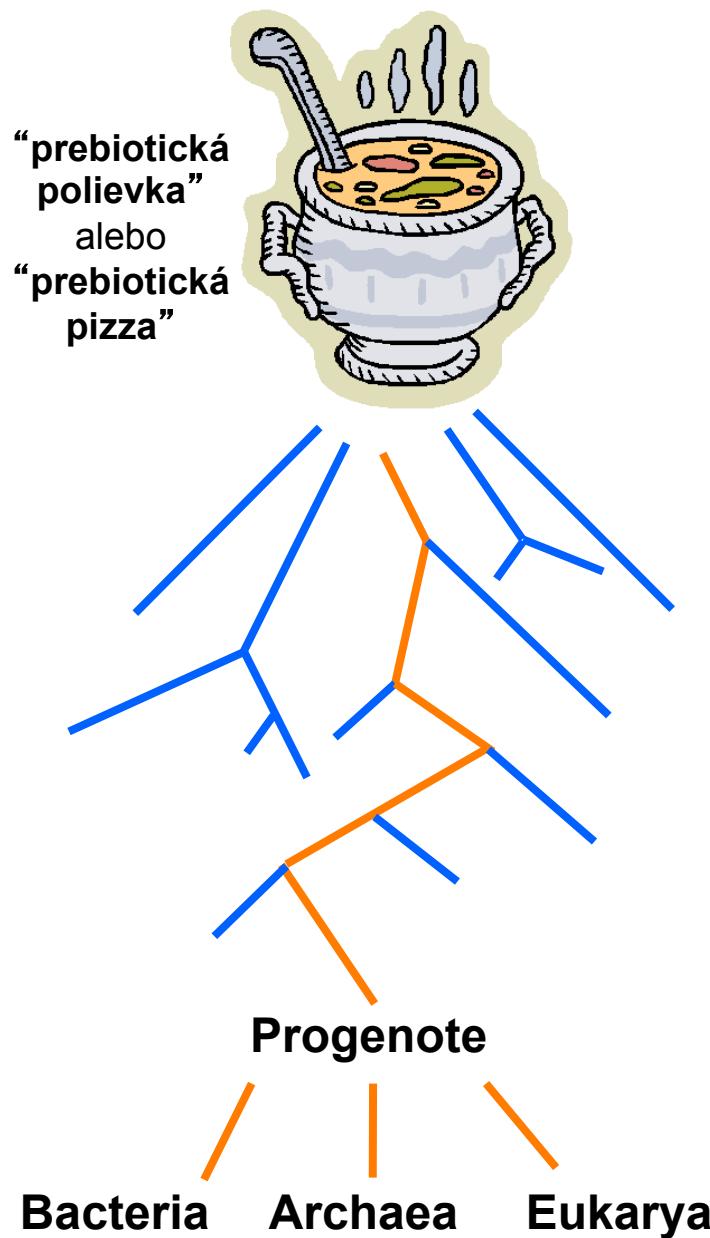
TABLE 6–1 Principal Types of RNAs Produced in Cells

Type of RNA	Function
mRNAs	Messenger RNAs, code for proteins
rRNAs	Ribosomal RNAs, form the basic structure of the ribosome and catalyze protein synthesis
tRNAs	Transfer RNAs, central to protein synthesis as adaptors between mRNA and amino acids
snRNAs	Small nuclear RNAs, function in a variety of nuclear processes, including the splicing of pre-mRNA
snoRNAs	Small nucleolar RNAs, help to process and chemically modify rRNAs
miRNAs	MicroRNAs, regulate gene expression by blocking translation of specific mRNAs and cause their degradation
siRNAs	Small interfering RNAs, turn off gene expression by directing the degradation of selective mRNAs and the establishment of compact chromatin structures
piRNAs	Piwi-interacting RNAs, bind to piwi proteins and protect the germ line from transposable elements
lncRNAs	Long noncoding RNAs, many of which serve as scaffolds; they regulate diverse cell processes, including X-chromosome inactivation

Štruktúrne prvky v RNA

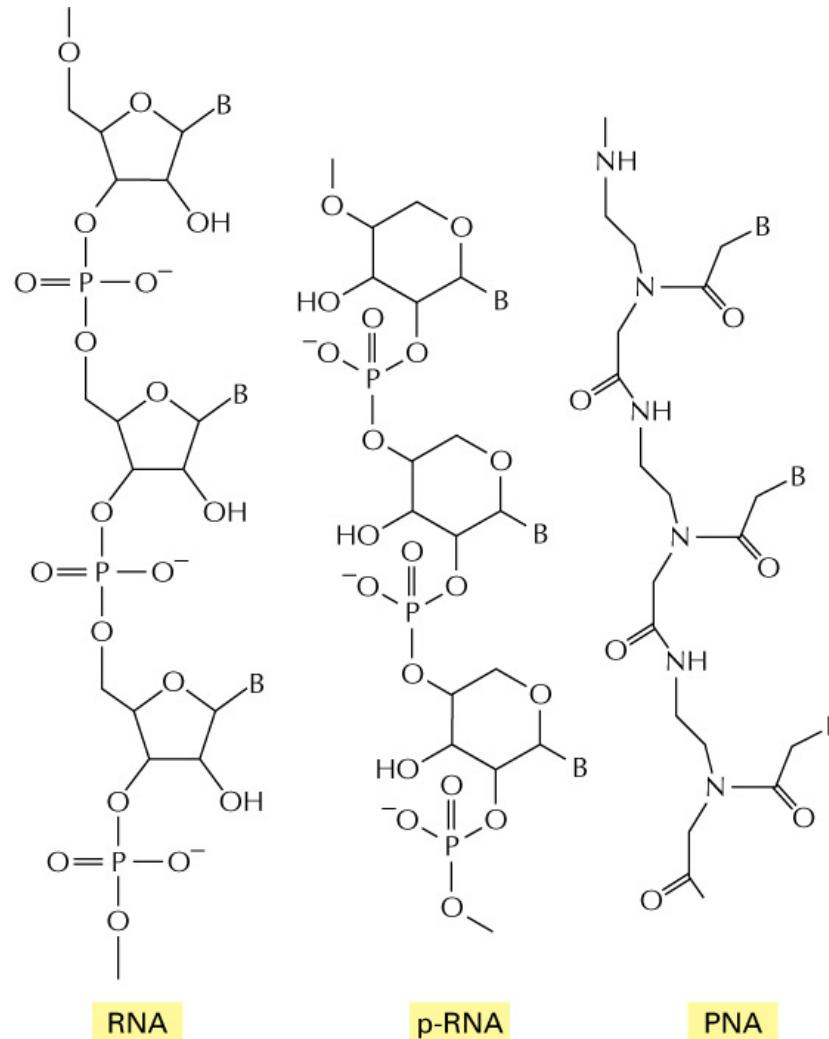


RNA mala kľúčovú úlohu v evolúcii živých systémov

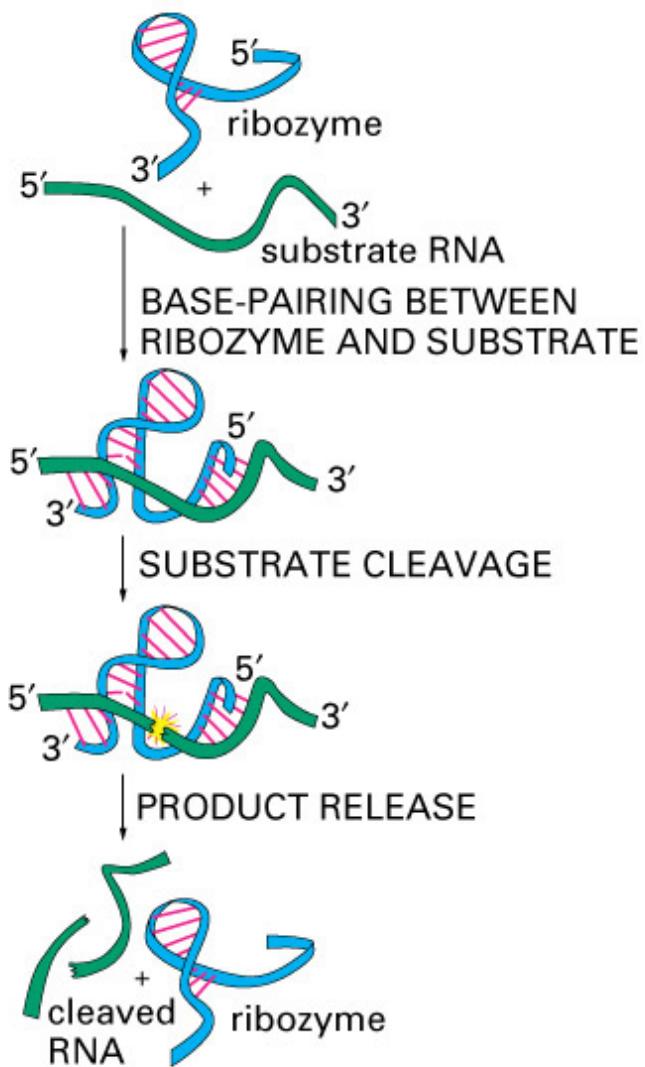


RNA nemusela byť' prvou informačnou biomakromolekulou

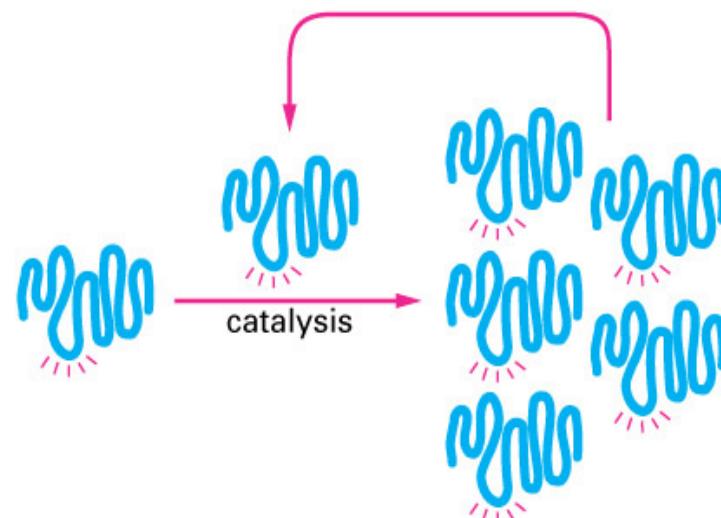
(furanosyl) RNA pyranosyl RNA peptidová nukleová kyselina



Katalytická RNA



replikátor vs. replikant



The Nobel Prize in Chemistry 1989 was awarded jointly to Sidney Altman and Thomas R. Cech "***for their discovery of catalytic properties of RNA***"



Sidney Altman
(1939-)
Canada, USA

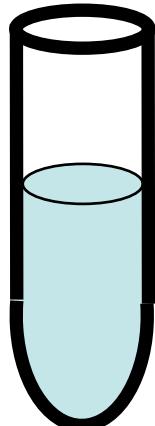
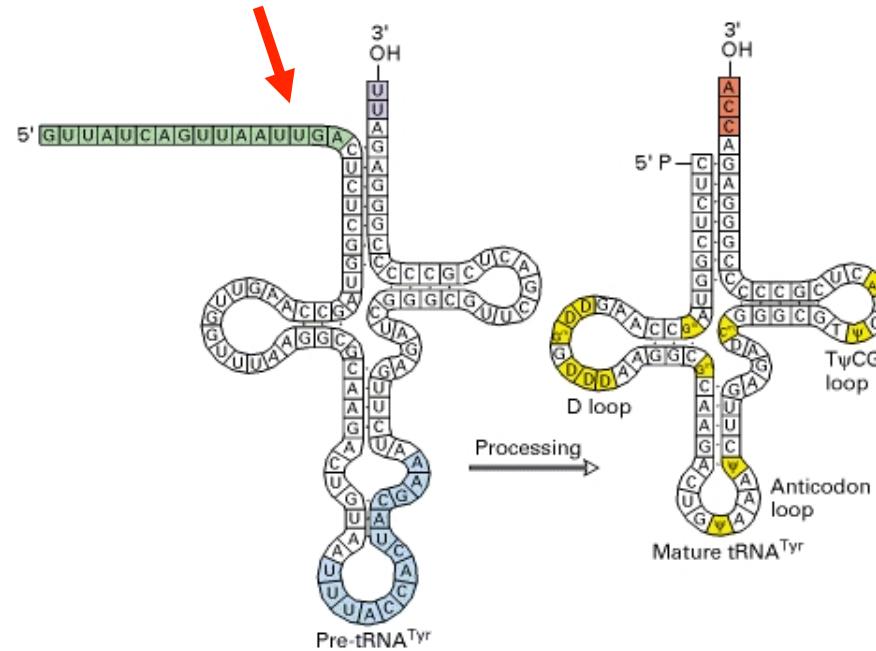


Thomas R. Cech
(1947-)
USA

RNA enzym = ribozym

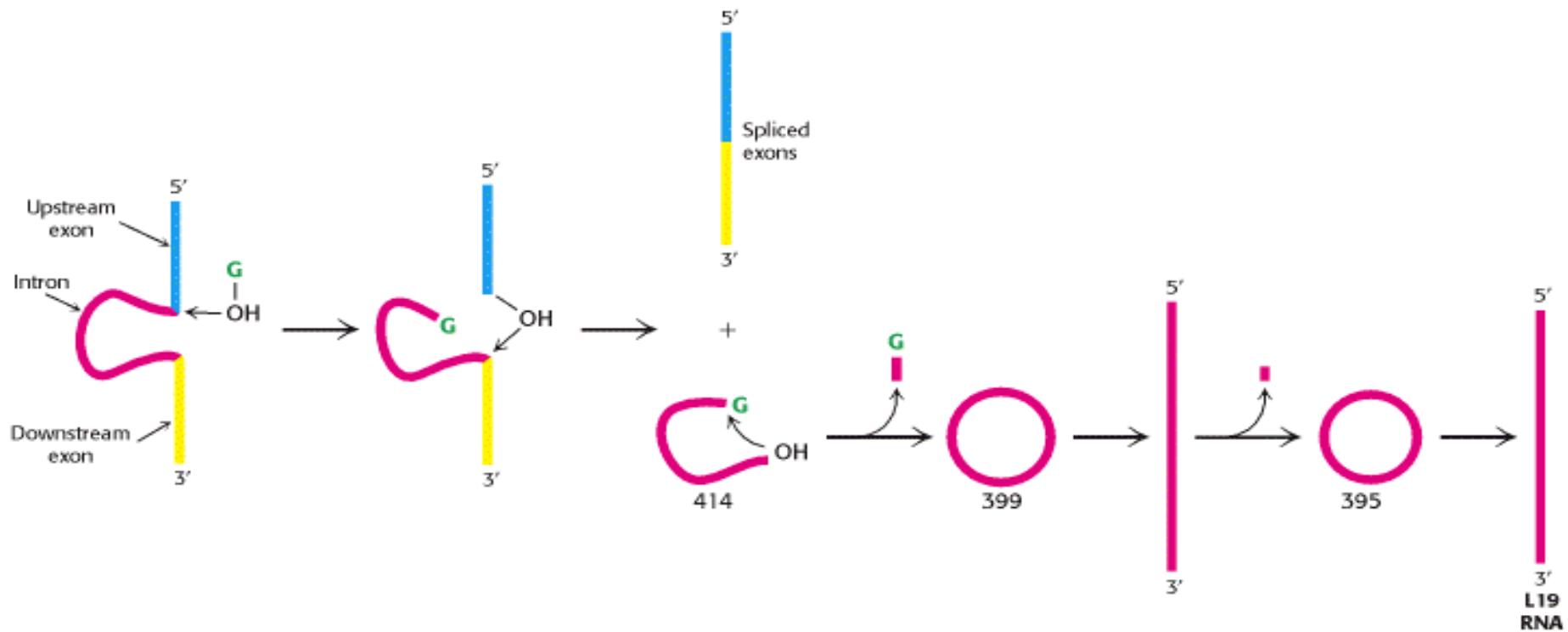
RNáza P (*processing* pre-tRNA)

= 14 kDa proteín + 377 nt RNA (= M1 RNA)

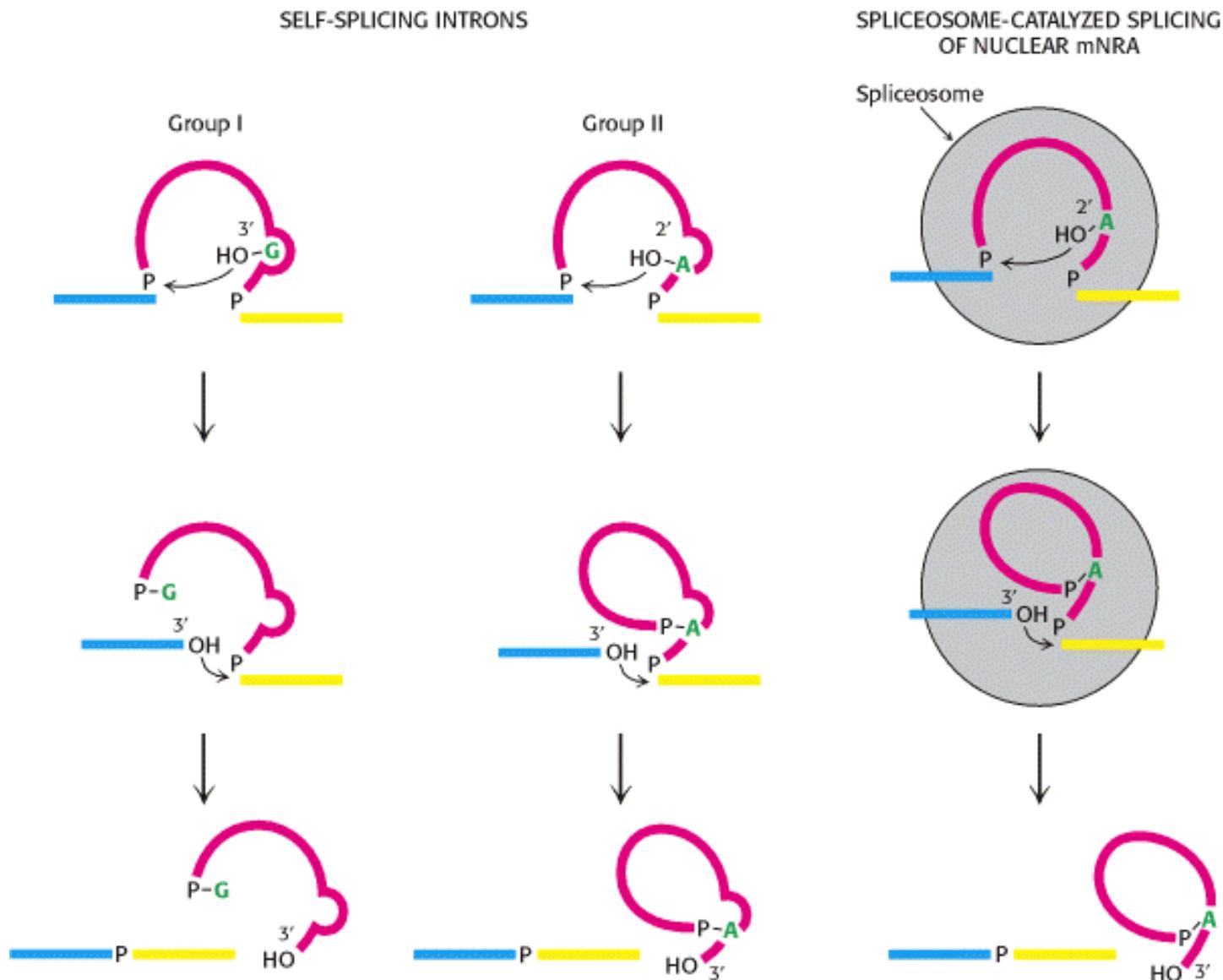


	aktivita
+ proteín + RNA	→ +
- proteín + RNA	→ -
+ proteín - RNA	→ -
+ proteín + Mg ²⁺ - RNA	→ -
- proteín + Mg ²⁺ + RNA	→ +

Autokatalyticky sa vyštepujúci intrón (self-splicing intron) splicing pre-rRNA v bunkách prvoka *Tetrahymena*



Mechanizmy zostrihu RNA (*splicing*)



The Nobel Prize in Physiology or Medicine 1993 was awarded jointly to Richard J. Roberts and Phillip A. Sharp **"for their discoveries of split genes"**



Richard J. Roberts **Phillip A. Sharp**

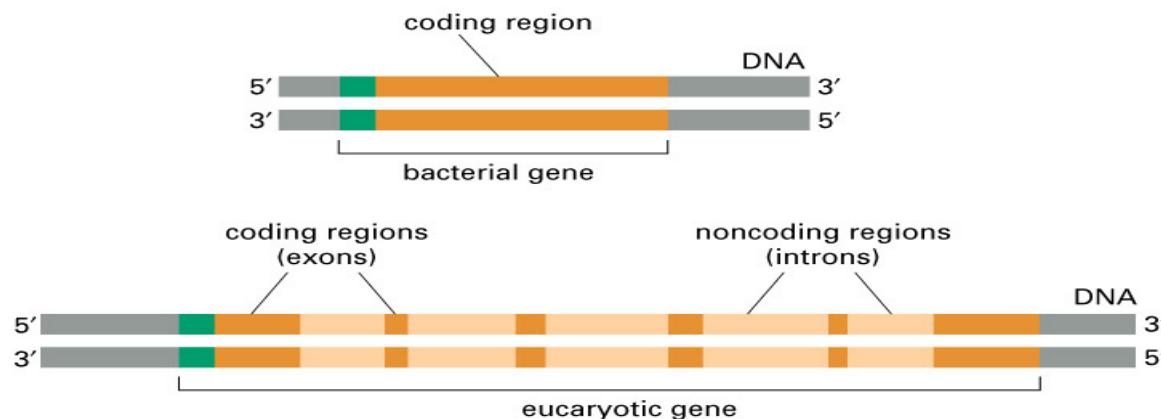
(1943-)

UK / USA

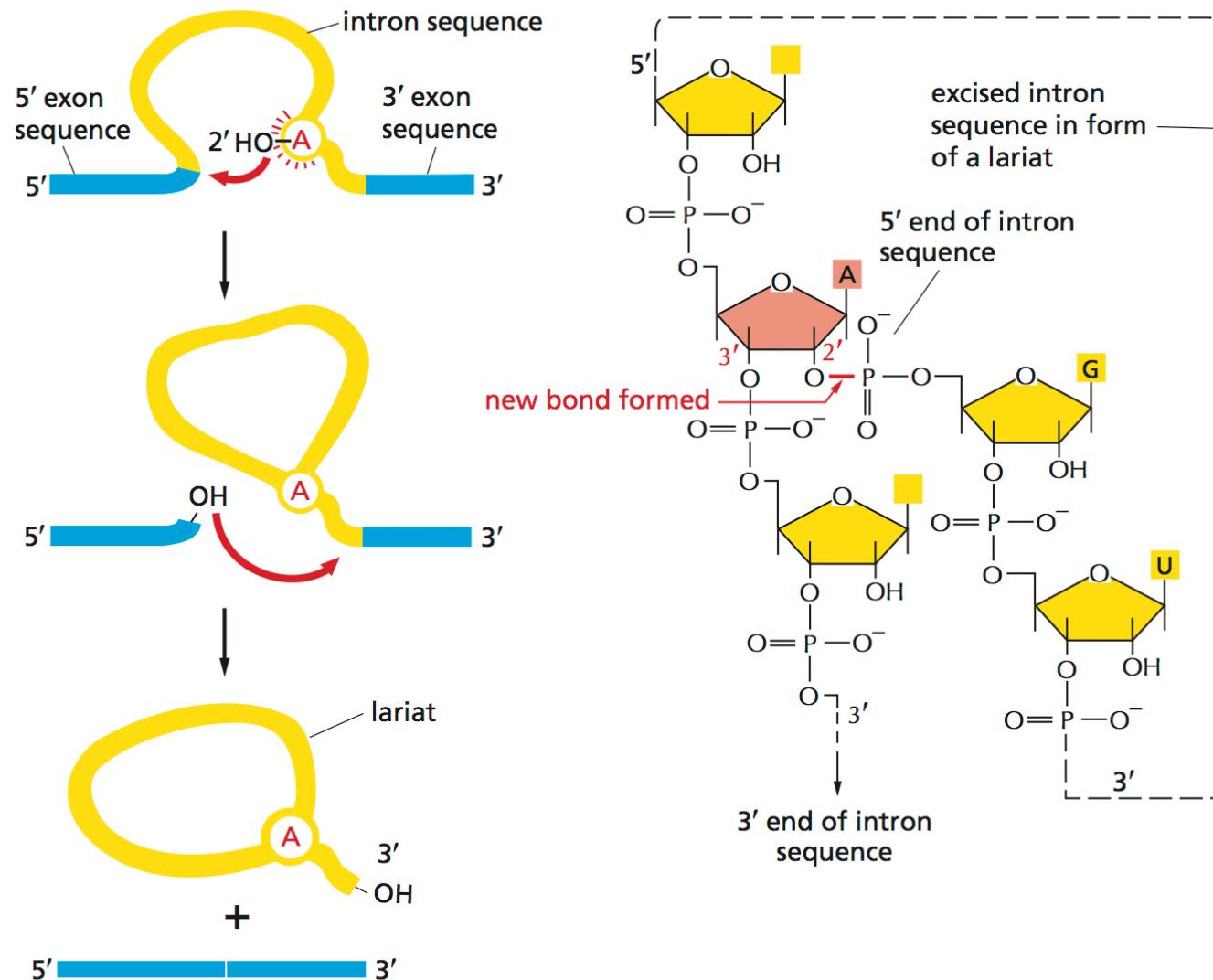
(1944-)

USA

Nobelprize.org

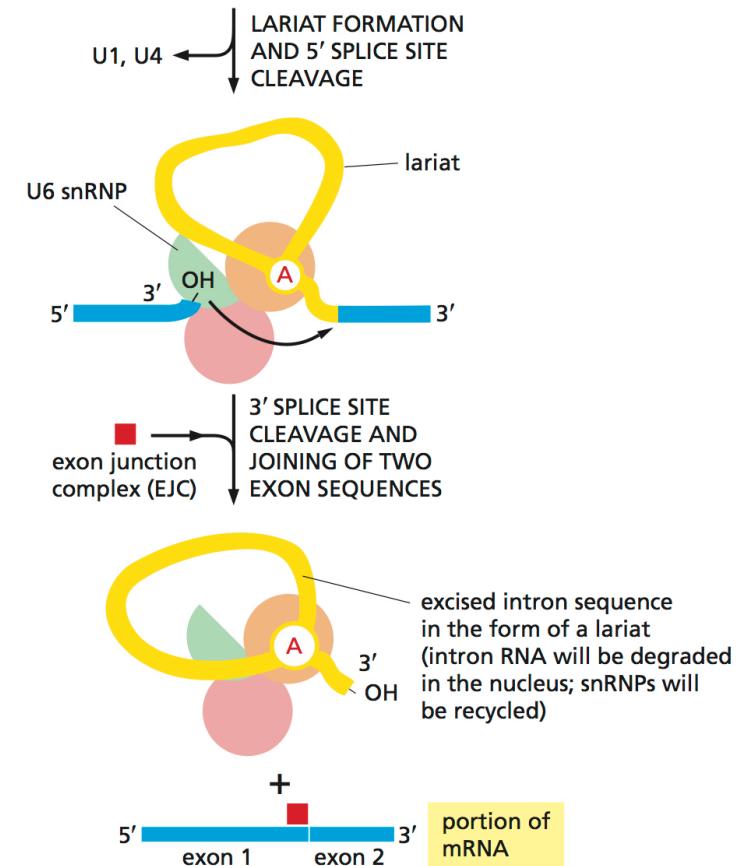
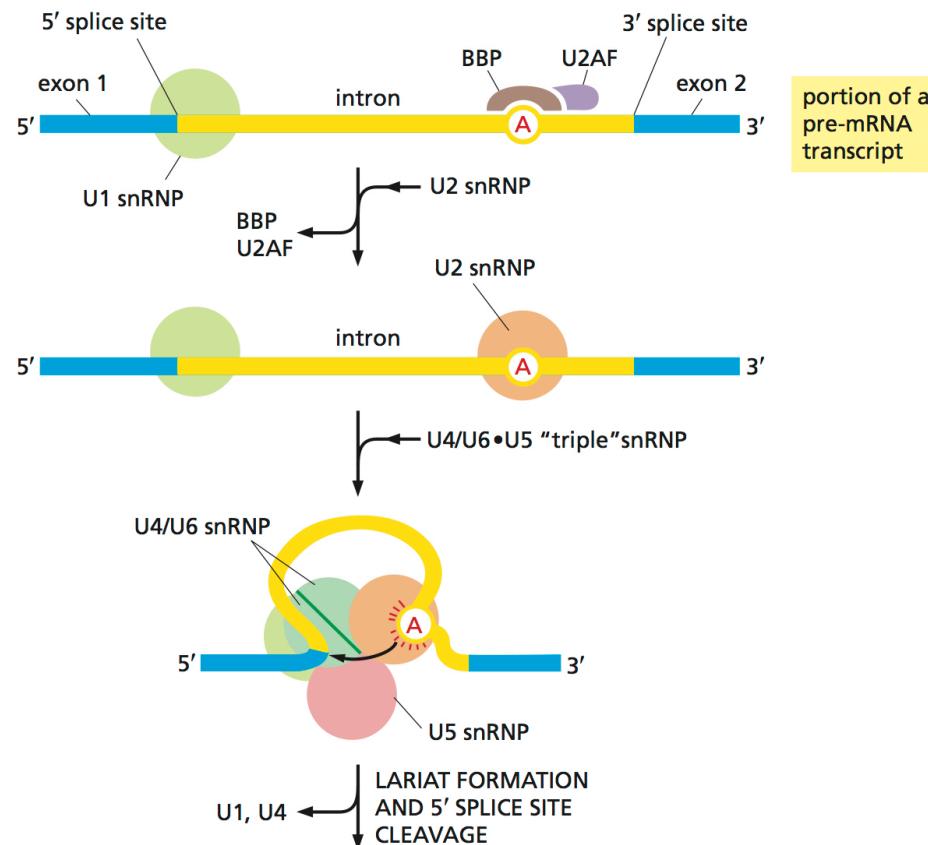


Splicing pre-mRNA

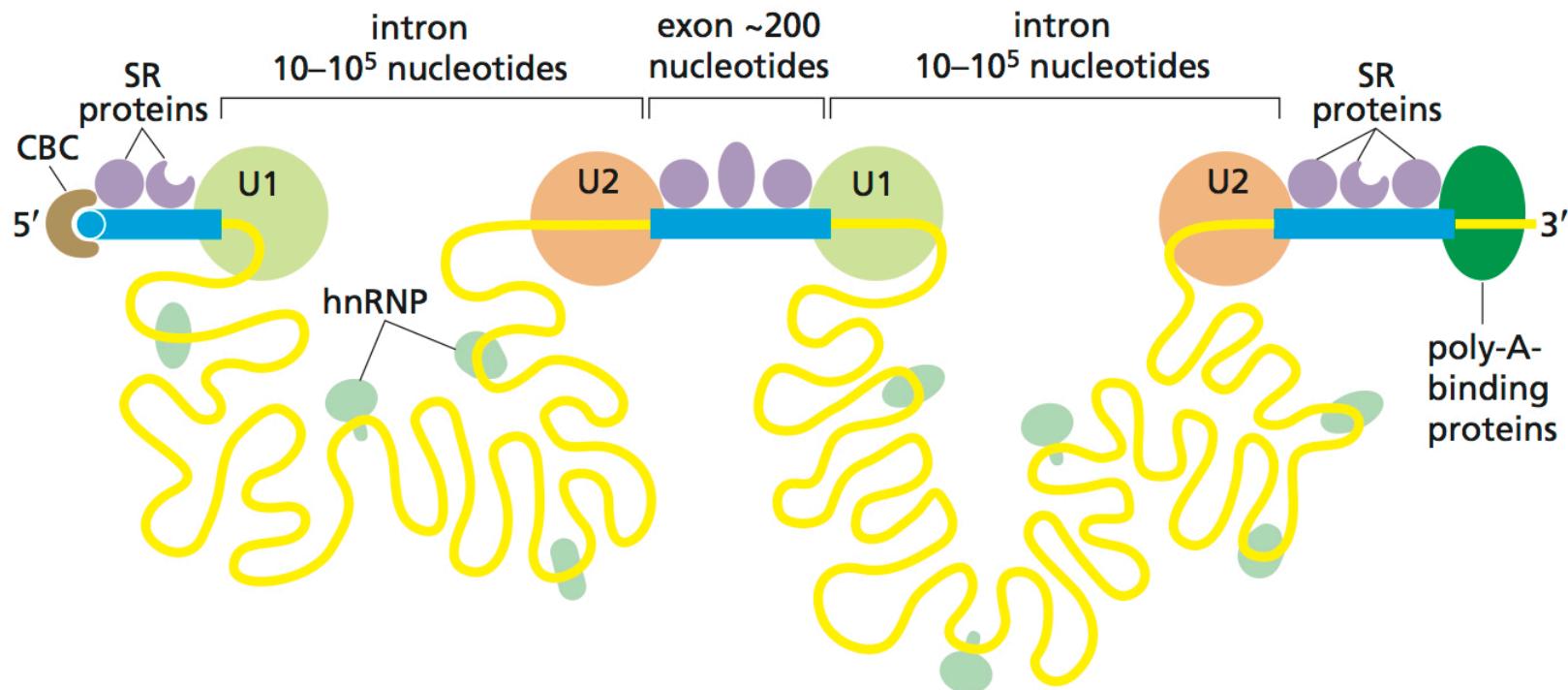


transesterifikačná reakcia

Splicing pre-mRNA

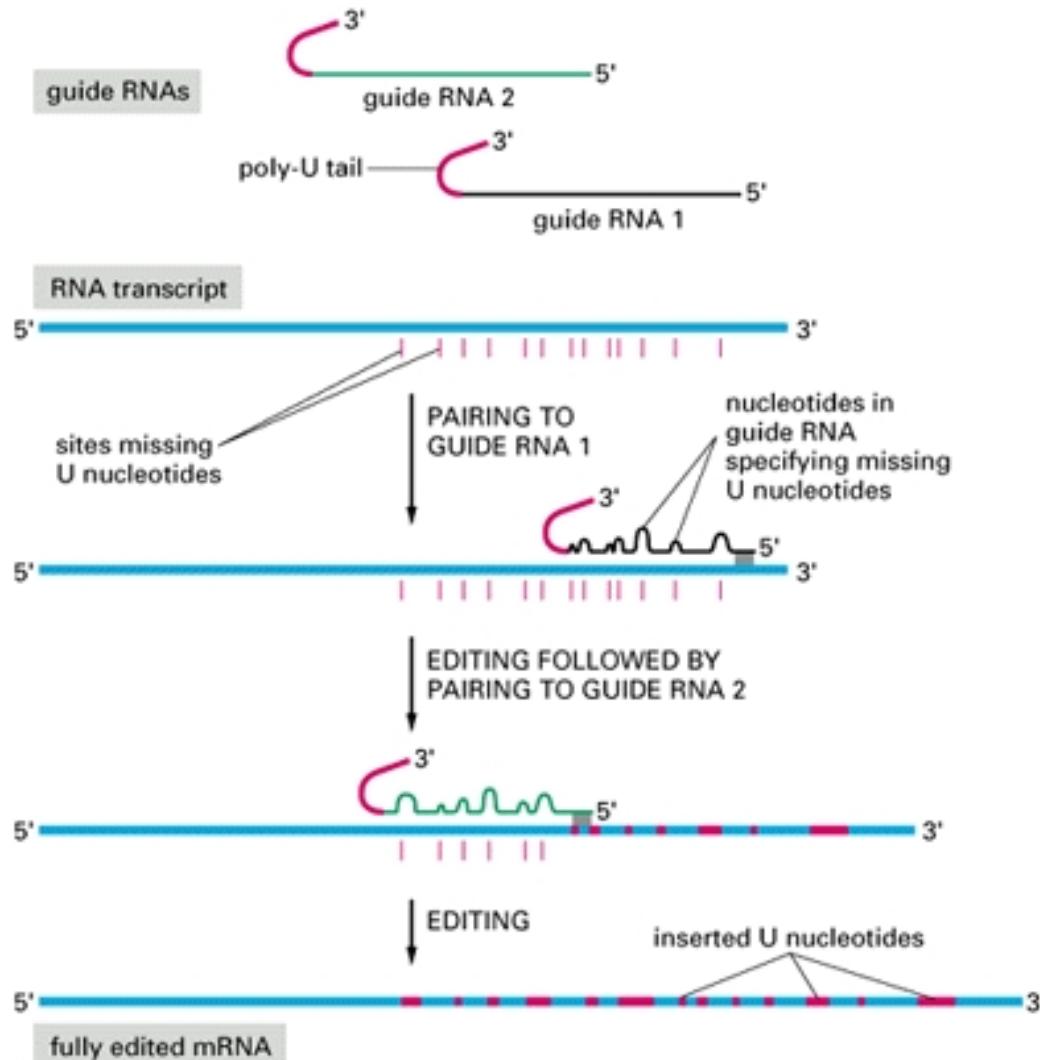


Ako bunky identifikujú exóny?

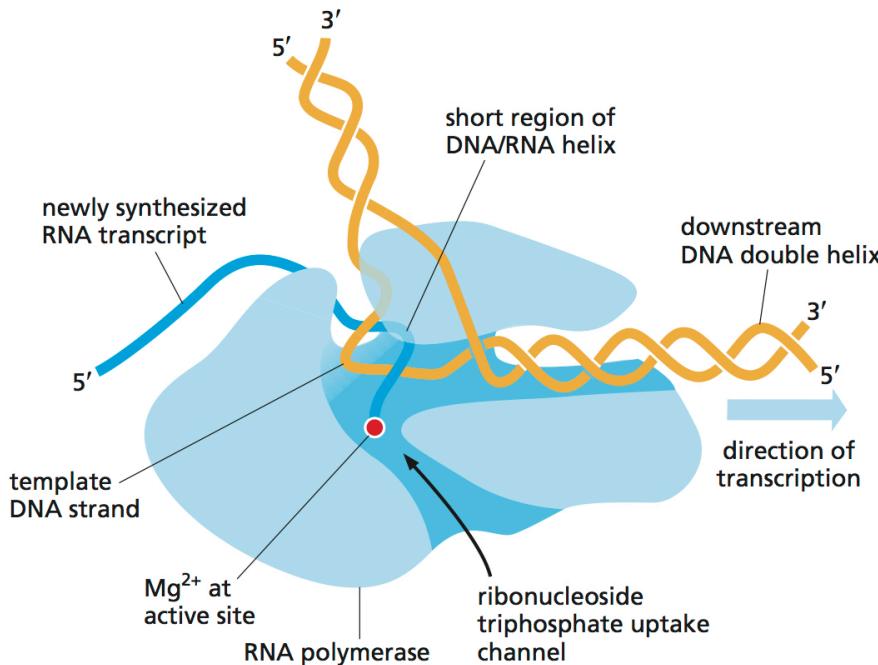


Editovanie RNA (RNA editing)

guide RNA v mitochondriách prvoka *Trypanosoma*



Transkripcia - DNA závislá syntéza RNA v bunkách



Baktérie:

RNA polymeráza $\alpha_2\beta\beta'$ $\omega\sigma$ [β - katalytická podjednotka, σ -transkripčný faktor]

Eukaryoty:

RNA polymeráza I - syntéza rRNA (5.8S, 18S a 28S rRNA)

RNA polymeráza II - syntéza mRNA, snRNA, snoRNA, lncRNA, microRNA (citlivá na α -amanitin)

RNA polymeráza III - syntéza tRNA, 5S rRNA, ostatné malé RNA, niektoré snRNA

mtRNA polymeráza - syntéza RNA v mitochondriách (podobná fágovým RNA polymerázam)

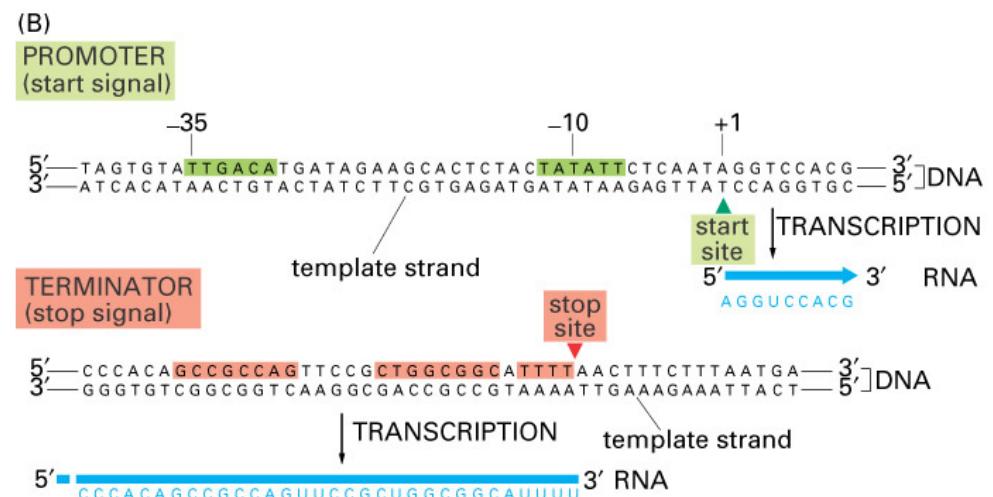
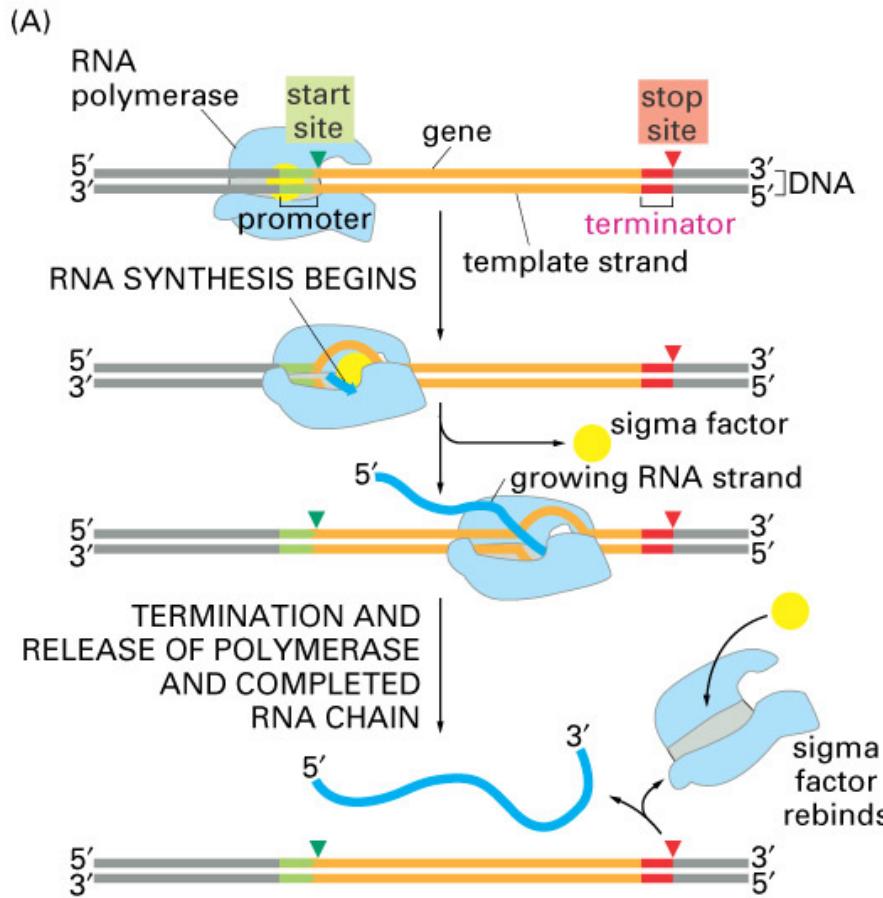
DNA primáza - syntéza RNA primerov



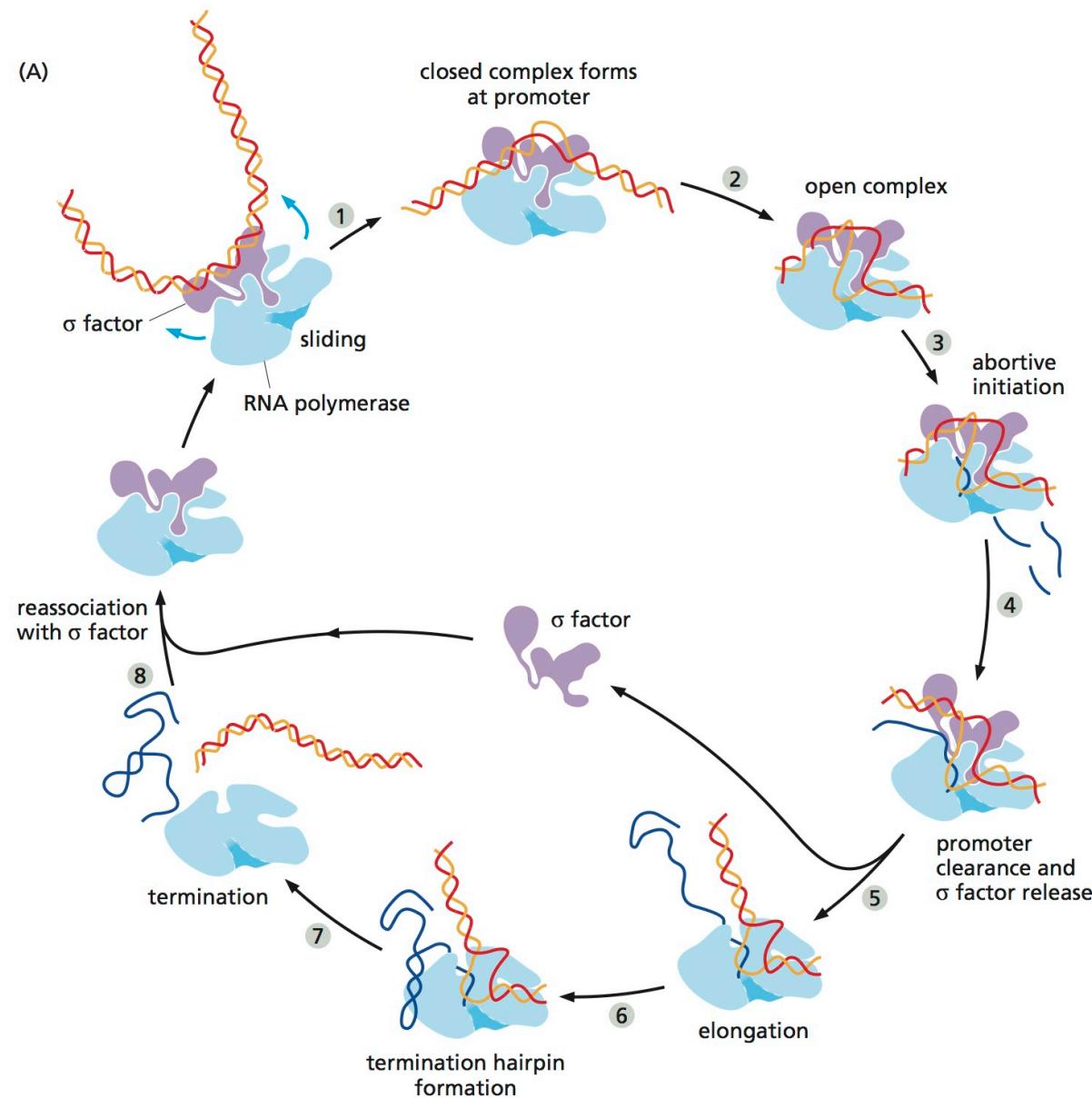
Archaea:

RNA polymeráza podobná eukaryotickým RNAP I, II a III

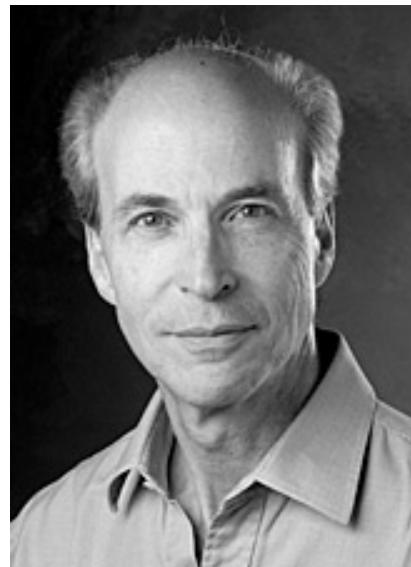
Transkripcia v baktériach



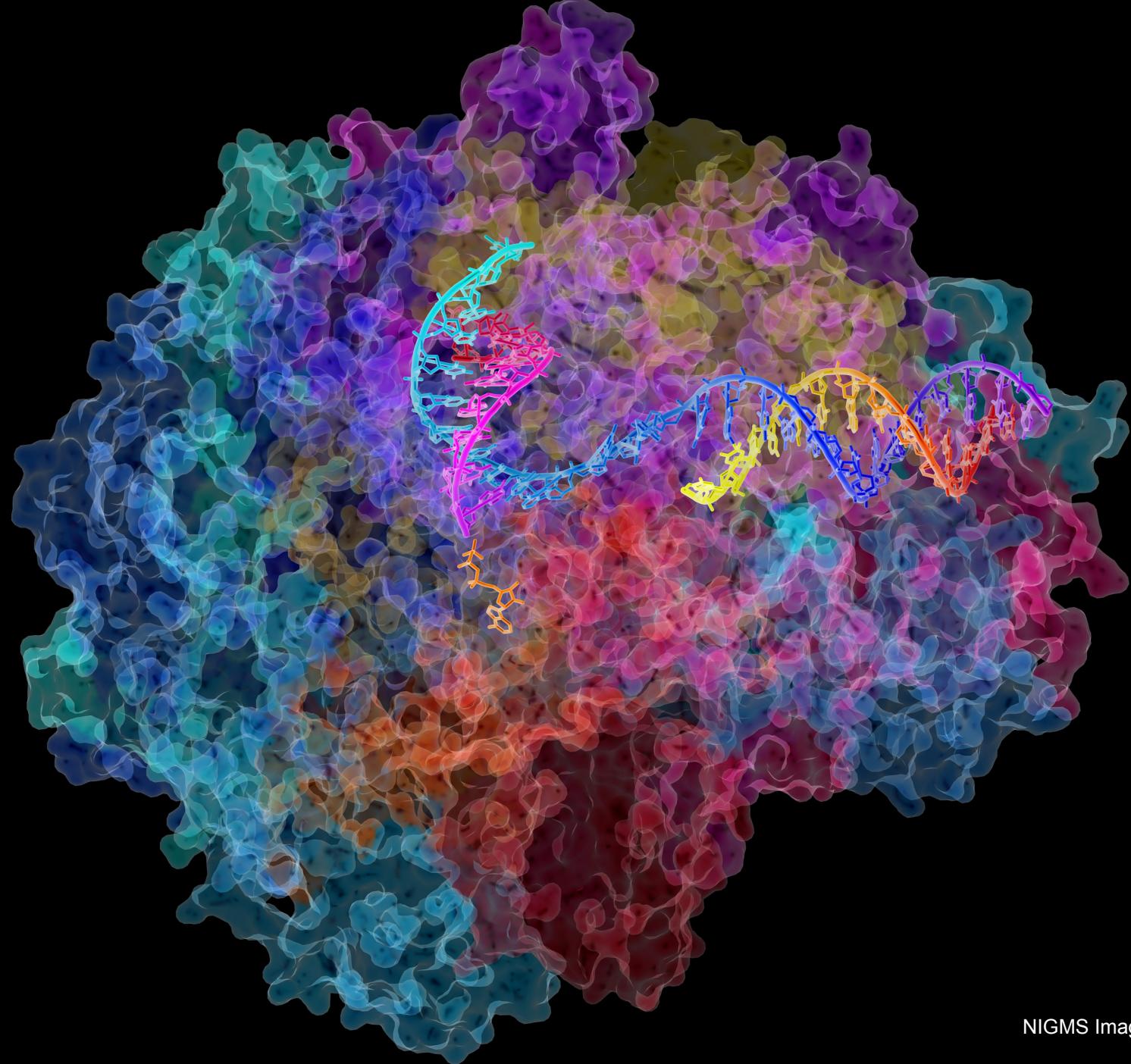
Iniciácia, elongácia a terminácia syntézy bakteriálnej RNA



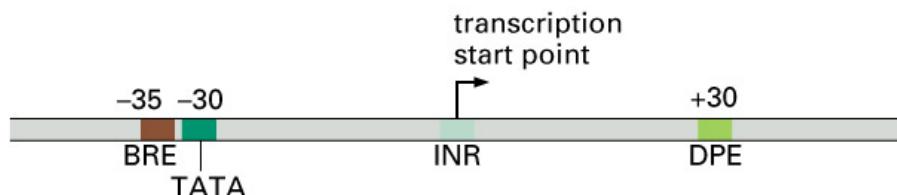
The Nobel Prize in Chemistry 2006 was awarded to Roger D. Kornberg ***"for his studies of the molecular basis of eukaryotic transcription".***



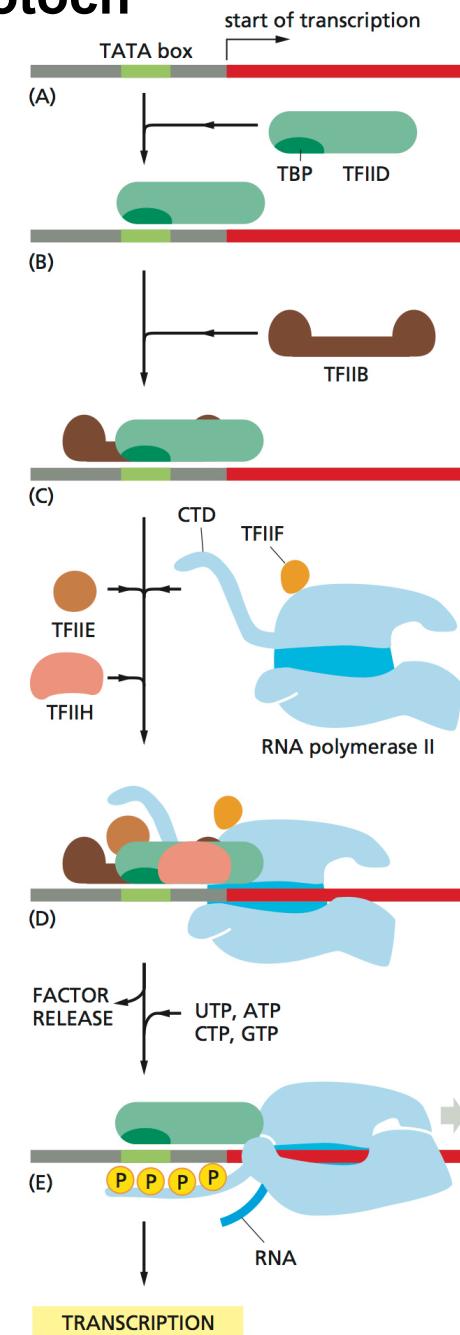
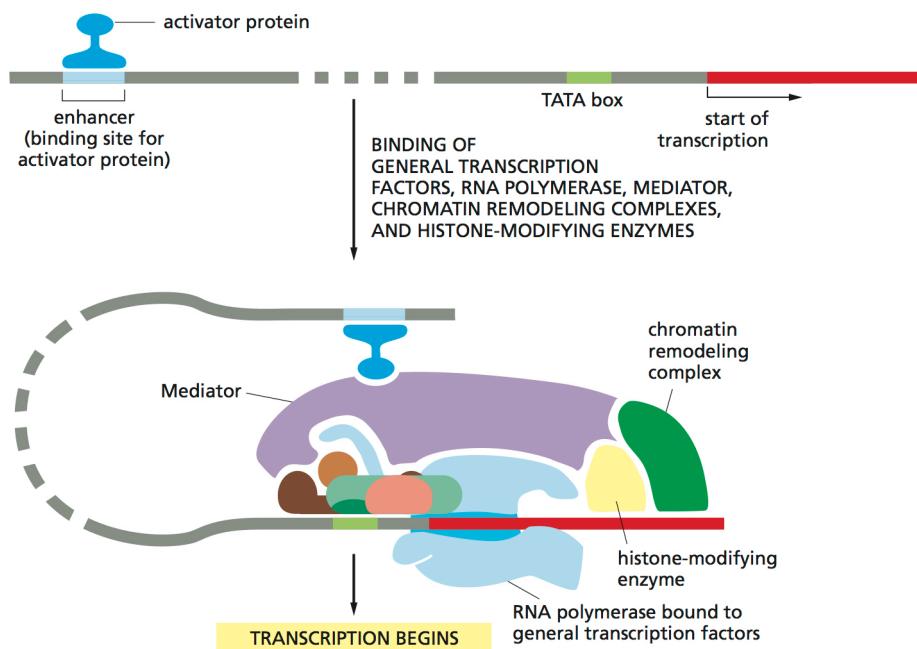
Roger D. Kornberg
(1947-)
USA



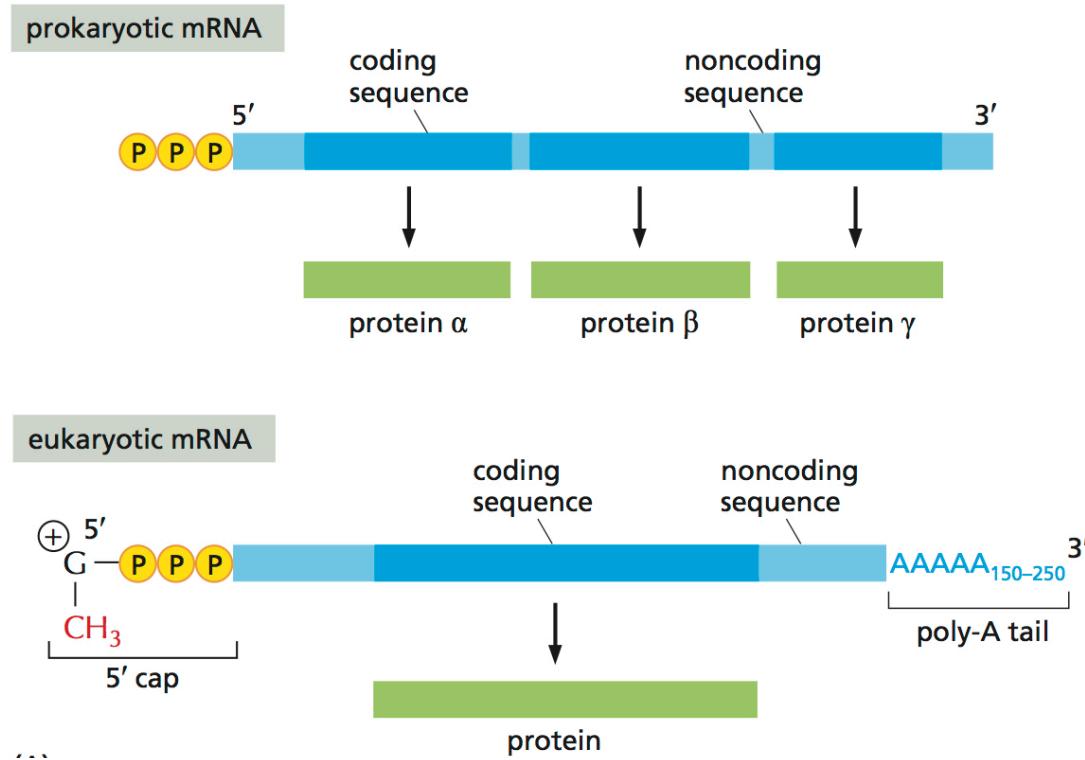
Iniciácia transkripcie v eukaryotoch



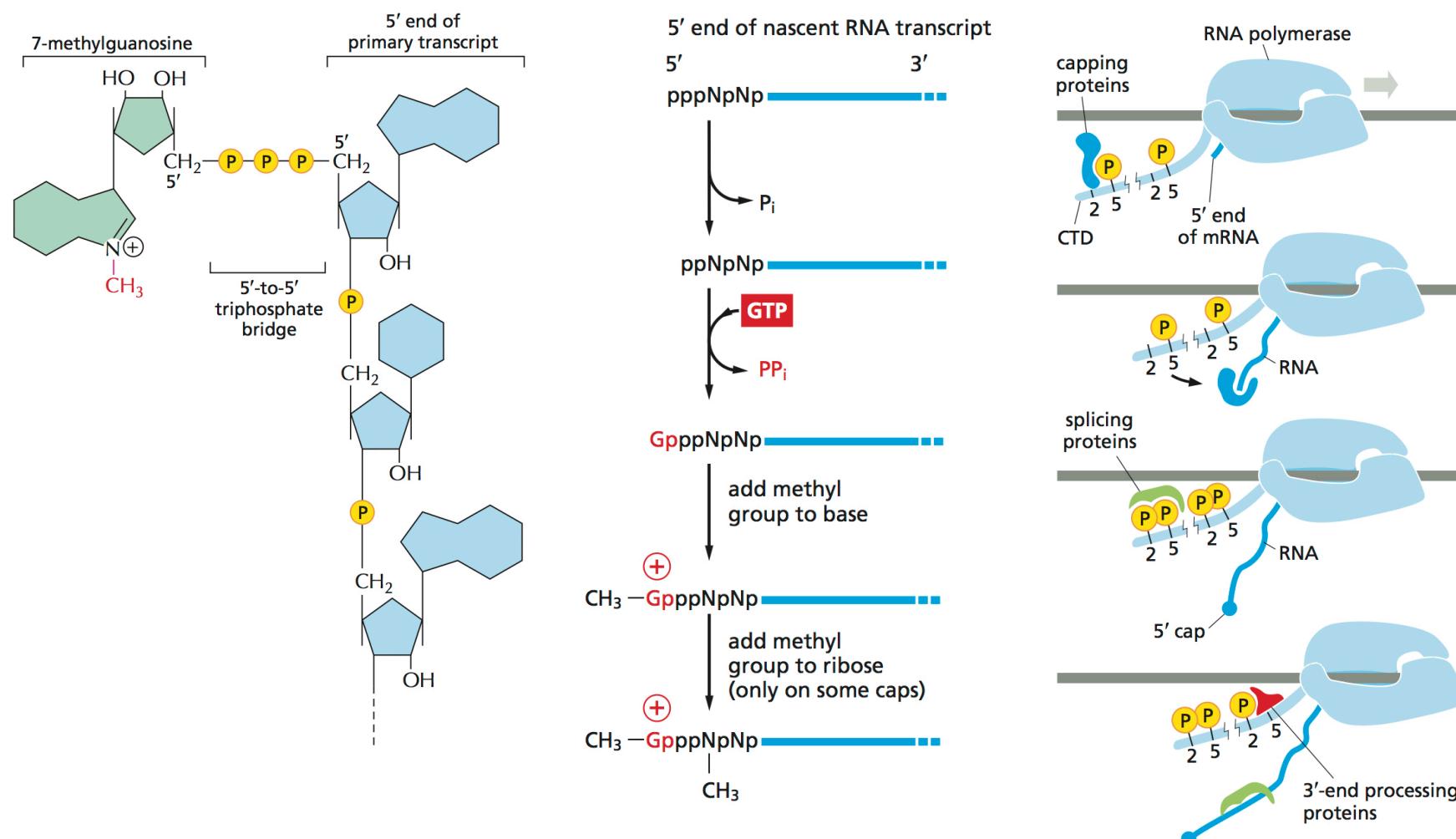
element	consensus sequence	general transcription factor
BRE	G/C G/C G/A C G C C	TFIIB
TATA	T A T A A/T A A/T	TBP
INR	C/T C/T A N T/A C/T C/T	TFIID
DPE	A/G G A/T C G T G	TFIID



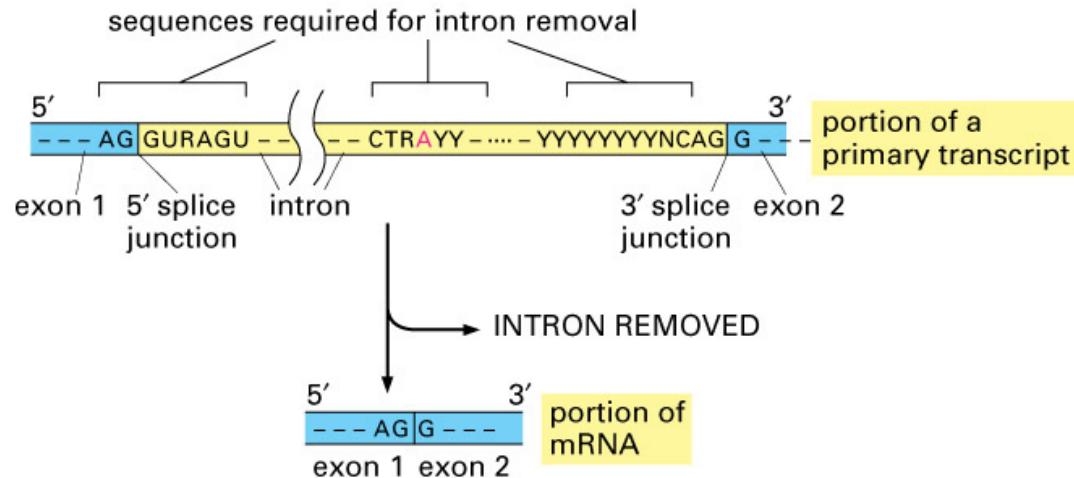
Úpravy (*processing*) primárnych transkriptov (mRNA)



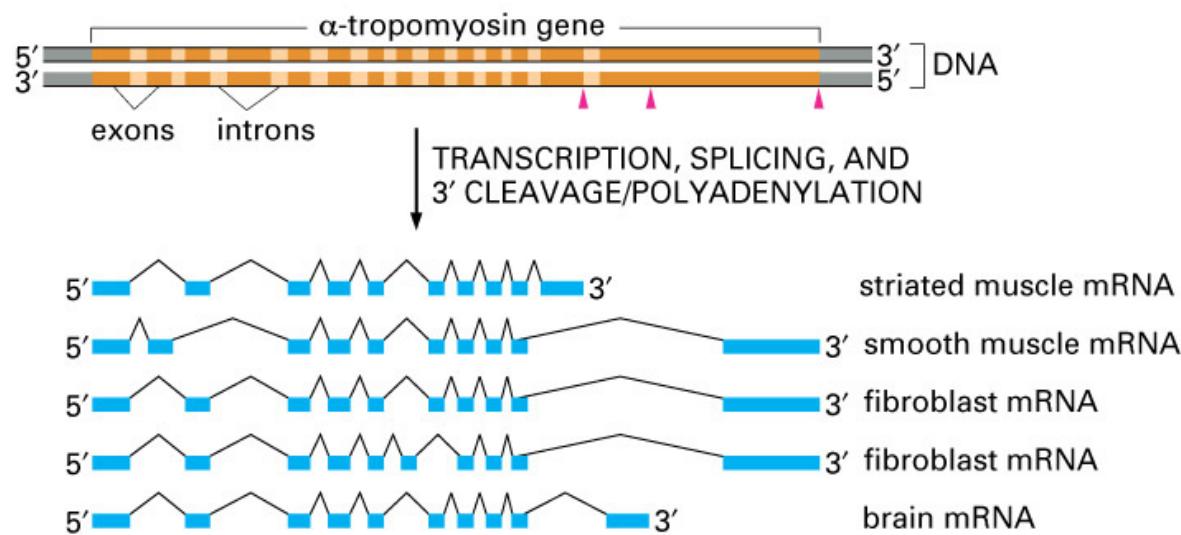
Pridanie čiapočky (capping) na 5' konci eukaryotickej mRNA



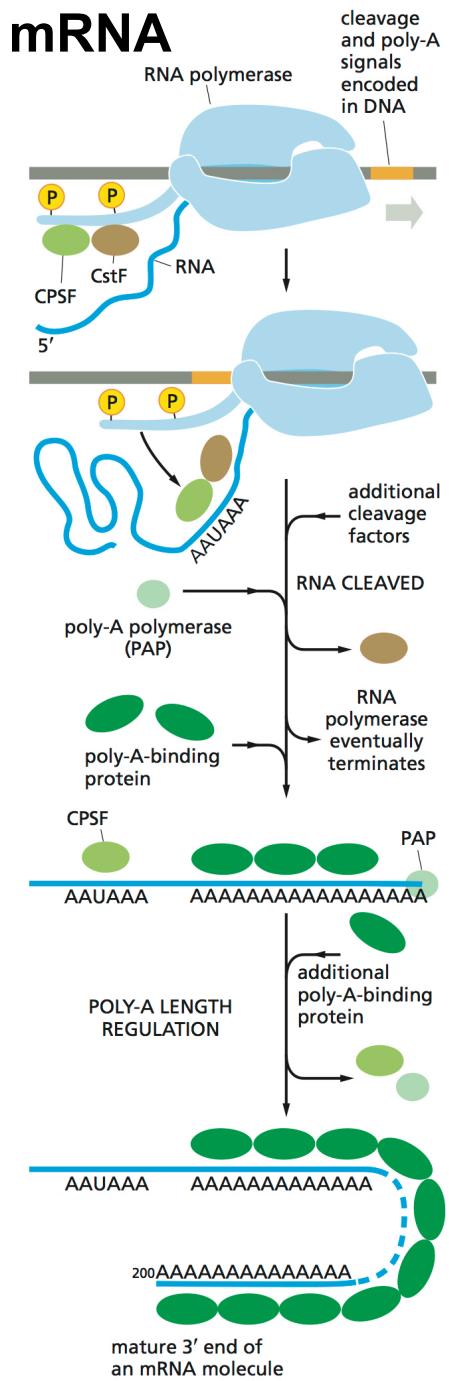
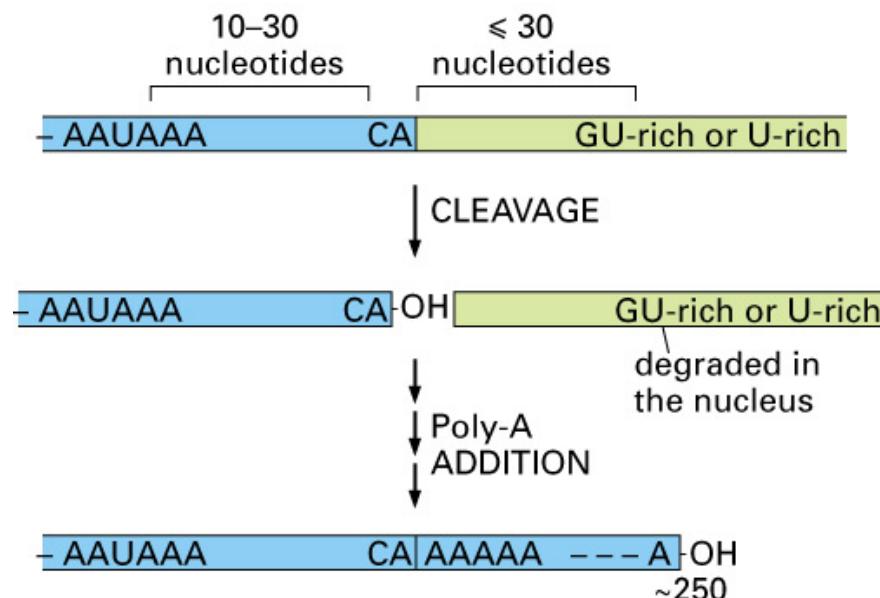
Vystrihnutie intrónov (*splicing*)



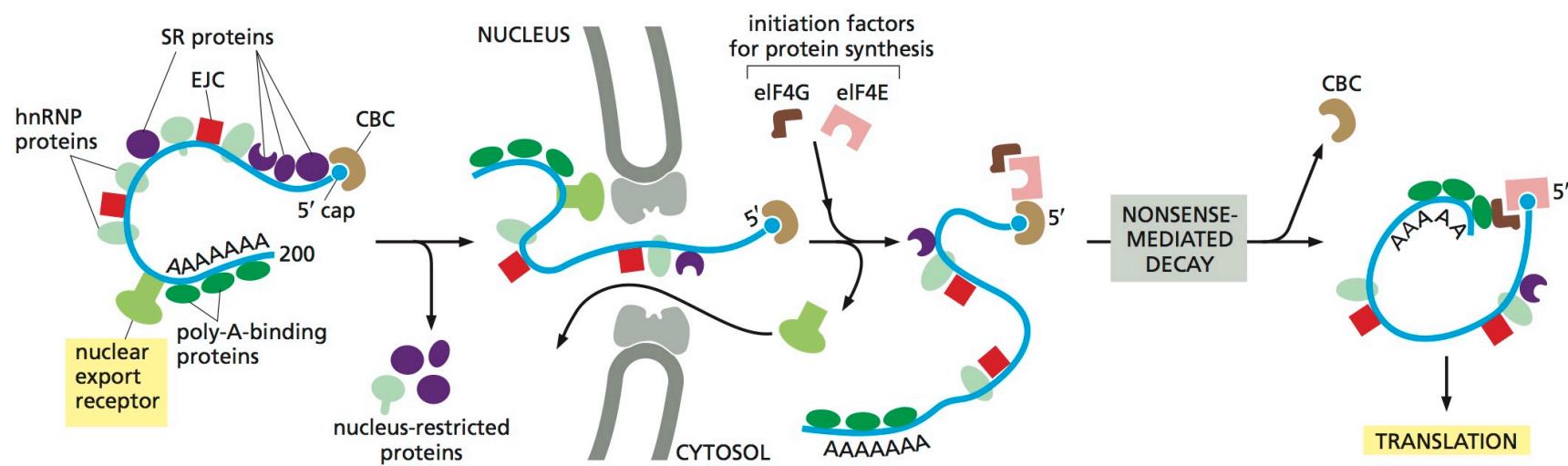
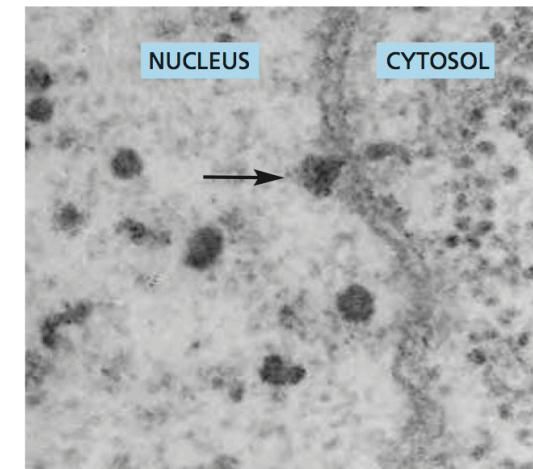
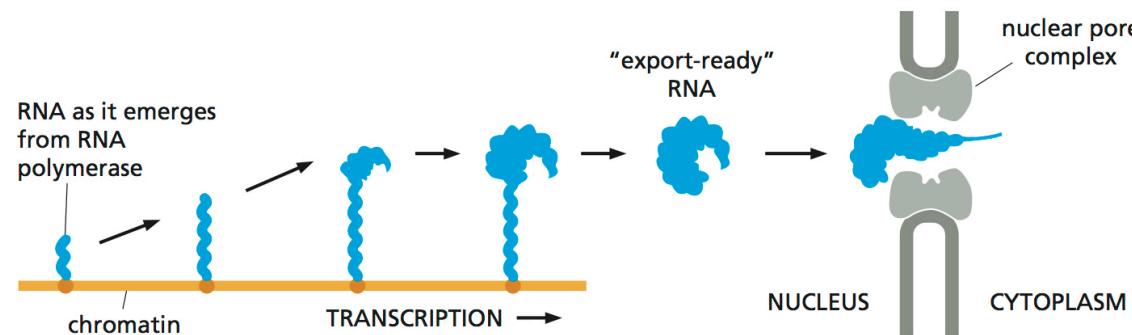
Alternatívny splicing



Polyadenylácia na 3' konci eukaryotickej mRNA

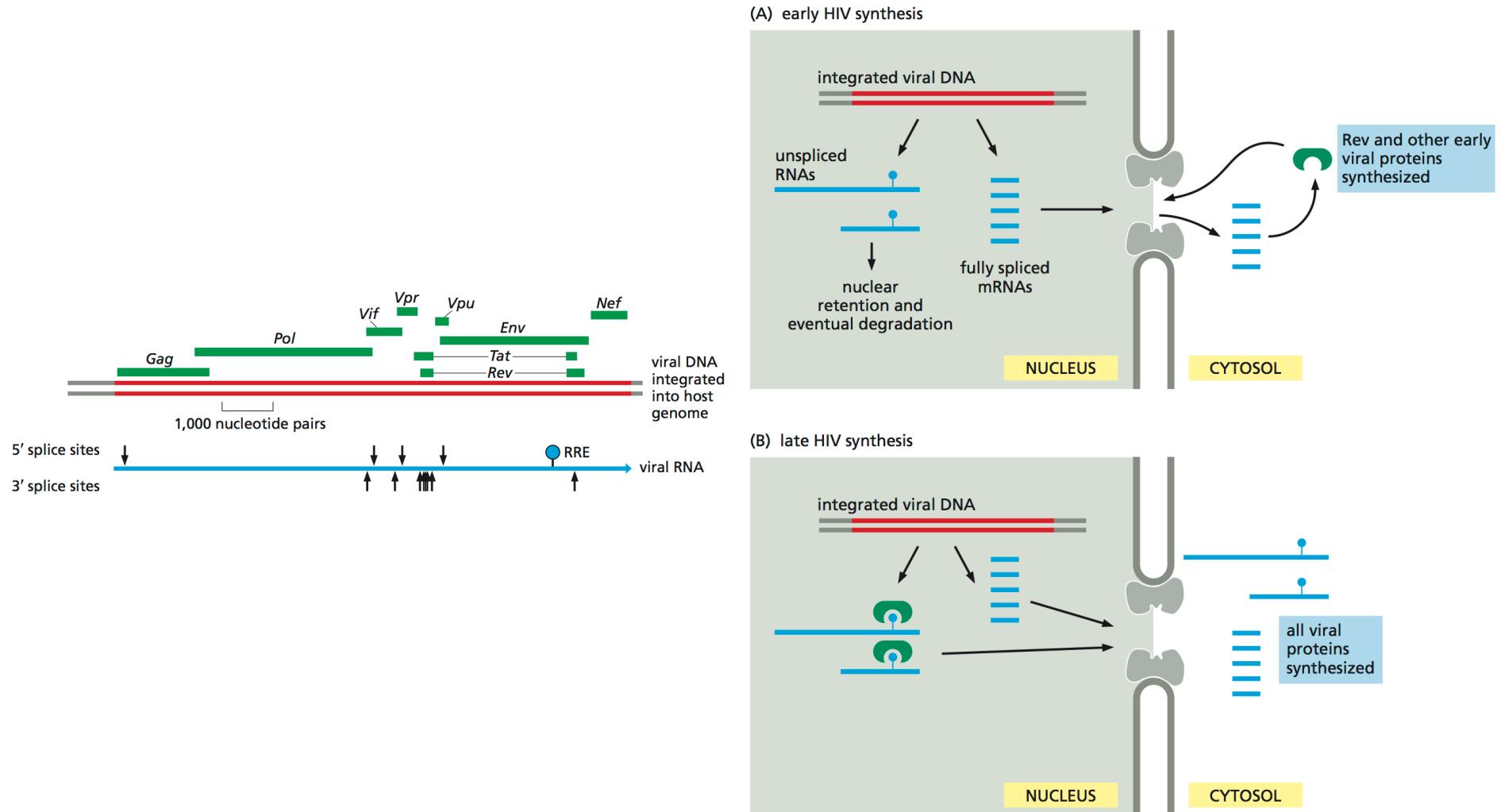


Export mRNA z jadra vo forme hnRNP komplexov

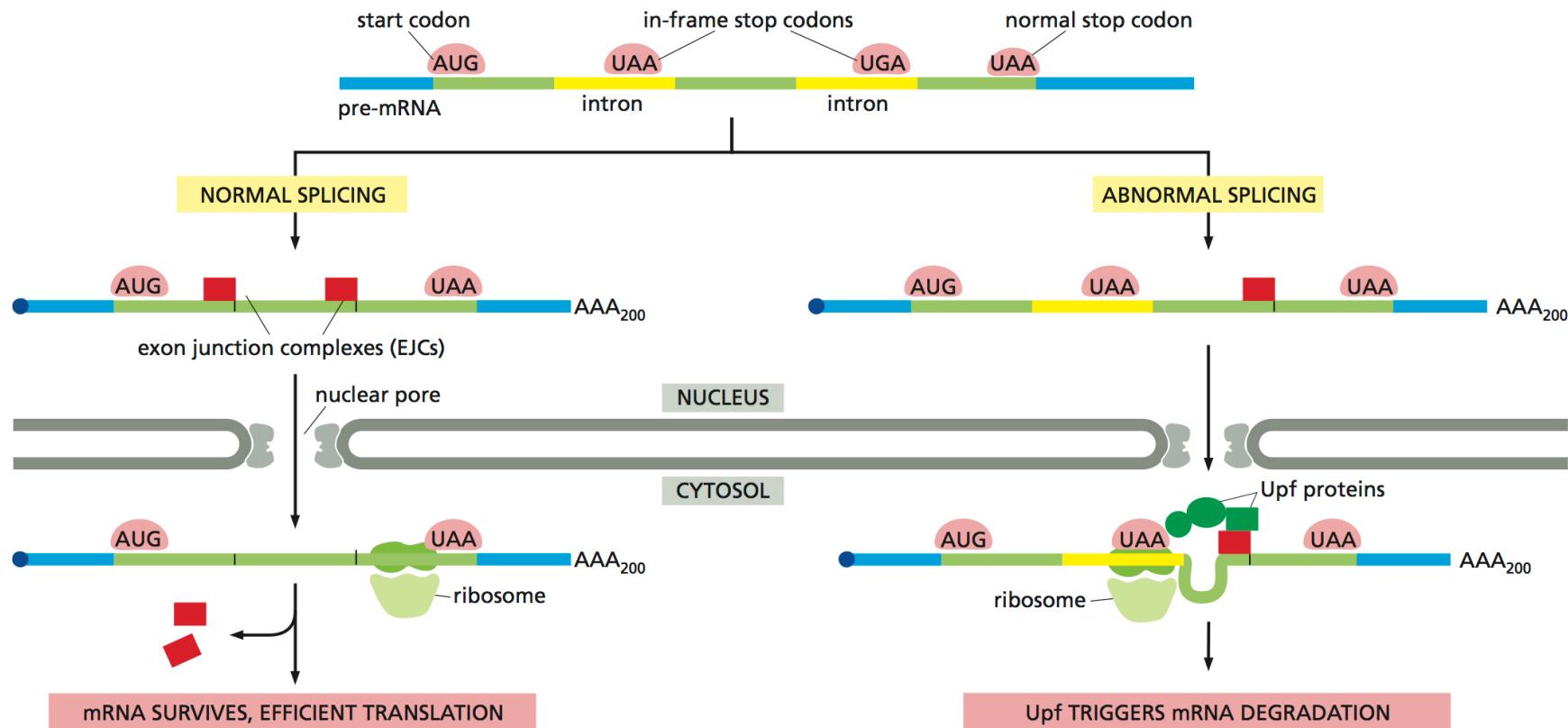


Regulácia životného cyklu vírusu HIV

export RNA vírusu z jadra buniek

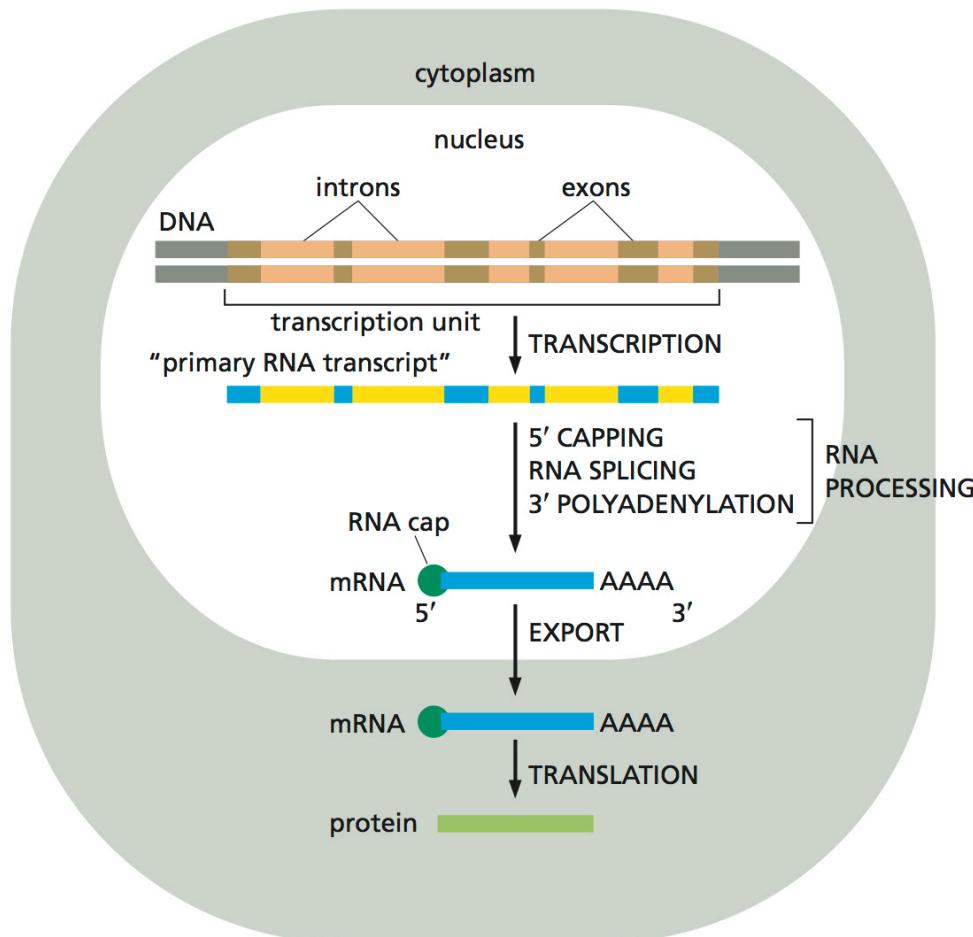


Degradácia chybne zostrihnutej mRNA

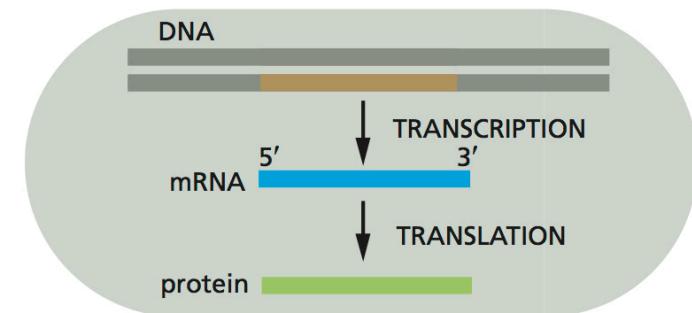


Eukaryotické vs. prokaryotické bunky

(A) EUKARYOTES



(B) PROKARYOTES



Nabudúce:

5. Syntéza a distribúcia proteínov v bunkách.

- Objav a vlastnosti genetického kódu.
- Štruktúra a vlastnosti tRNA.
- Štruktúra a funkcie ribozómov.
- Ribozomálne RNA a proteínové komponenty ribozómu.
- Základné etapy translácie (iniciácia, elongácia a terminácia).
- Porovnanie prokaryotickej a eukaryotickej proteosyntézy.
- Inhibítory proteosyntézy.
- Vnútrobunková lokalizácia proteosyntézy.
- Distribúcia proteínov v bunke.