Život =

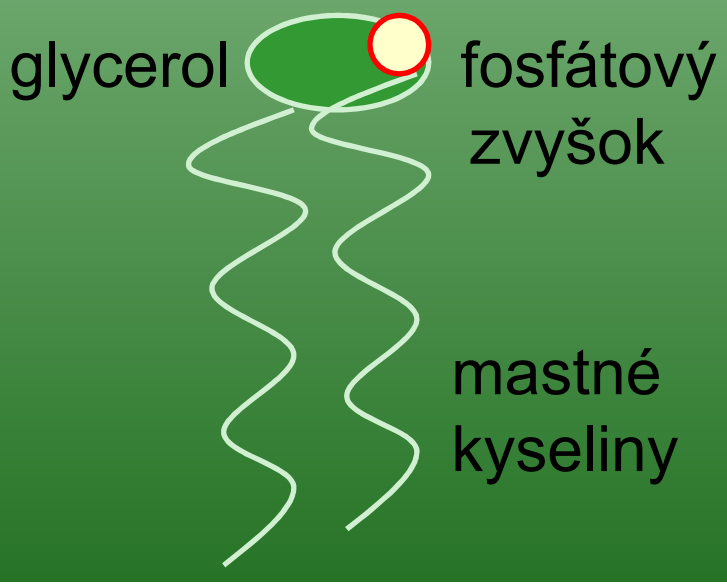
- organizácia
- metabolizmus
  - anabolizmus
  - katabolizmus
- reprodukcia
- homeostáza
- rast
- dráždivosť
- adaptabilita

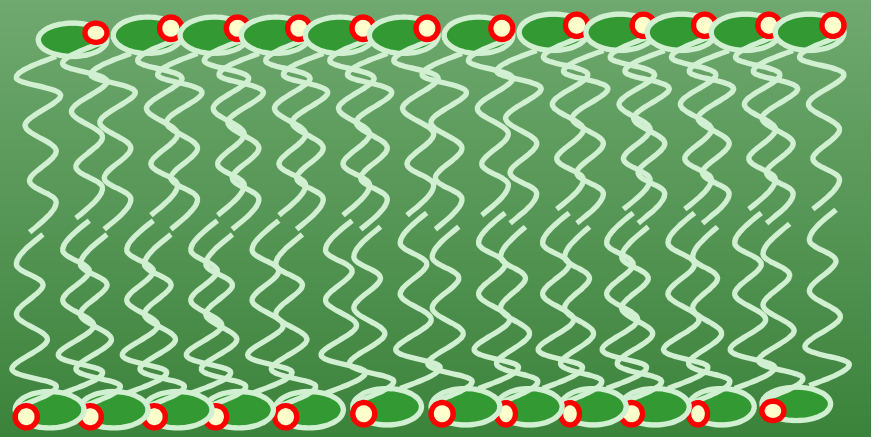
Život =
organizácia

Rozdelenie bunky na kompartmenty – lipidové dvojvrstvy

Bunková membrána, steny organel, endoplazmatické retikulum...

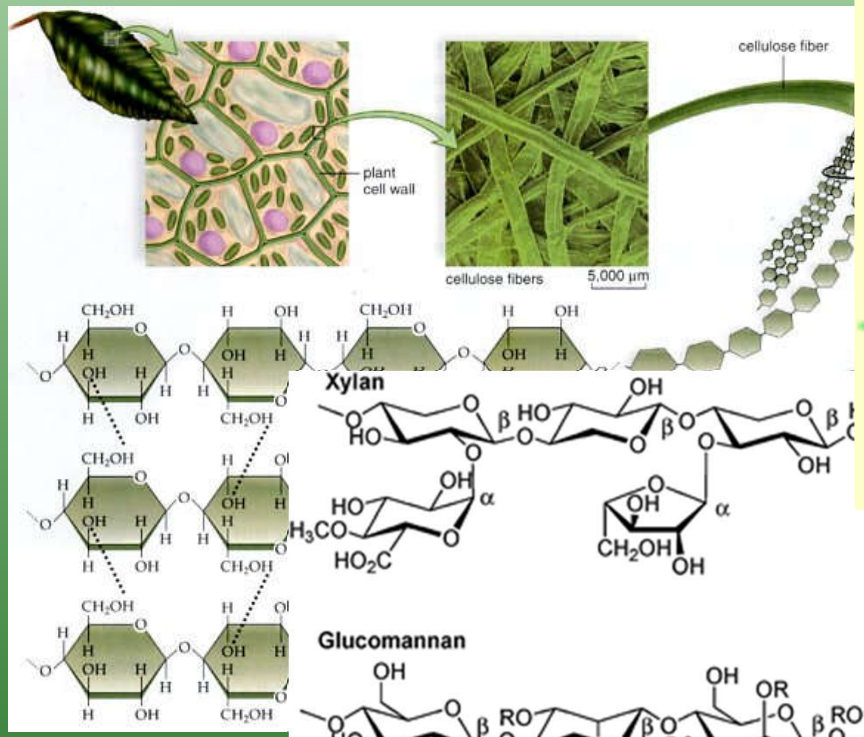
Fosfolipid=

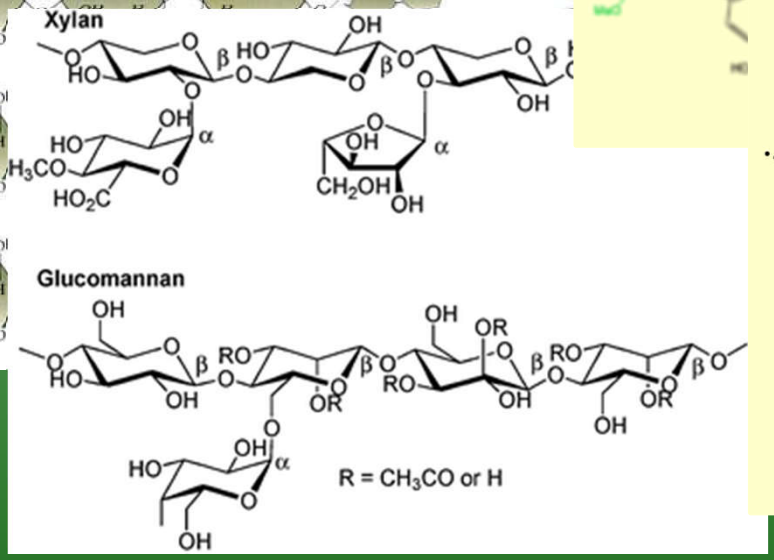


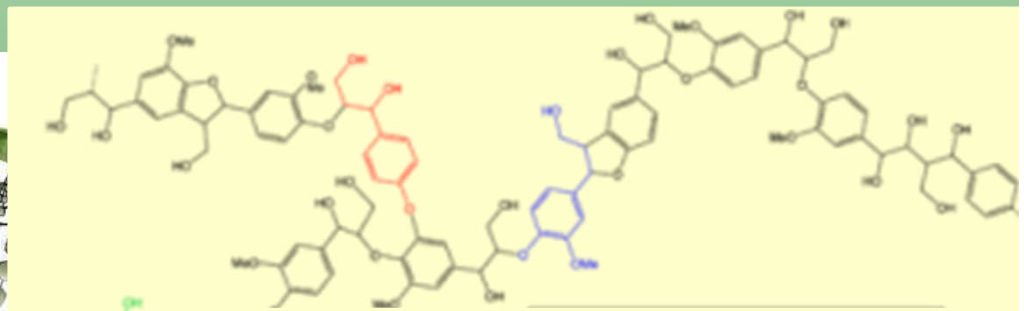


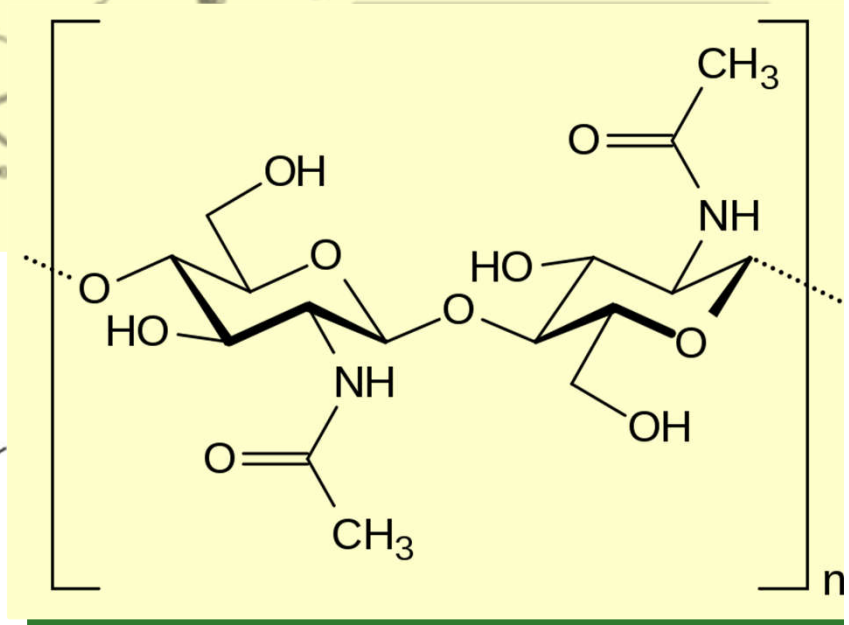
Život =
organizácia

Bunková stena – polysacharidy, lignín, chitín





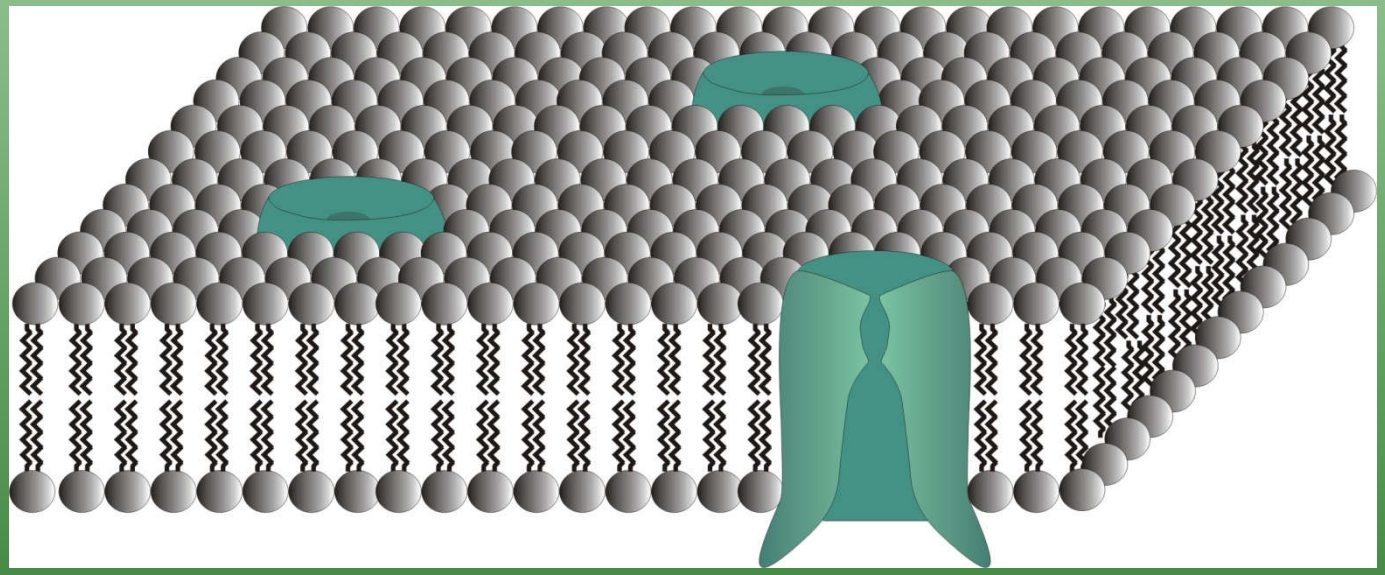




Život =
organizácia

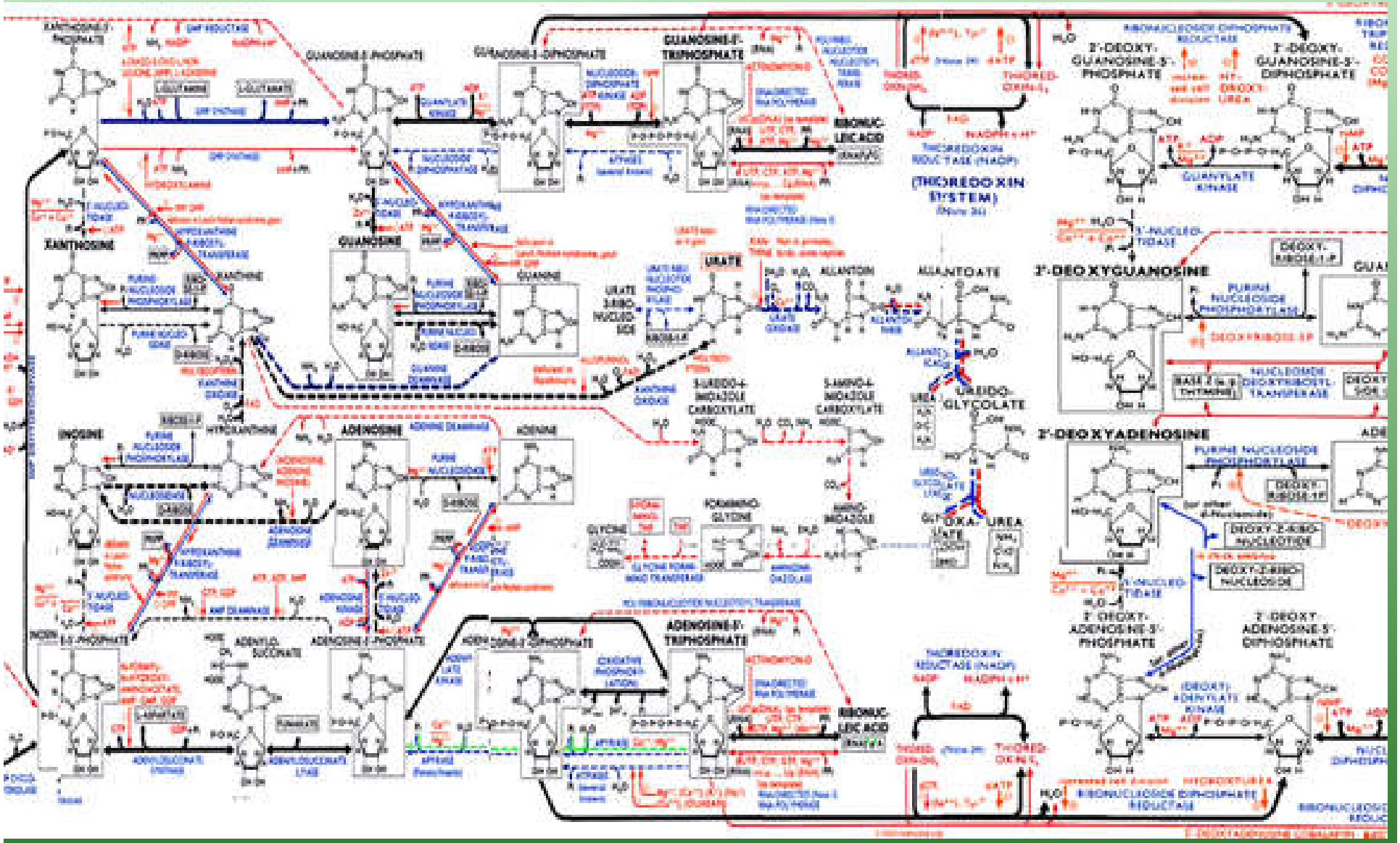
Rozdelenie bunky na kompartmenty – lipidové dvojvrstvy

Prenosové kanály – proteíny



Proteín = polymér aminokyselín $HO\text{-}\underset{\underset{O}{\|}}{C} - \underset{\underset{R}{|}}{CH} - NH_2$

Život =


GUANOSINE-5'-TRIPHOSPHATE
RIBONUCLEIC ACID
(THIOREDOXIN SYSTEM)
2'-DEOXY-GUANOSINE-5'-PHOSPHATE
2'-DEOXY-GUANOSINE-5'-DIPHOSPHATE
XANTHOSINE
GUANOSINE
GUANINE
URATE
ALLANTOIN
ALLANTOATE
2'-DEOXYGUANOSINE
INOSINE
ADENOSINE
ADENINE
2'-DEOXYADENOSINE
ADENOSINE-5'-TRIPHOSPHATE
2'-DEOXY-ADENOSINE-5'-PHOSPHATE
2'-DEOXY-ADENOSINE-5'-DIPHOSPHATE
UREA

Život =

organizácia

metabolizmus

anabolizmus

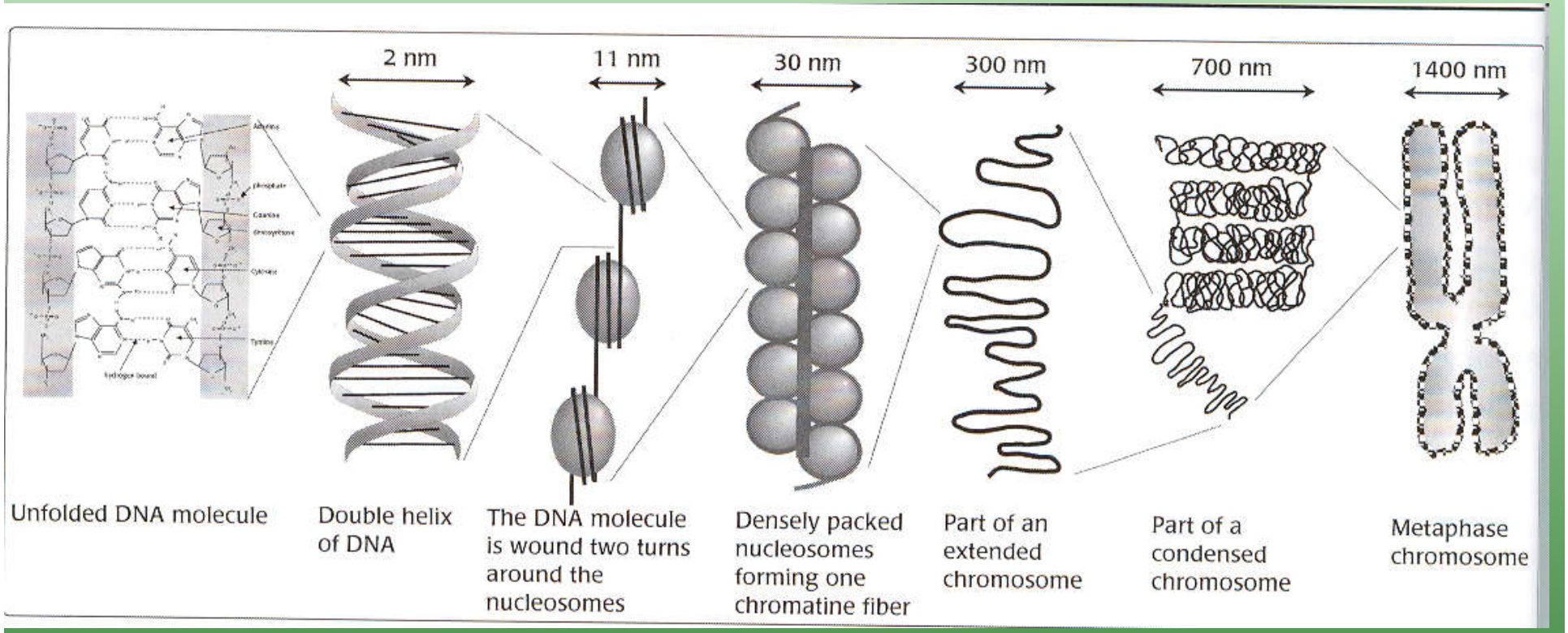
katabolizmus

reprodukcia

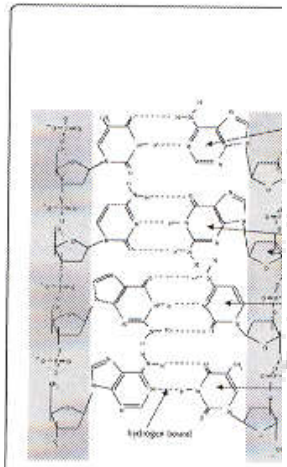
Informácia, nutná pre výstavbu organizmu
= informácia o riadiacich molekulách (proteínoch)

Fyzický nositeľ dedičnej informácie – DNA (RNA)
Mechanizmus „čítania“ dedičnej informácie

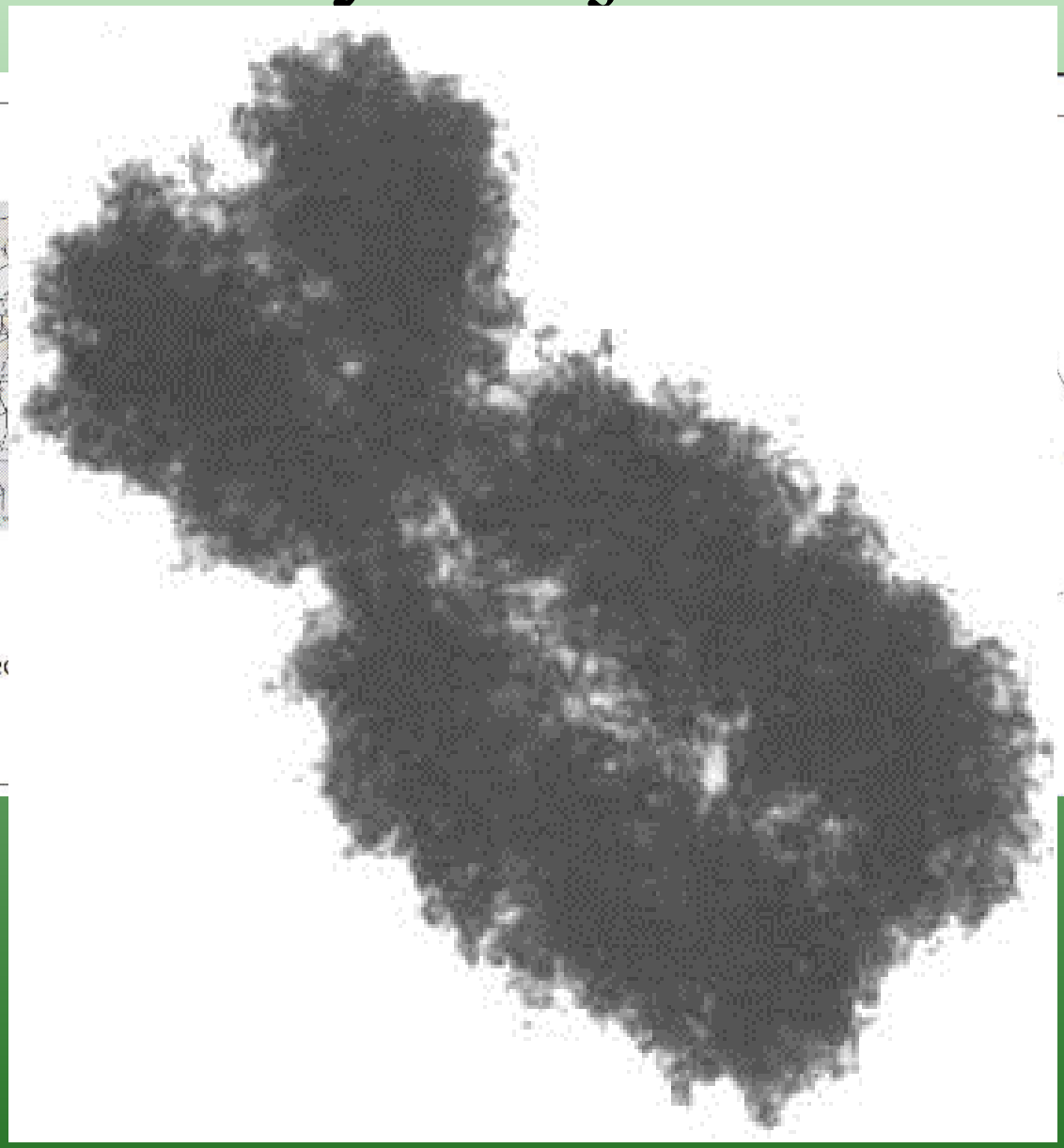
Ako vyzerá jadrová DNA?

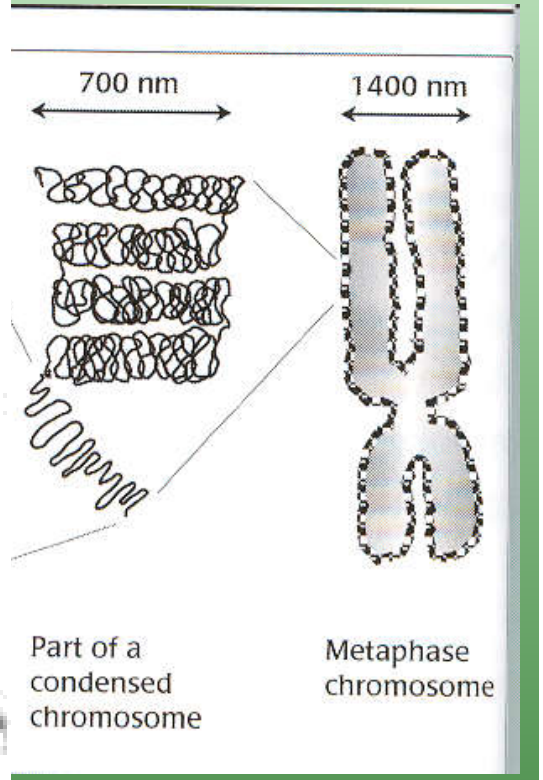


Ako vyzerá jadrová DNA?

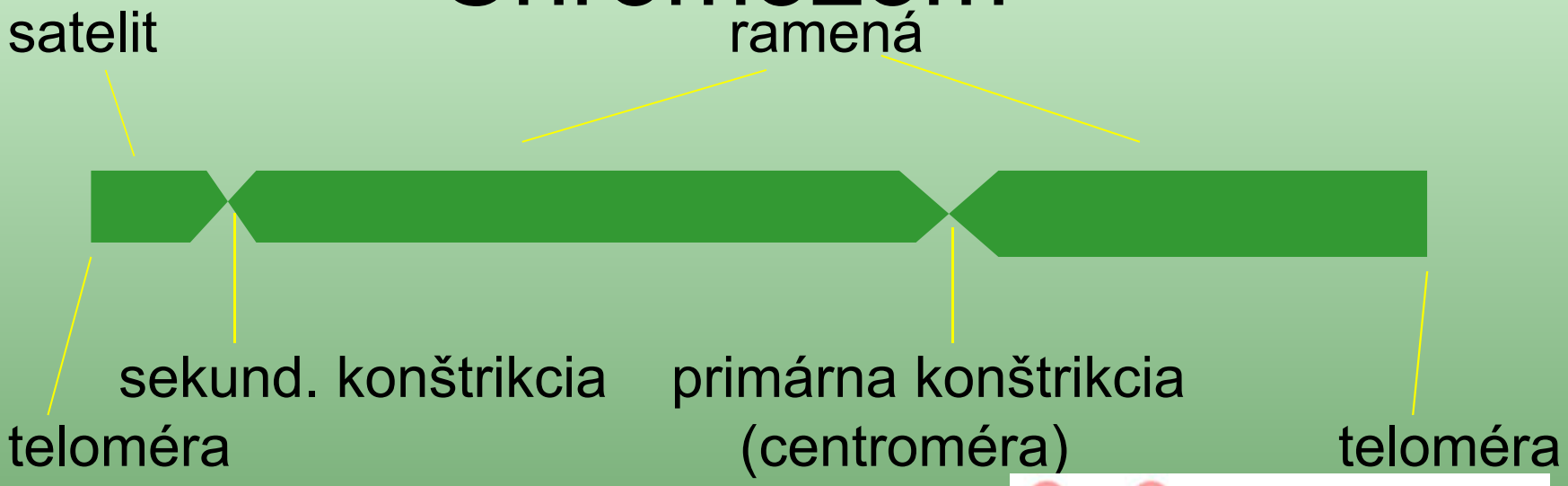


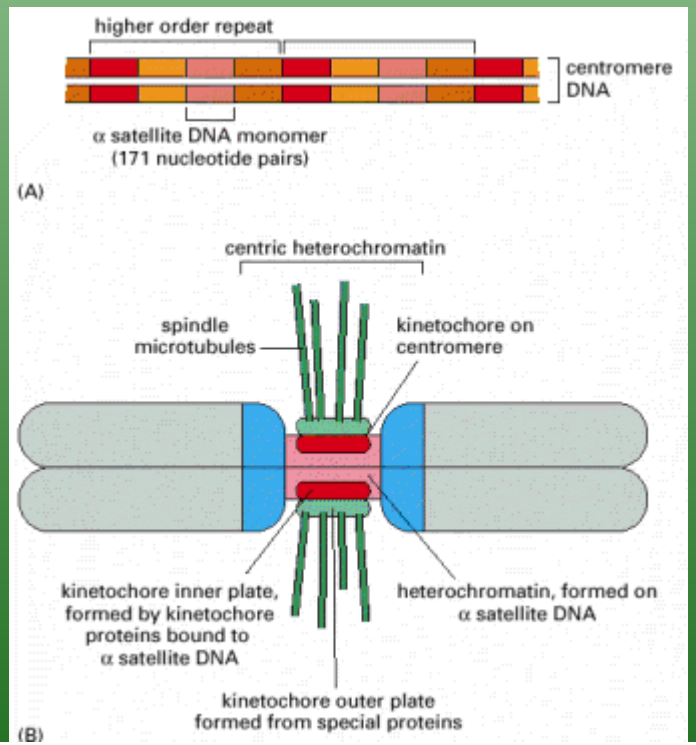
Unfolded DNA molec

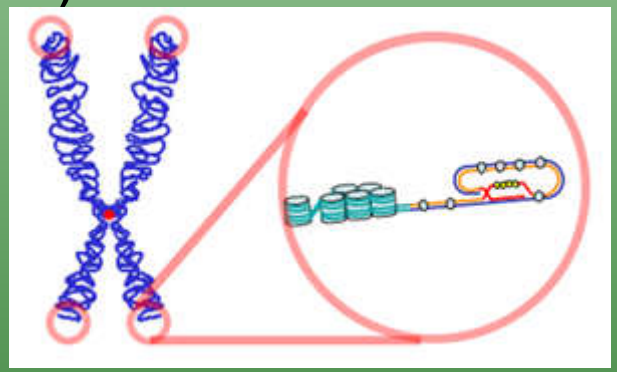




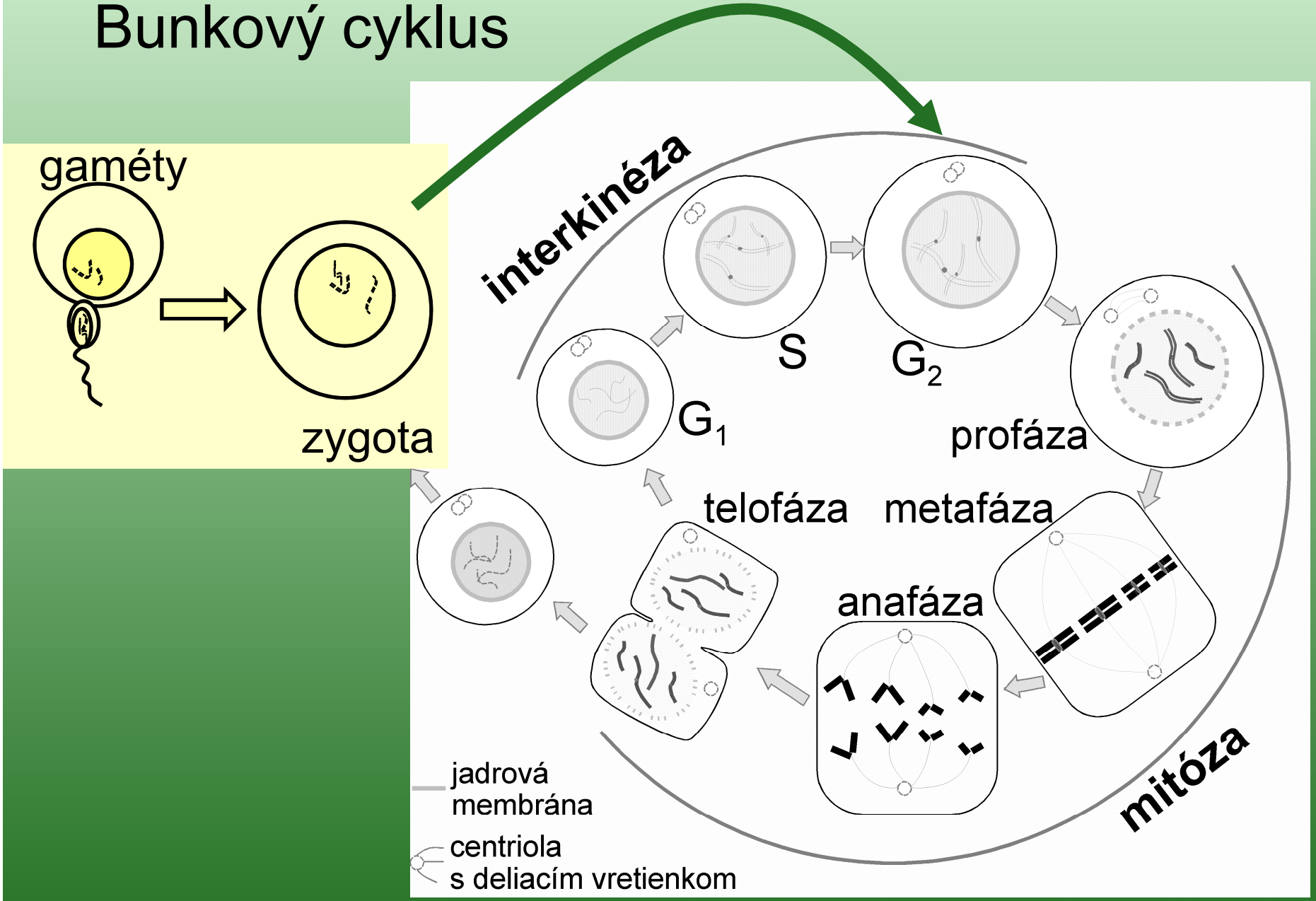
Chromozóm


satelit
ramená
sekund. konštrikcia
primárna konštrikcia
(centroméra)
teloméra
teloméra

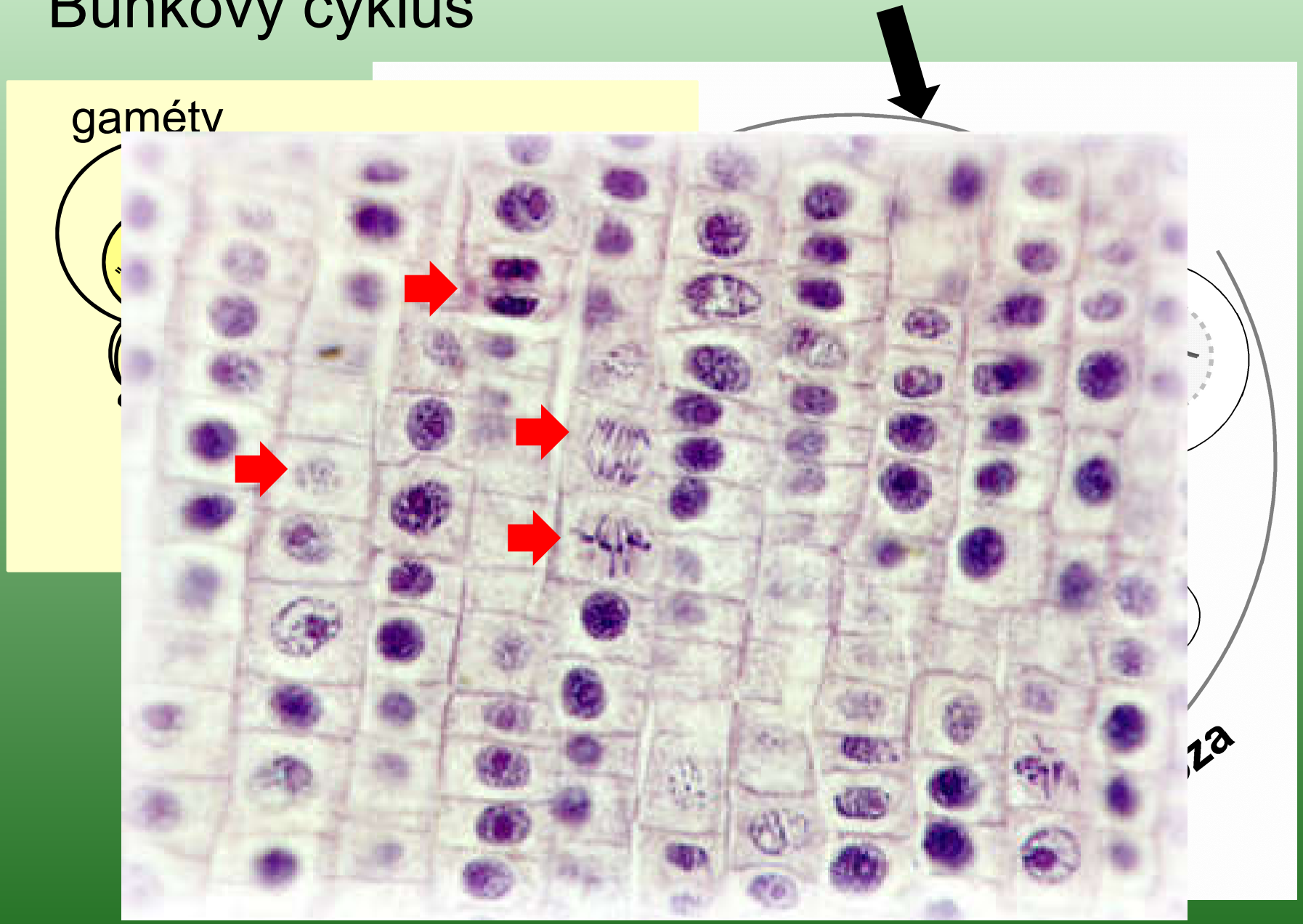

higher order repeat
centromere DNA
α satellite DNA monomer
(171 nucleotide pairs)
(A)
centric heterochromatin
spindle microtubules
kinetochore on centromere
kinetochore inner plate, formed by kinetochore proteins bound to α satellite DNA
heterochromatin, formed on α satellite DNA
kinetochore outer plate formed from special proteins
(B)



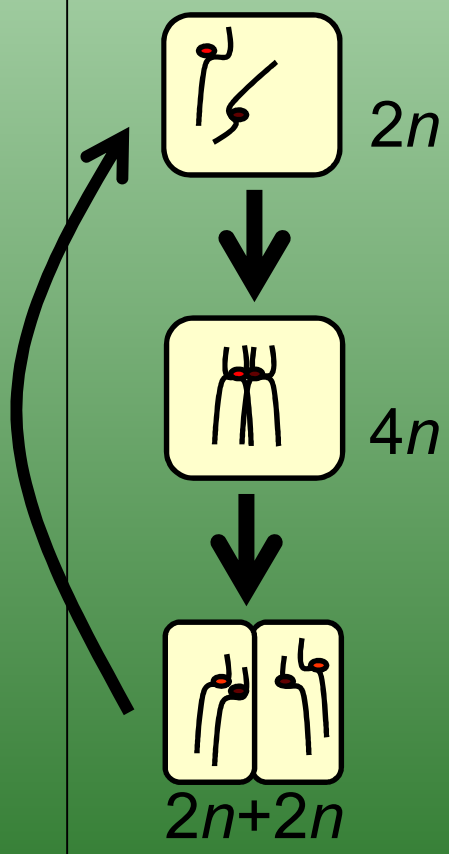
Bunkový cyklus

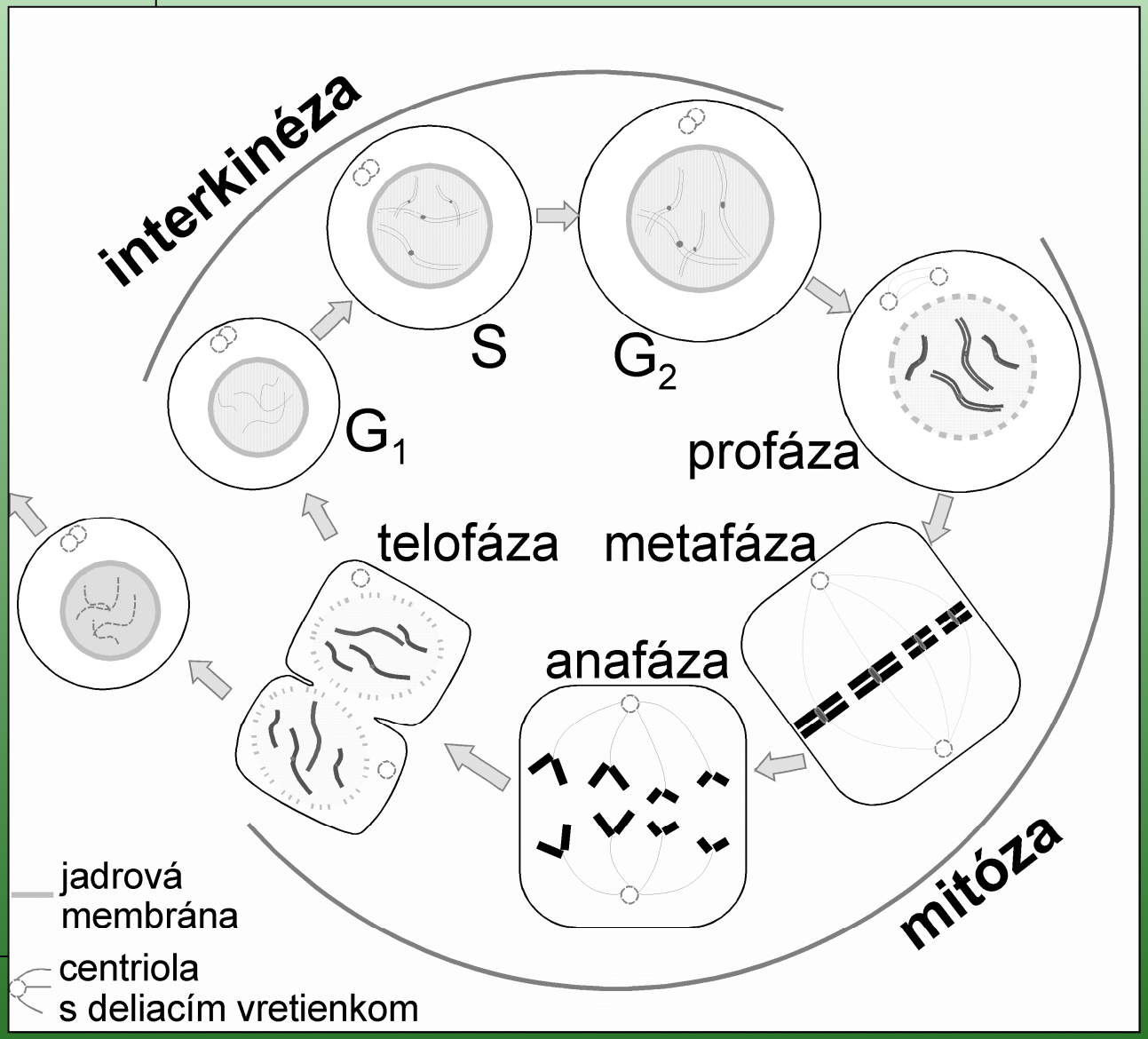


Bunkový cyklus



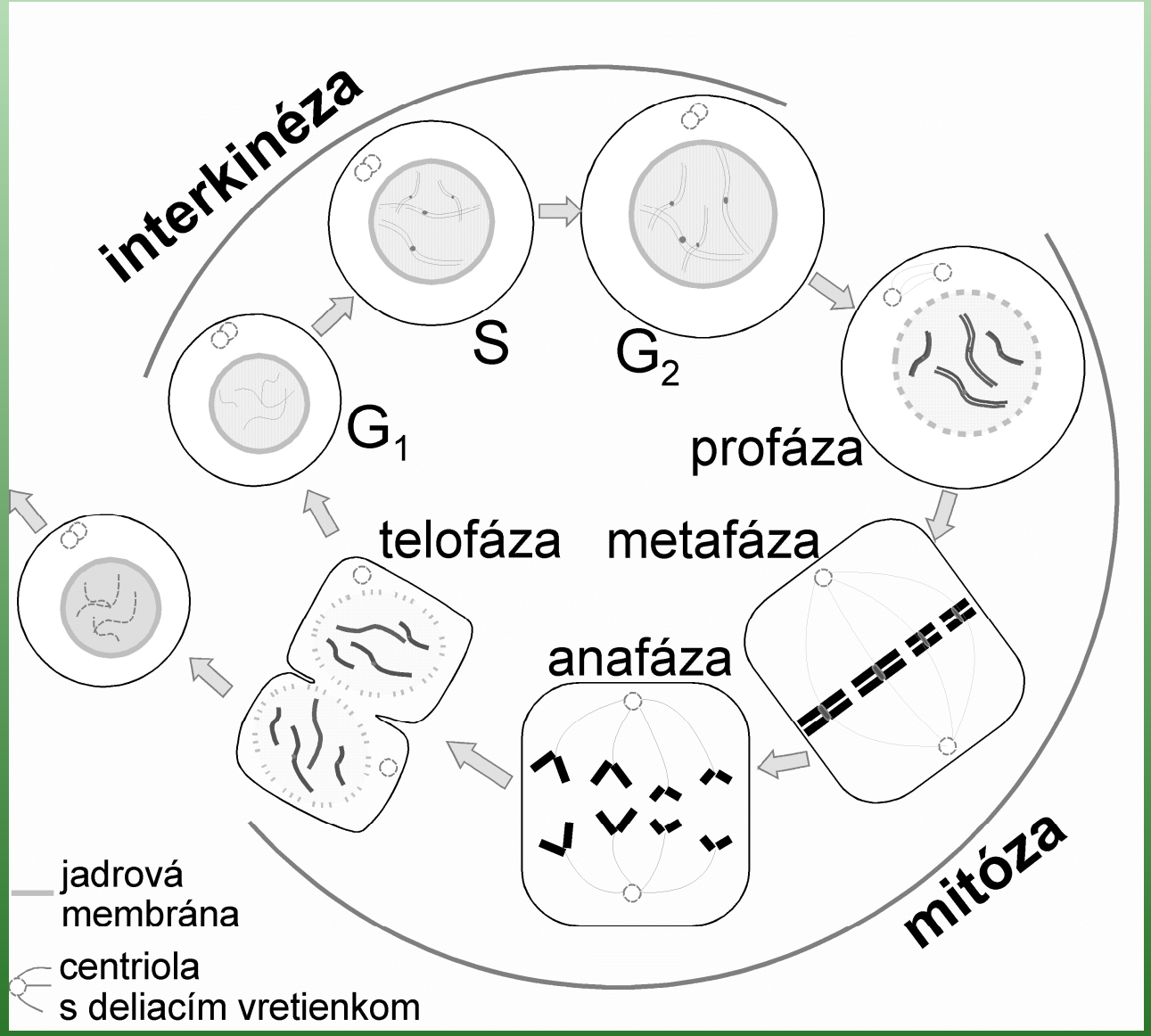
Bunkový cyklus





Bunkový cyklus

diferenciácia ←
↓
fungovanie bunky
↓
apoptóza
(programovaná
smrť bunky)
resp. nekróza



Gametogenéza: meióza

Profáza I

- leptotén — špiralizácia
- zygotén — párovanie homológov, synapsa
- pachytén — bivalent
- diplotén — chiazma
- diakinéza — presun

Metafáza I

Anafáza I

Telofáza I

Profáza II

Metafáza II

Anafáza II

Telofáza II

Gametogenéza: meióza

Profáza I

- leptotén — špiralizá
- zygotén — párovan
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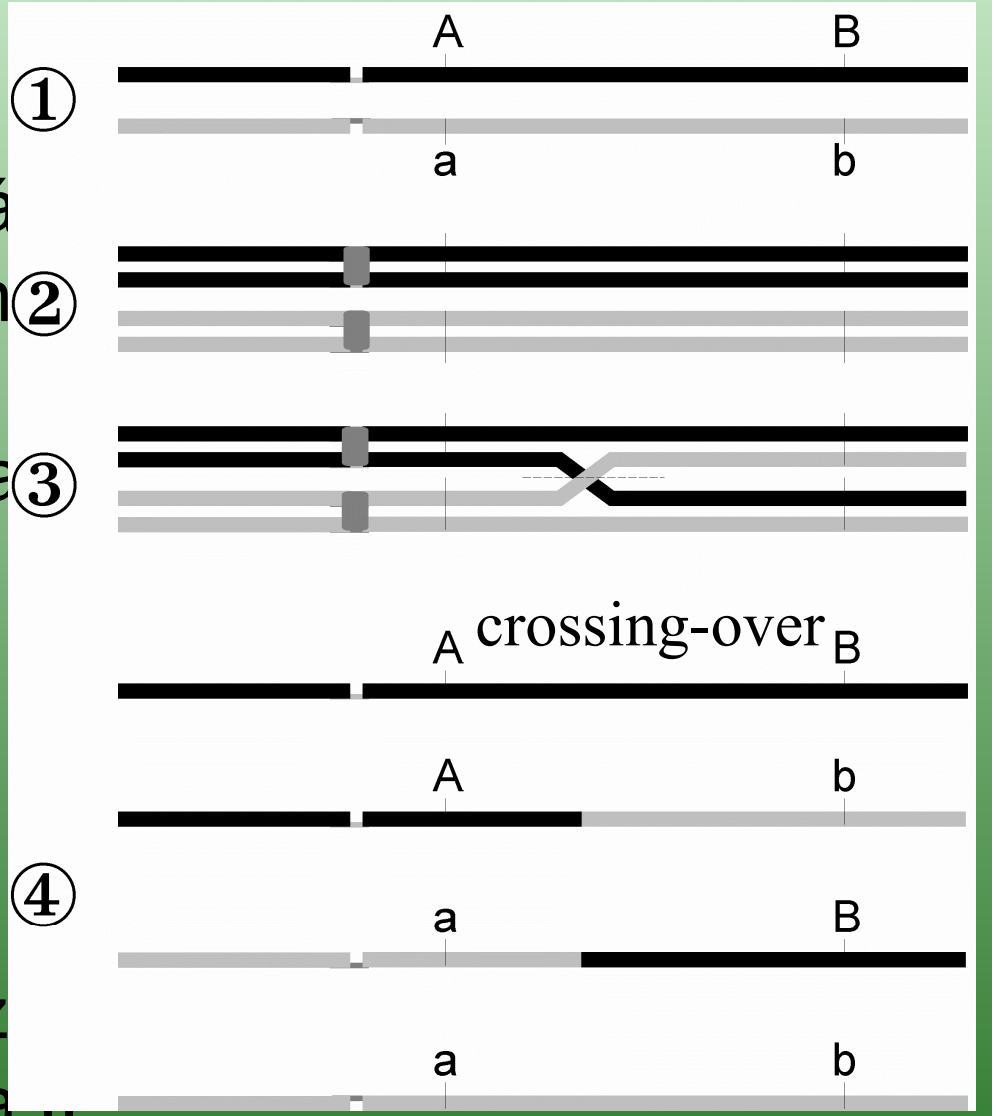
- diakinéza — presun

Metafáza I

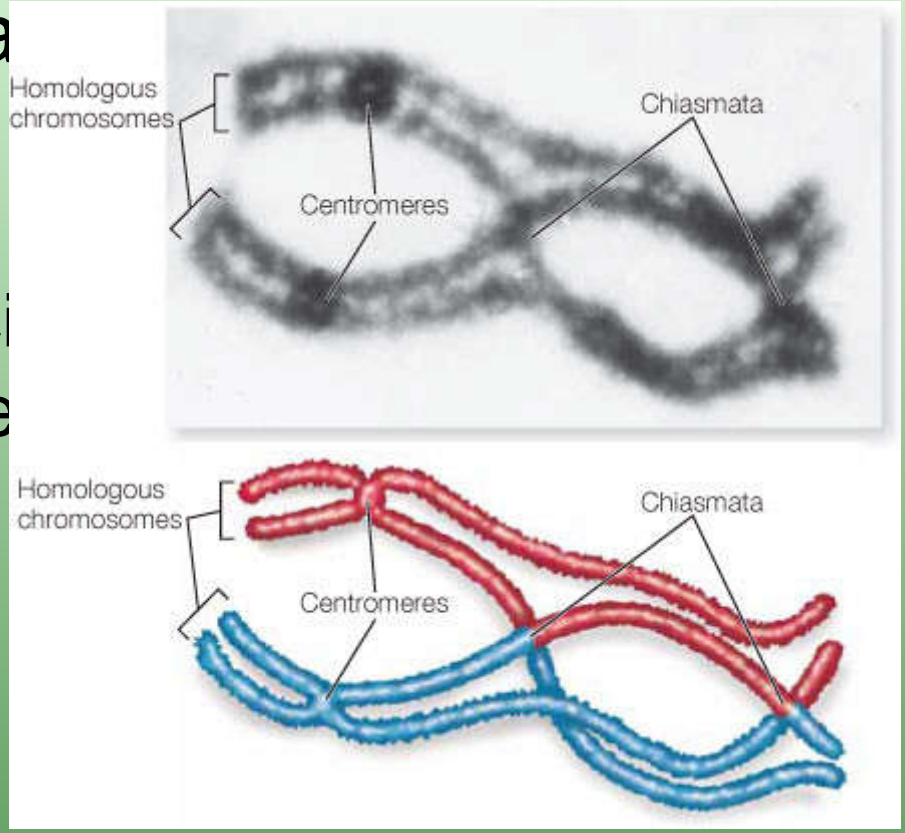
Anafáza I

Telofáza I

Profáza
Metafáz
Anafáza II
Telofáza II



Gametogenéza: meióza



Profáza I
- leptotén — špiralizáci
- zygotén — párovanie
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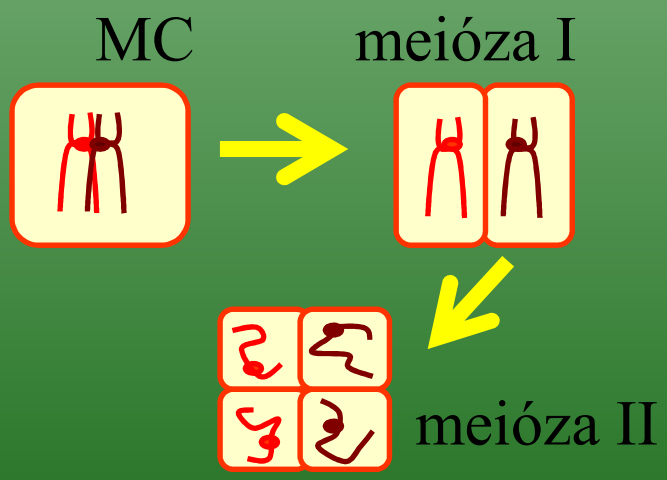
Metafáza I
Anafáza I
Telofáza I

Profáza II
Metafáza II
Anafáza II
Telofáza II

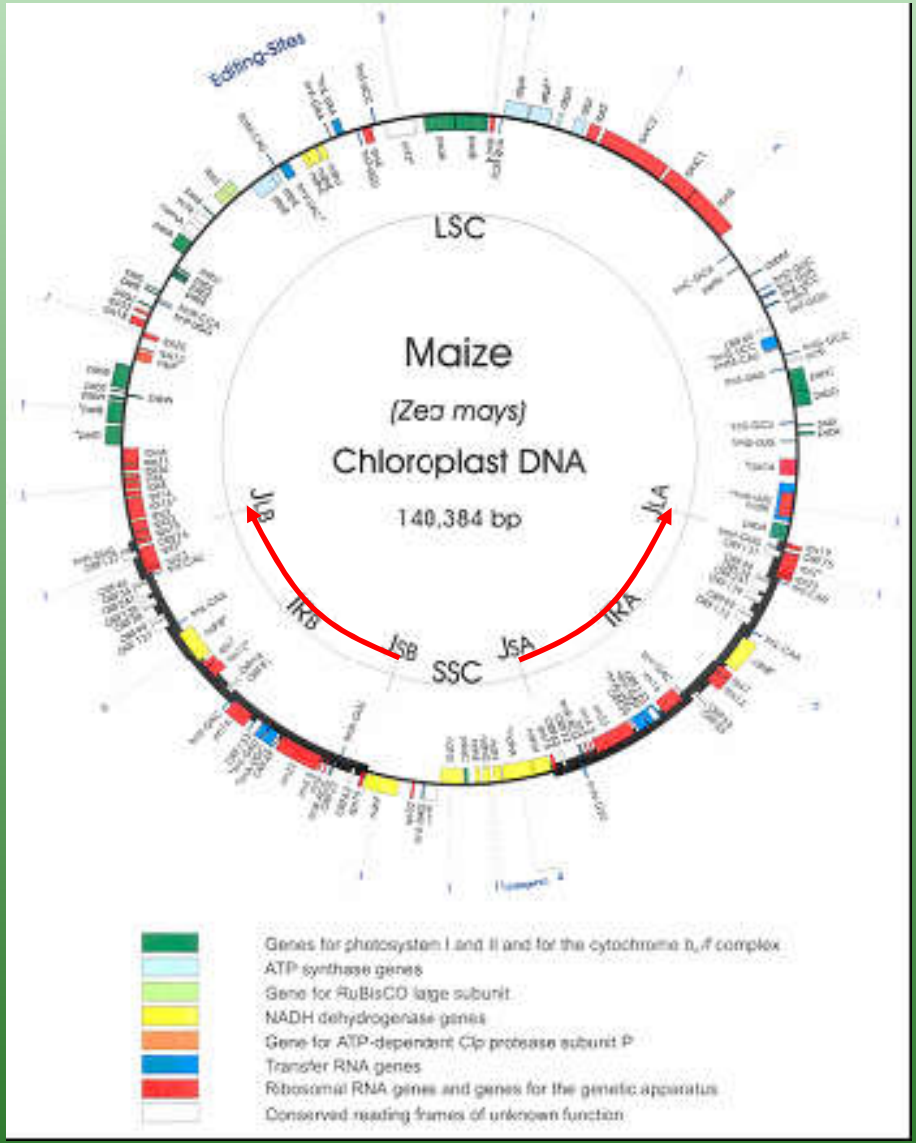


Ako vyzerá organelová DNA?

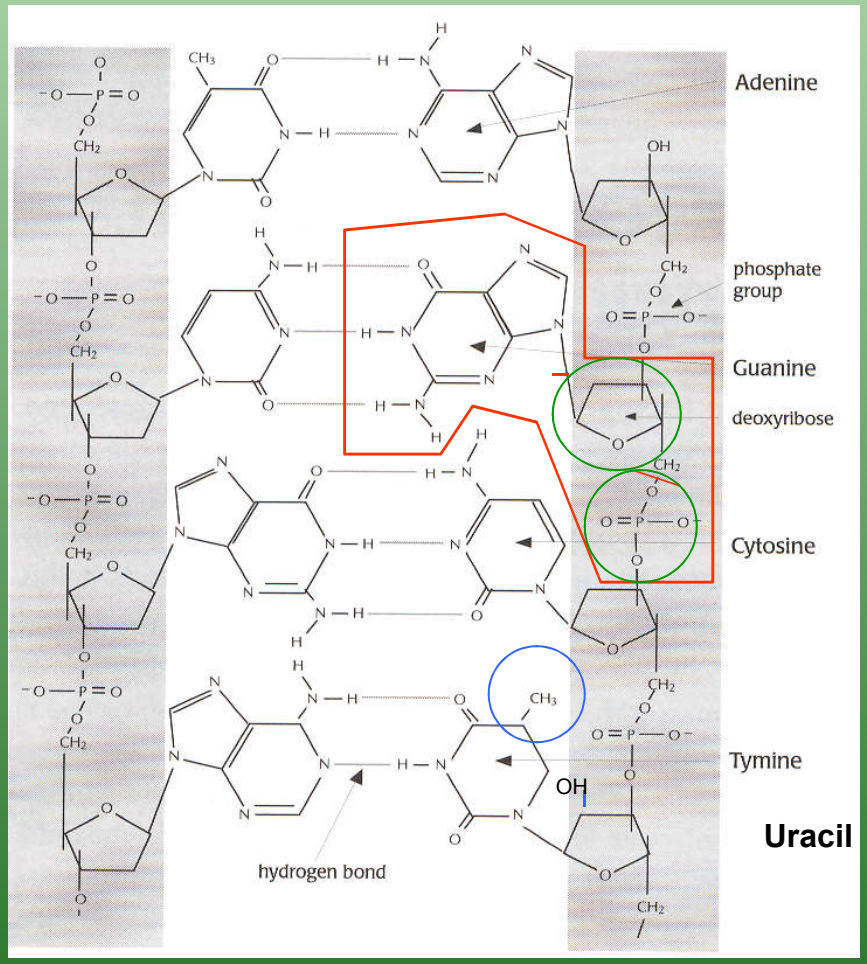
Kruhové molekuly

Chloroplastová:
veľkosť cca 120-180 kbp
100-120 génov
2 invertované opakované sekvencie

Mitochondriálna
veľkosť cca 300-600 kbp
(200-2500 kbp)
40-50 génov
časté opakované sekvencie



Gén – úsek na molekule DNA

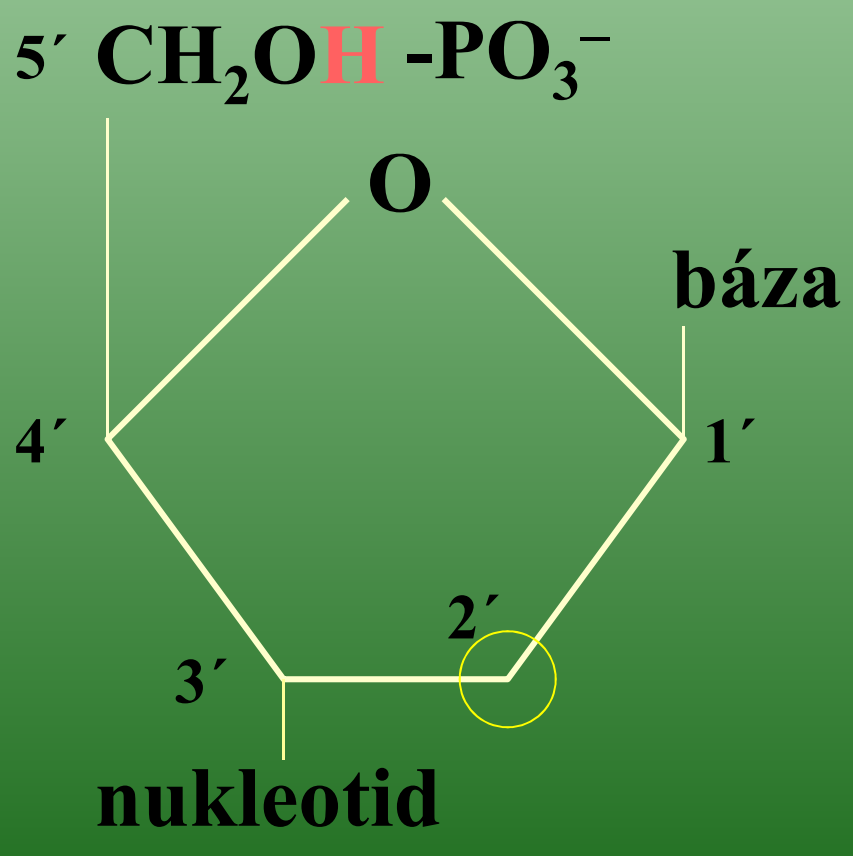


(deoxy)nukleotid =

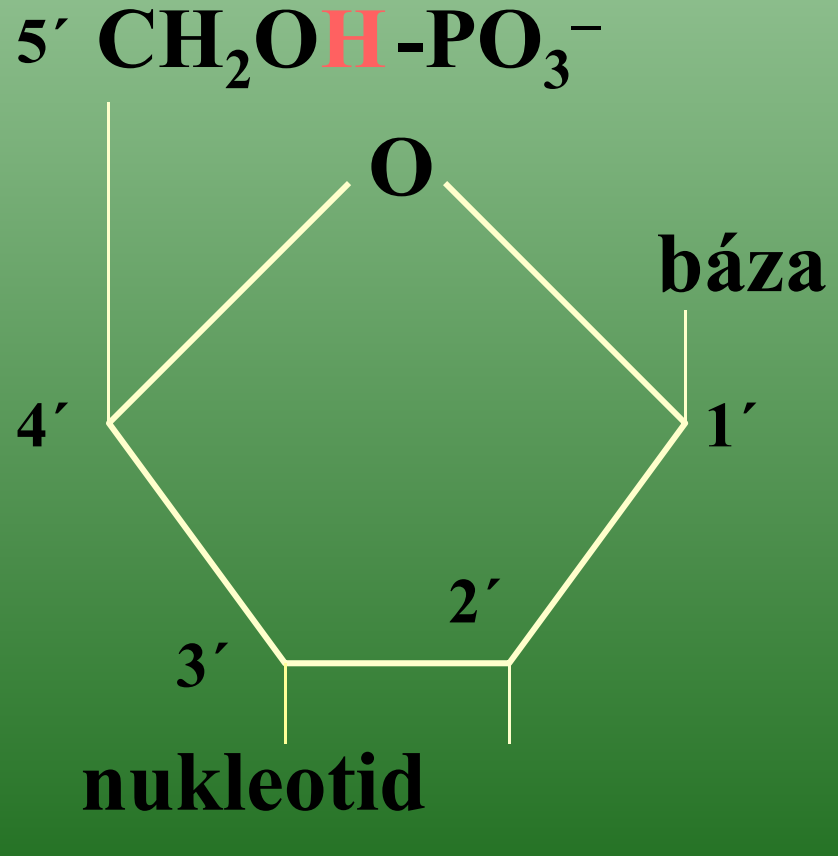
- (deoxy)ribóza +
- PO_3^- +
- heterocyklická báza (adenín, guanín cytozín, tymín/ uracil)

RNA

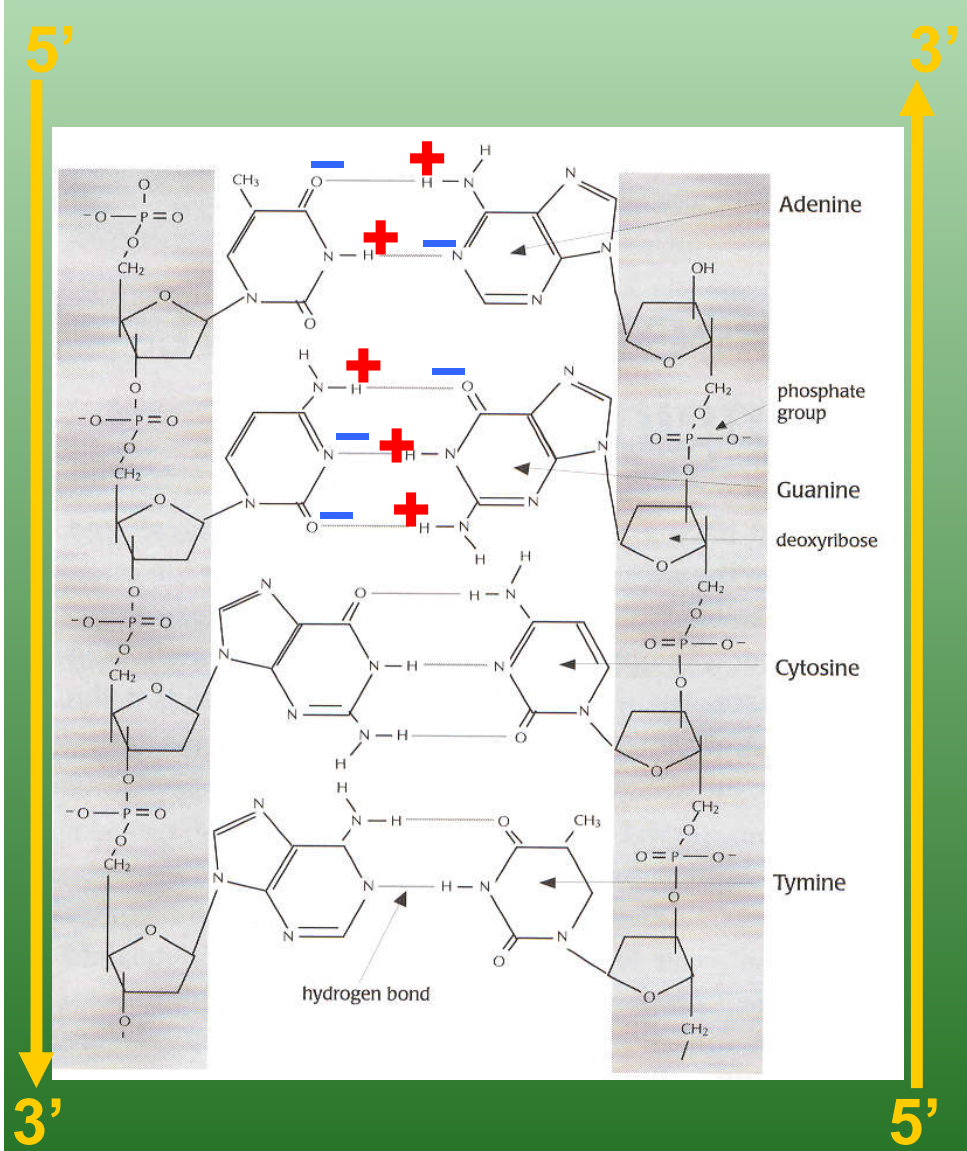
2´-deoxyribóza



ribóza

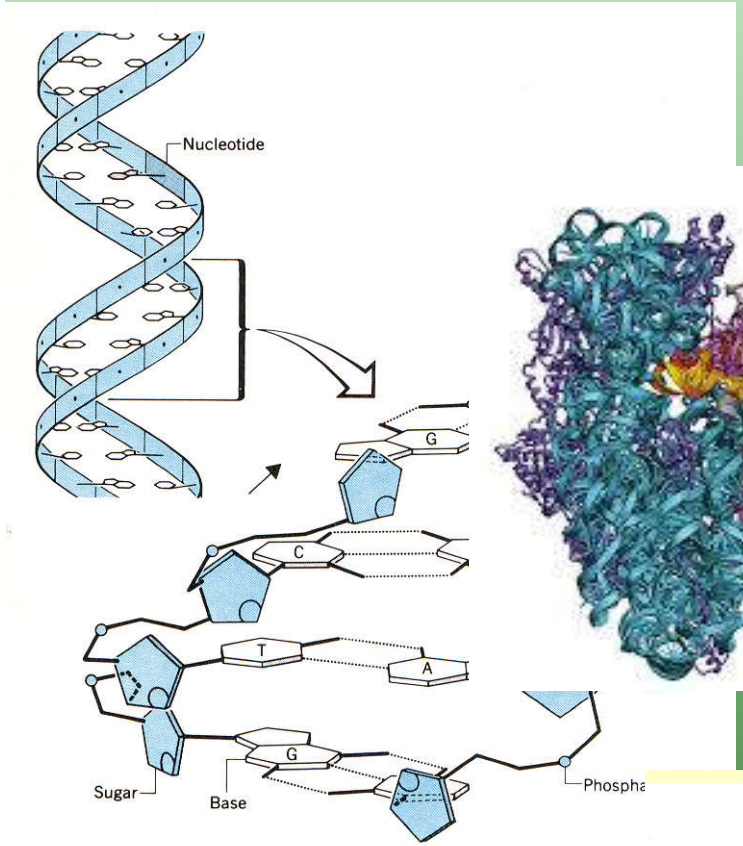


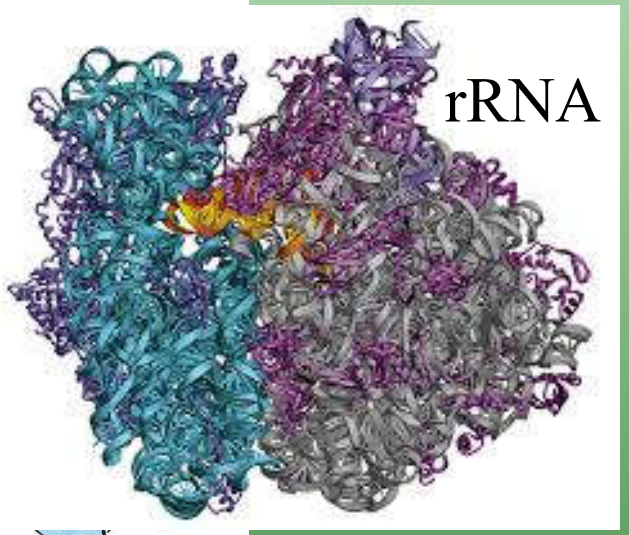
Gén – úsek na molekule DNA

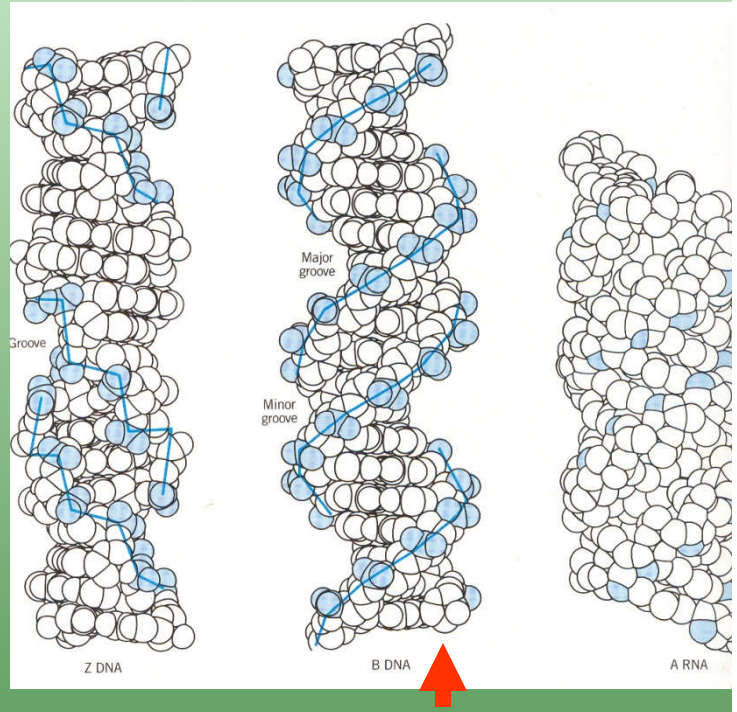


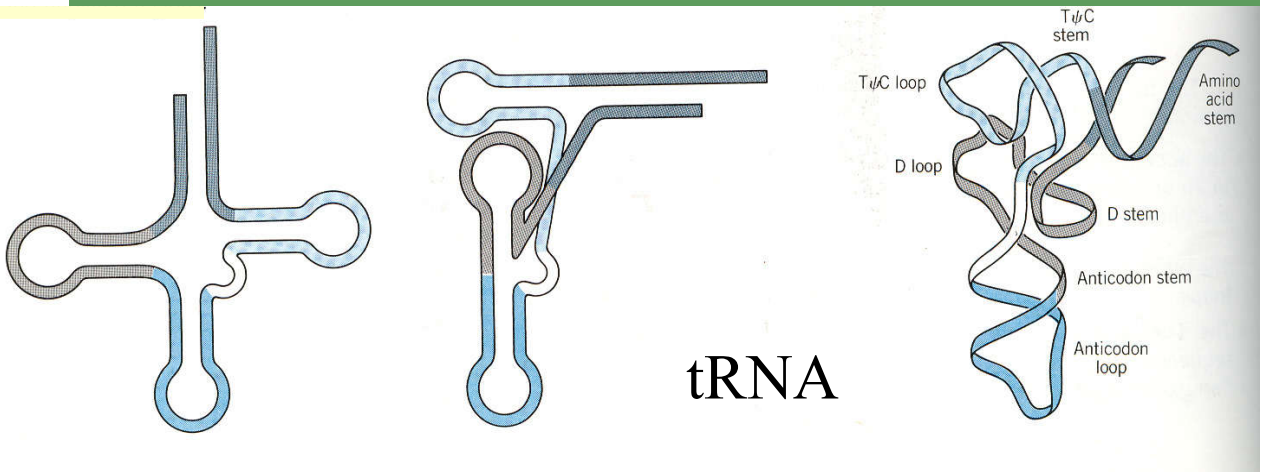
antiparalelná orientácia reťazcov

3D štruktúra nukleových kyselín



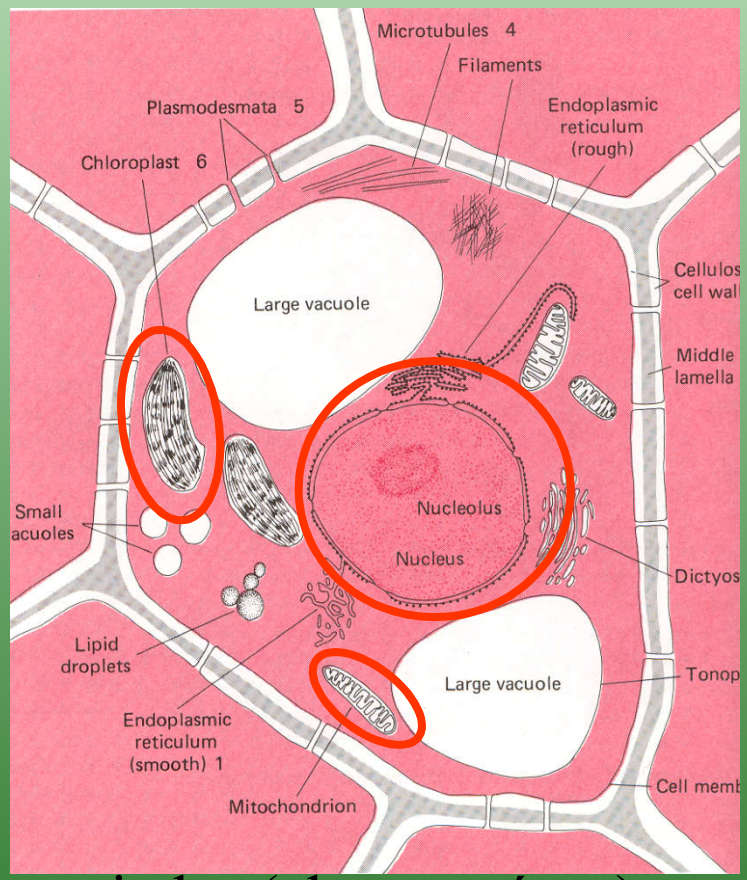






Kde v bunke nájdeme DNA?

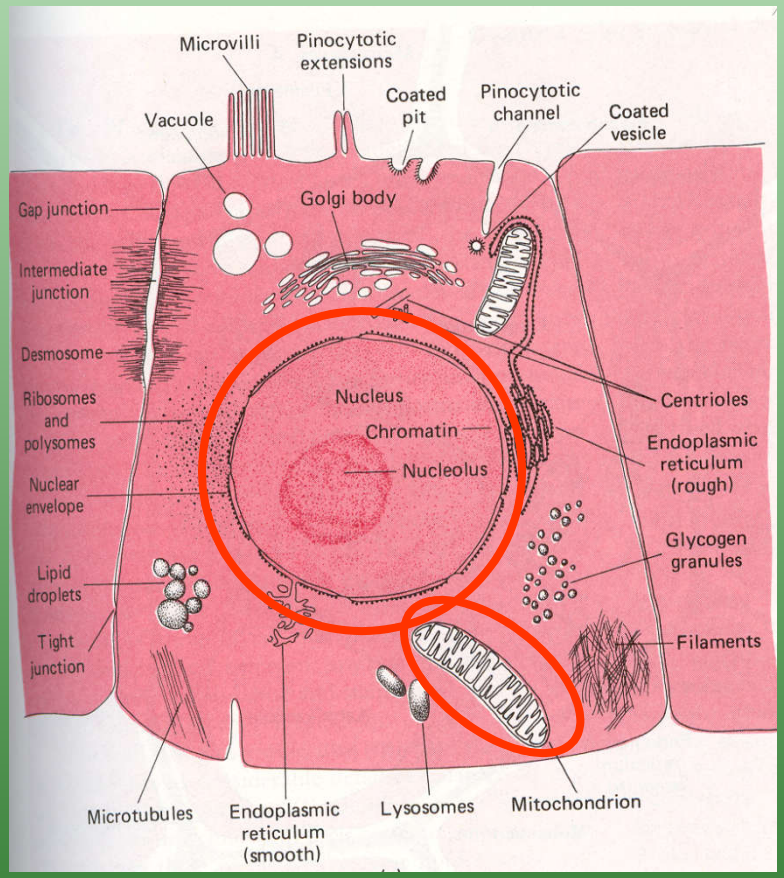
Rastlinná bunka



jadro (chromozómy)
mitochondrie
chloroplasty

vírusy

Živočíšna bunka



jadro (chromozómy)
mitochondrie

endoparazity (endosymbionty)

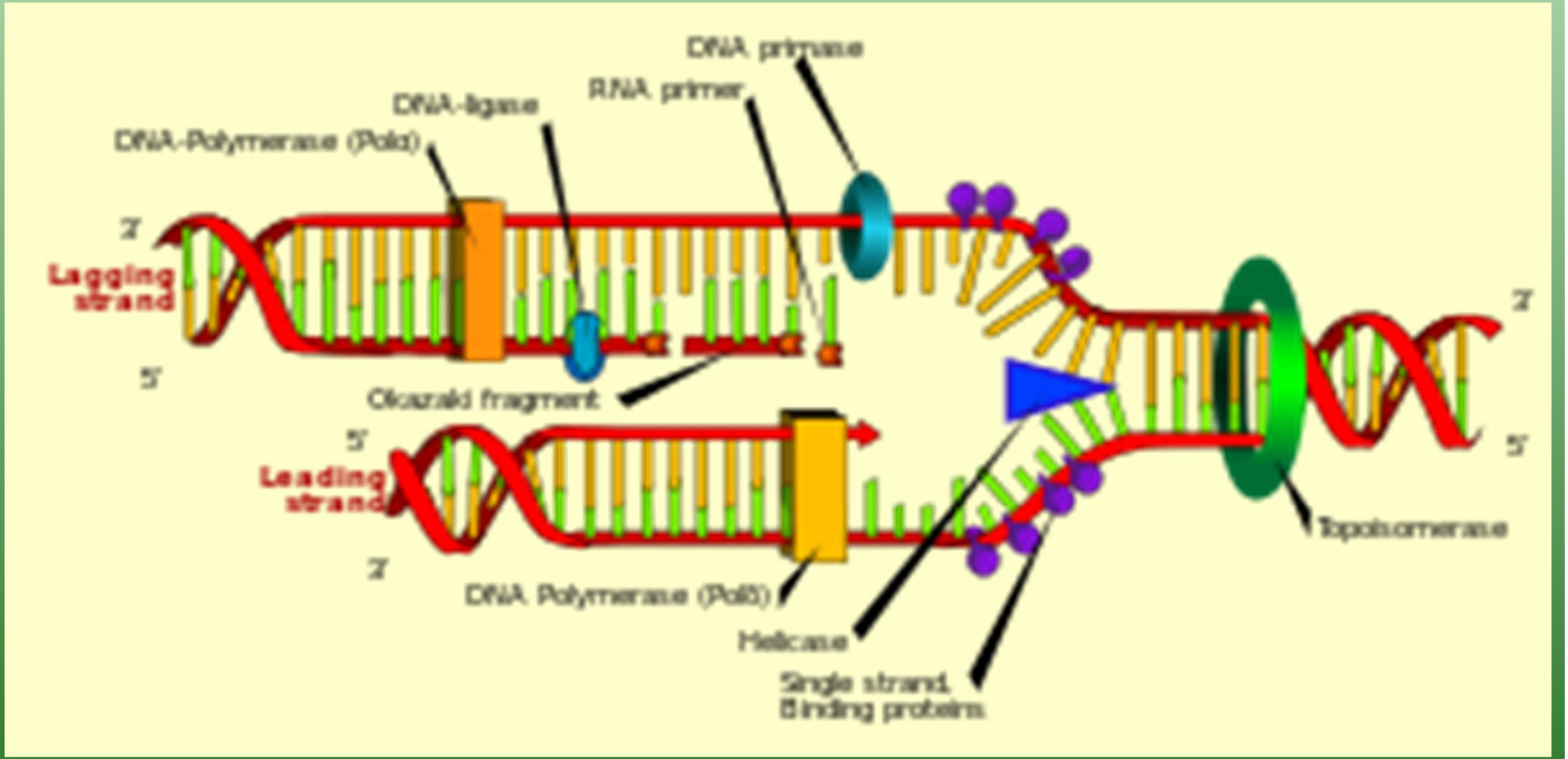
Kde v bunke nájdeme DNA?

Rastlinná bunka Živočíšna bunka

Charakteristiky genómu smreka obyčajného	
Veľkosť haploidného genómu	19,6 Gbp
Karyotyp	2n = 24
Obsah párov GC	37,9%
Podiel repetitívnych sekvencií	
LTR retrotranspozóny, z toho	
Gypsy	35%
Copia	16%
ostatné	7%
LINE retrotranspozóny	1%
DNA transpozóny	1%
Ostatné	10%
Podiel sekvencií génov	2,4%

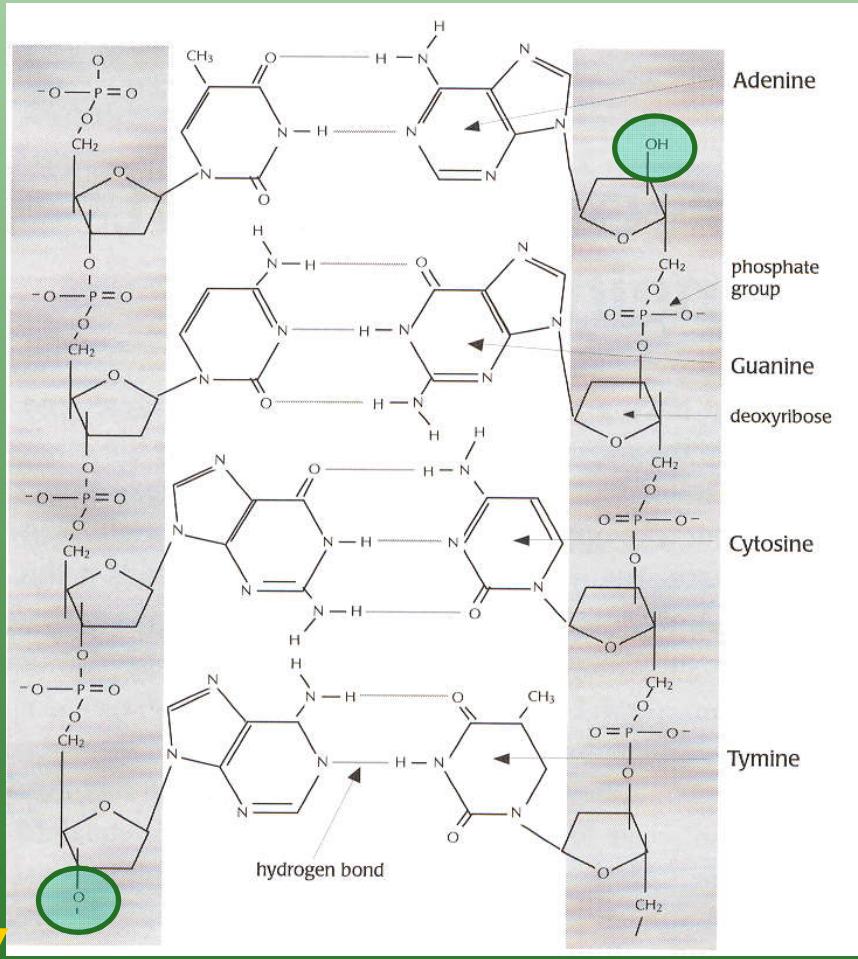
Organizmus	Typ	Veľkosť genómu (bp)	Odhadovaný počet génov
Bakteriofág λ	vírusy	48500	50
Escherichia coli	baktérie	$4,6.10^{6}$	4300
Saccharomyces cerevisae	huby	$1,3.10^{7}$	6200
Aspergillus fumigatus		$1,58.10^{7}$	14000
Caenorhabditis elegans	živočíchy	$9,7.10^{7}$	19000
Drosophila melanogaster		$1,8.10^{8}$	13600
Mus musculus		$2,7.10^{9}$	22-30000
Homo sapiens		$2,9.10^{9}$	28-35000
Protopterus aethiopicus		$1,3.10^{11}$	
Arabidopsis thaliana	rastliny	$1,25.10^{9}$	25500
Populus trichocarpa		$4,85.10^{8}$	45000
Zea mays		$2,2.10^{9}$	42-56000
Triticum aestivum		$1,6.10^{10}$	107000
Pinus sylvestris		$2,5.10^{10}$	30000
Psilotum nudum		$2,5.10^{11}$	

Replikácia DNA – vytváranie kópií molekúl DNA



5’

3’


Adenine
phosphate group
Guanine
deoxyribose
Cytosine
Tymine
hydrogen bond

3’

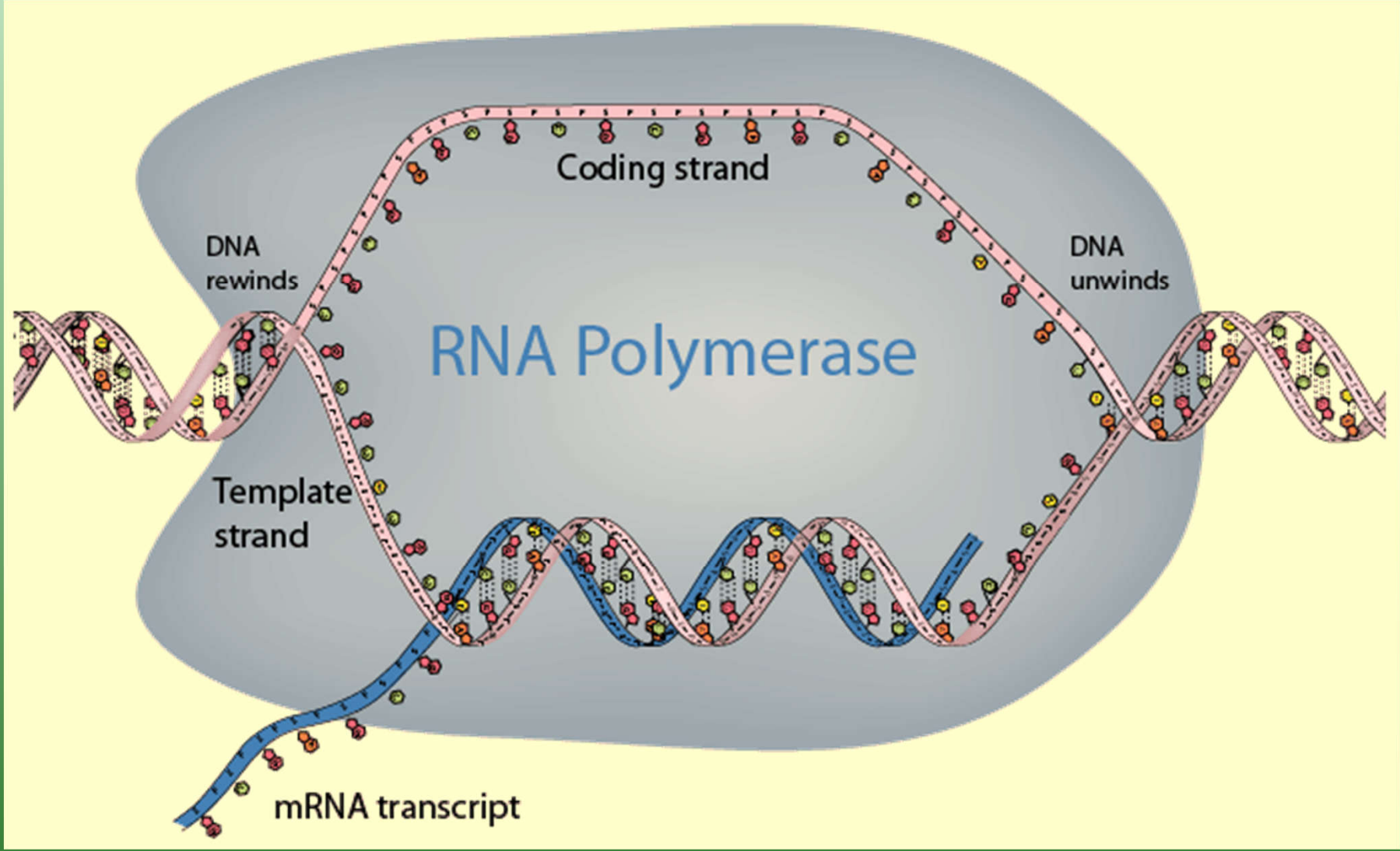
5’

Expresia génu – „prevod“ do fenotypu

prepis (transkripcia): DNA → mRNA, tRNA, rRNA

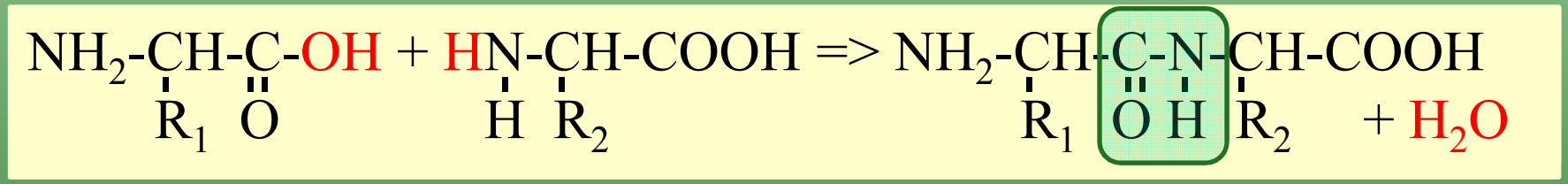
preklad (translácia): mRNA → polypeptid (bielkovina)

Prepis – transkripcia



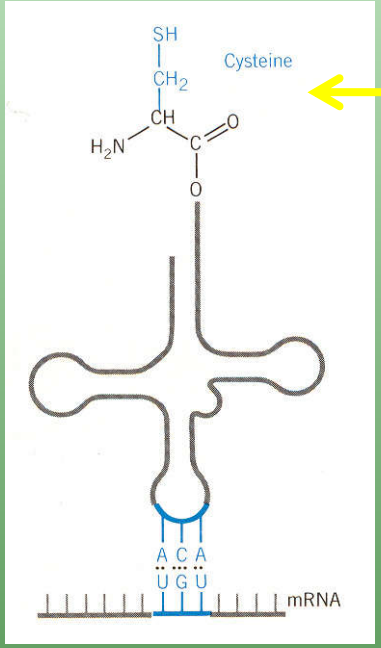
Translácia

Syntéza bielkovín (polypeptidov) z aminokyselín na základe informácie v mRNA

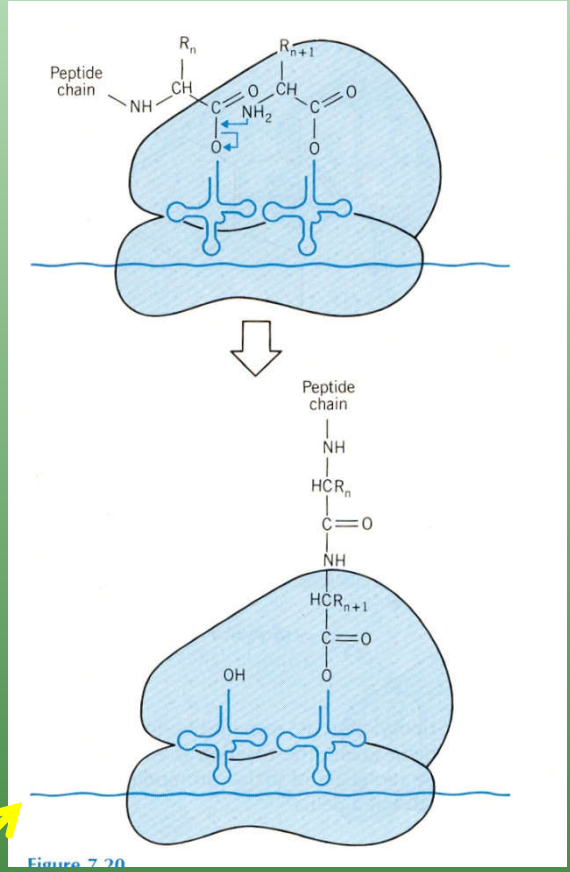


Translácia

ribozóm



aminokyselina

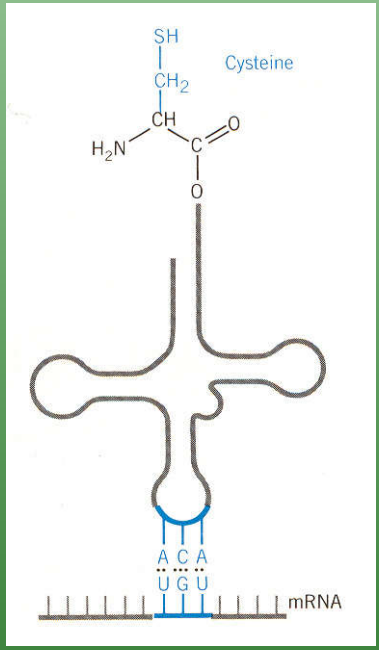


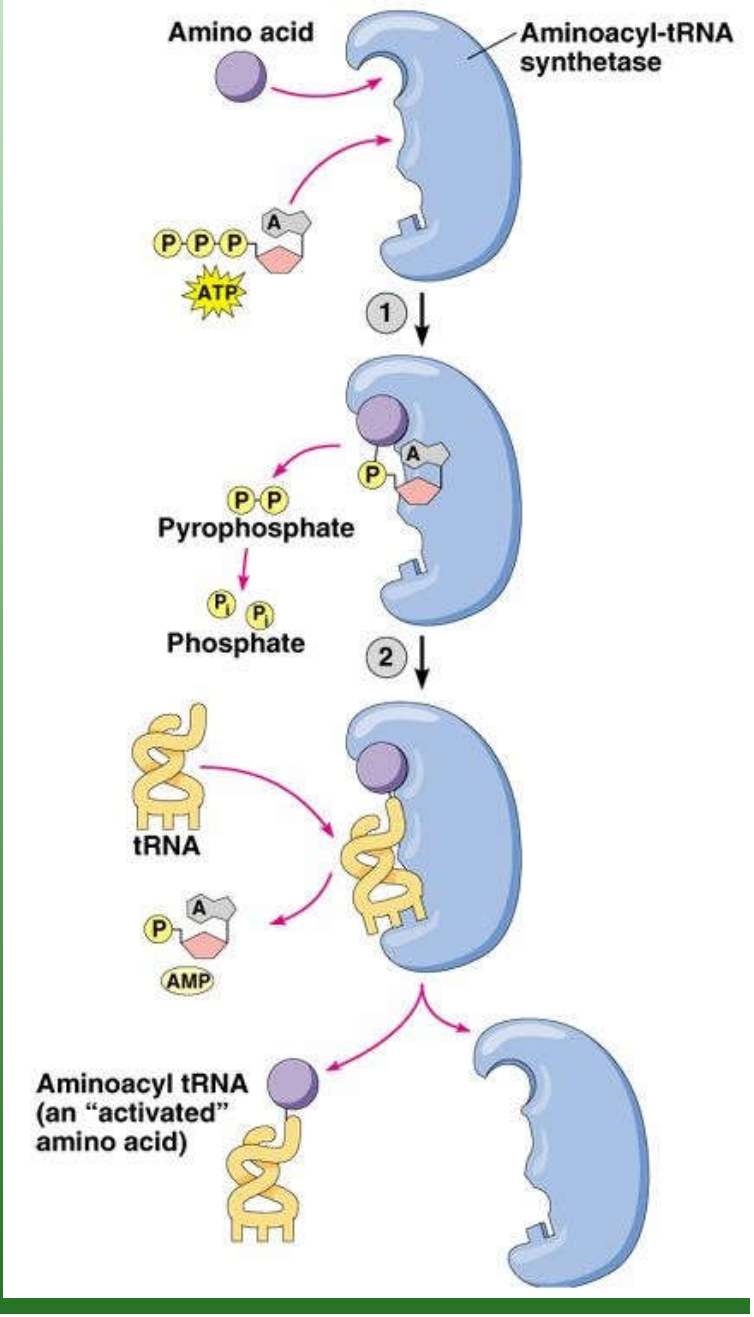
transferová RNA

mediátorová RNA

Translácia

párovanie tRNA a aminokyseliny
aminoacyl-tRNA-syntetáza





Genetický kód

4^3 = 64 kombinácií

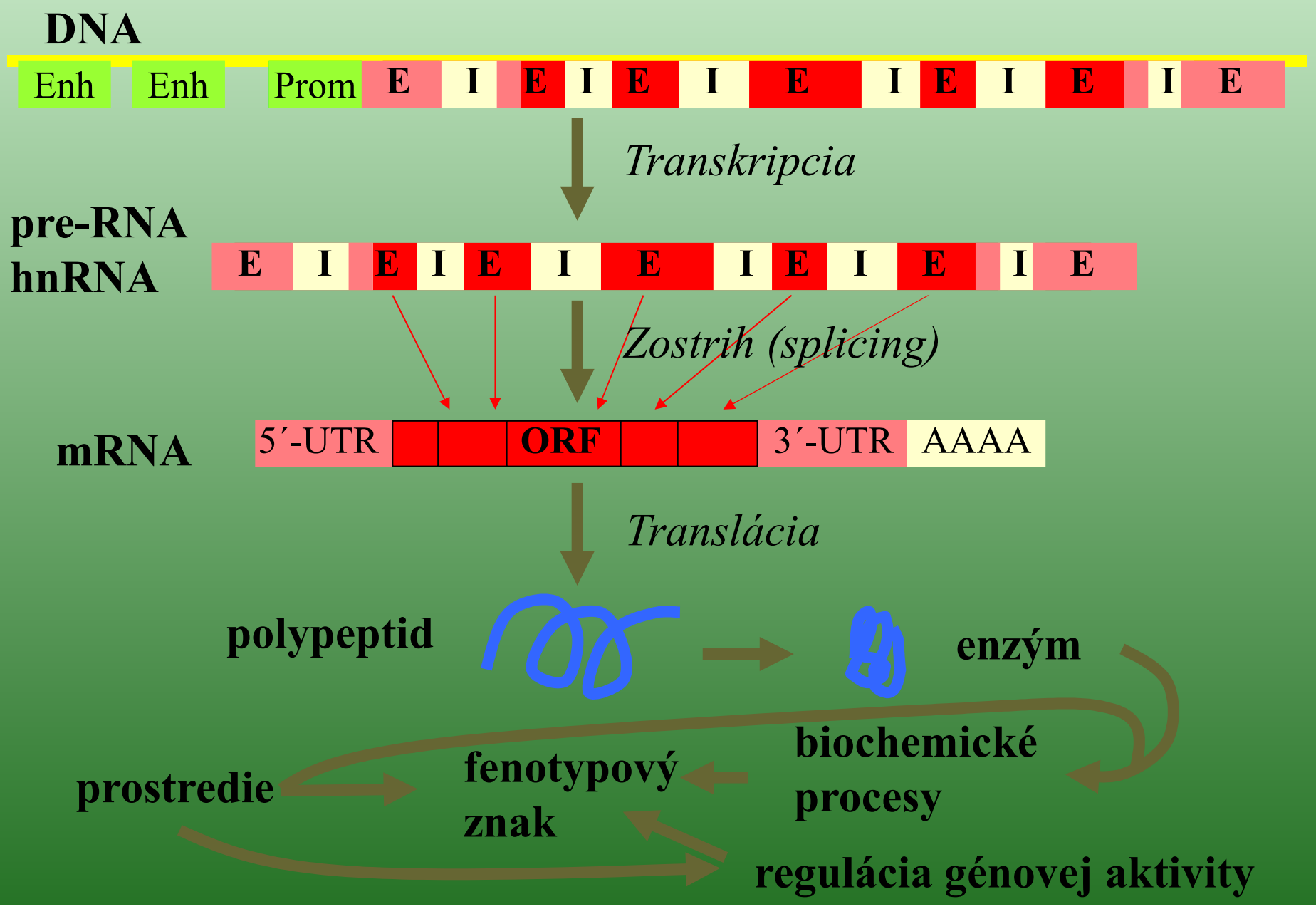
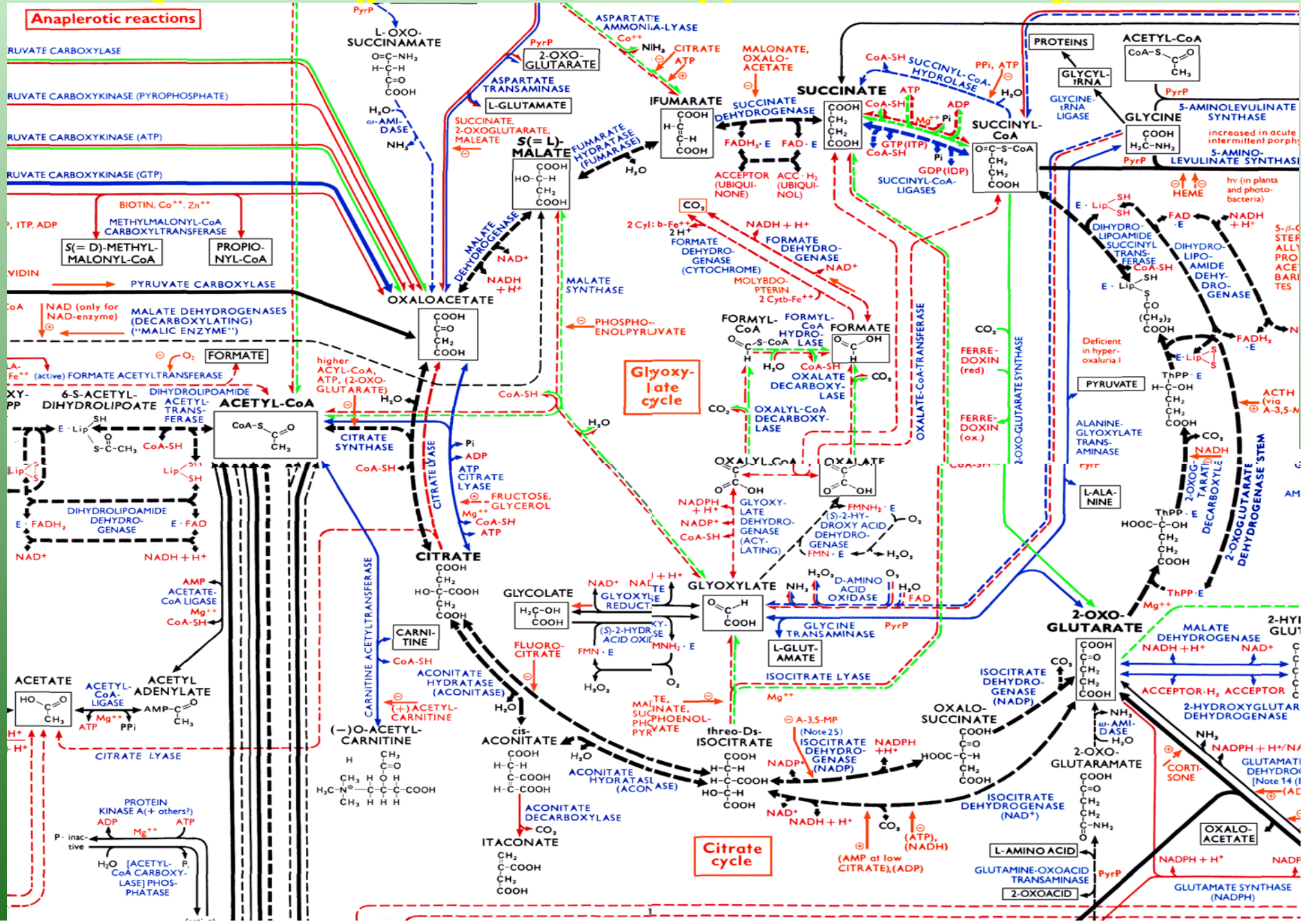
2

1

3

	U	C	A	G	
U	Phe Phe Leu Leu	Ser Ser Ser Ser	Tyr Tyr STOP STOP	Cys Cys STOP Trp	U C A G
C	Leu Leu Leu Leu	Pro Pro Pro Pro	His His Gln Gln	Arg Arg Arg Arg	U C A G
A	Ile Ile Ile Met	Thr Thr Thr Thr	Asn Asn Lys Lys	Ser Ser Arg Arg	U C A G
G	Val Val Val Val	Ala Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	U C A G

Expresia jadrového génu eukaryotov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