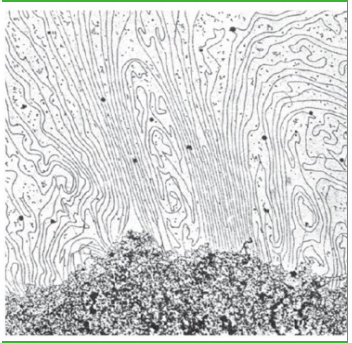
FACULTY
OF SCIENCE
Masaryk University

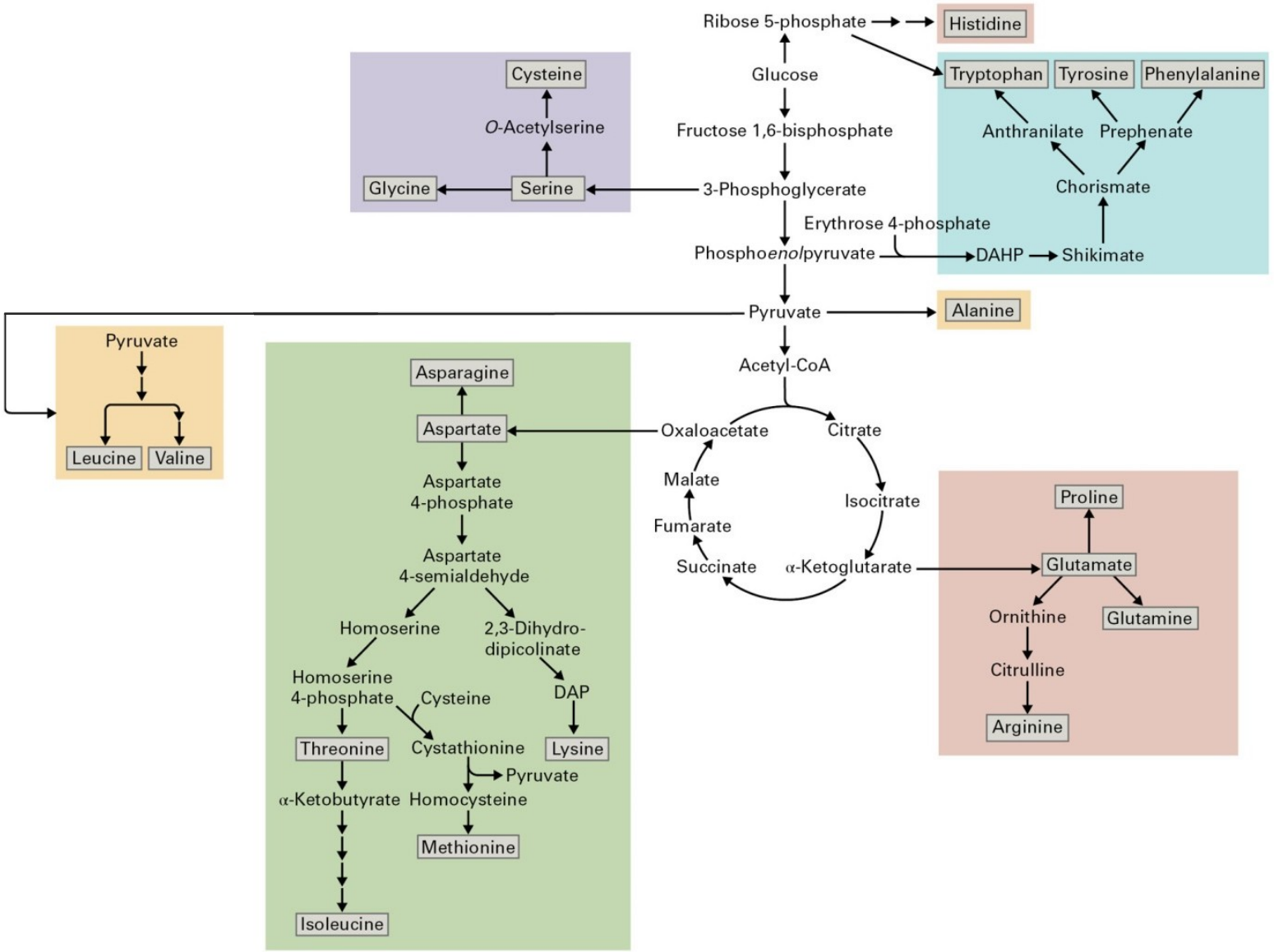


Genes and Proteins

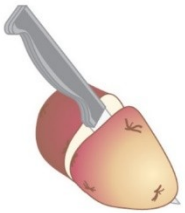
Katerina Dadakova, Department of Biochemistry

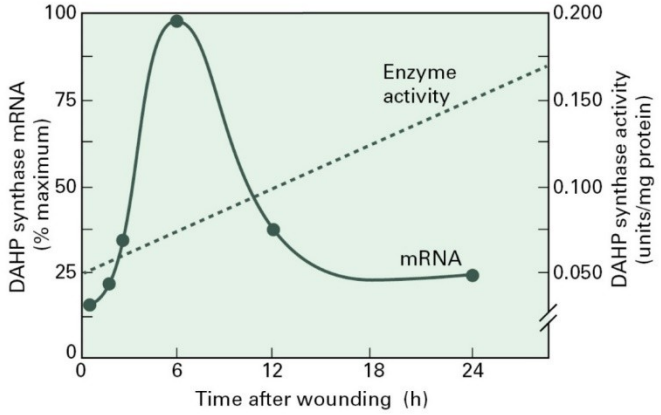
Figures adopted from Buchanan et al., Biochemistry & molecular biology of plants

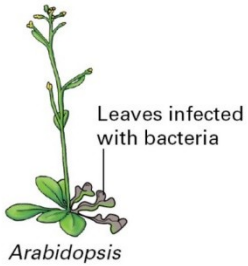
Amino acids

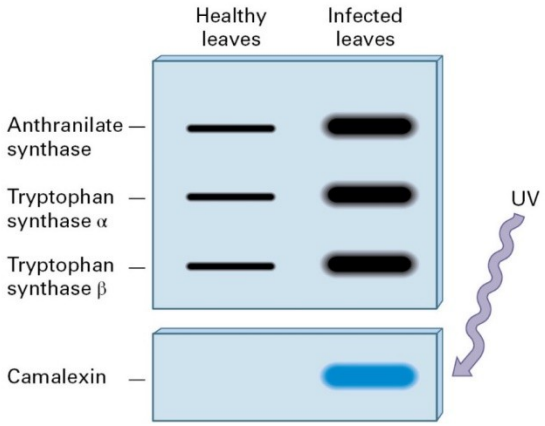

Ribose 5-phosphate
Histidine
Glucose
Cysteine
O-Acetylserine
Fructose 1,6-bisphosphate
Tryptophan
Tyrosine
Phenylalanine
Anthranilate
Prephenate
Glycine
Serine
3-Phosphoglycerate
Chorismate
Erythrose 4-phosphate
Phosphoenolpyruvate
DAHP
Shikimate
Pyruvate
Alanine
Pyruvate
Acetyl-CoA
Leucine
Valine
Asparagine
Aspartate
Oxaloacetate
Citrate
Aspartate 4-phosphate
Malate
Isocitrate
Fumarate
Proline
Aspartate 4-semialdehyde
Succinate
α-Ketoglutarate
Glutamate
Homoserine
2,3-Dihydro-dipicolinate
Ornithine
Glutamine
Homoserine 4-phosphate
Cysteine
DAP
Citrulline
Threonine
Cystathionine
Lysine
Arginine
Pyruvate
α-Ketobutyrate
Homocysteine
Methionine
Isoleucine

Aromatic amino acids

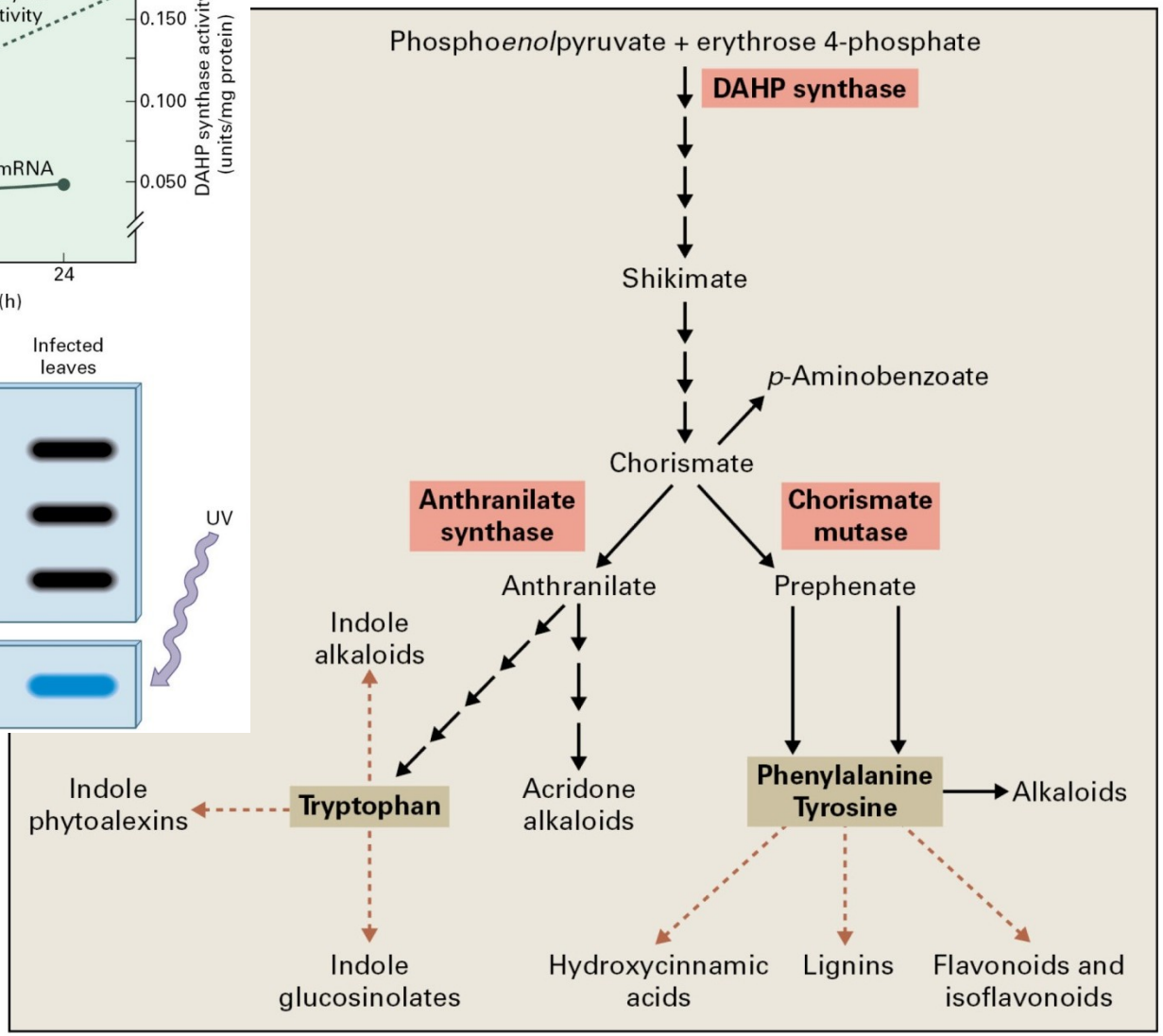




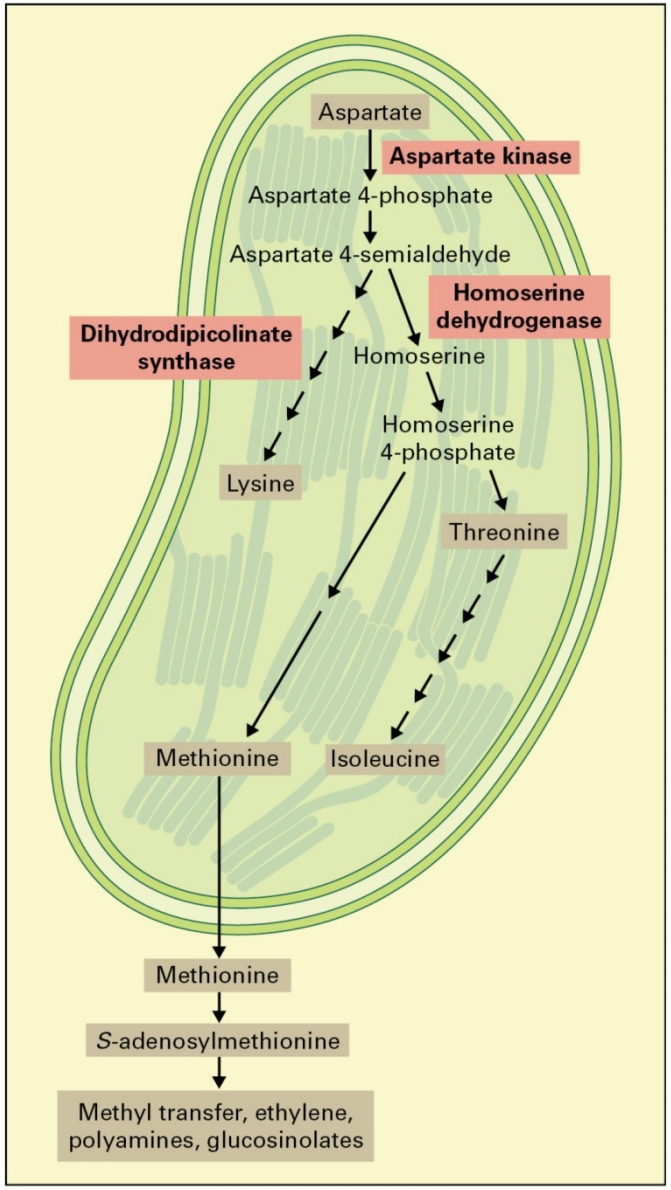


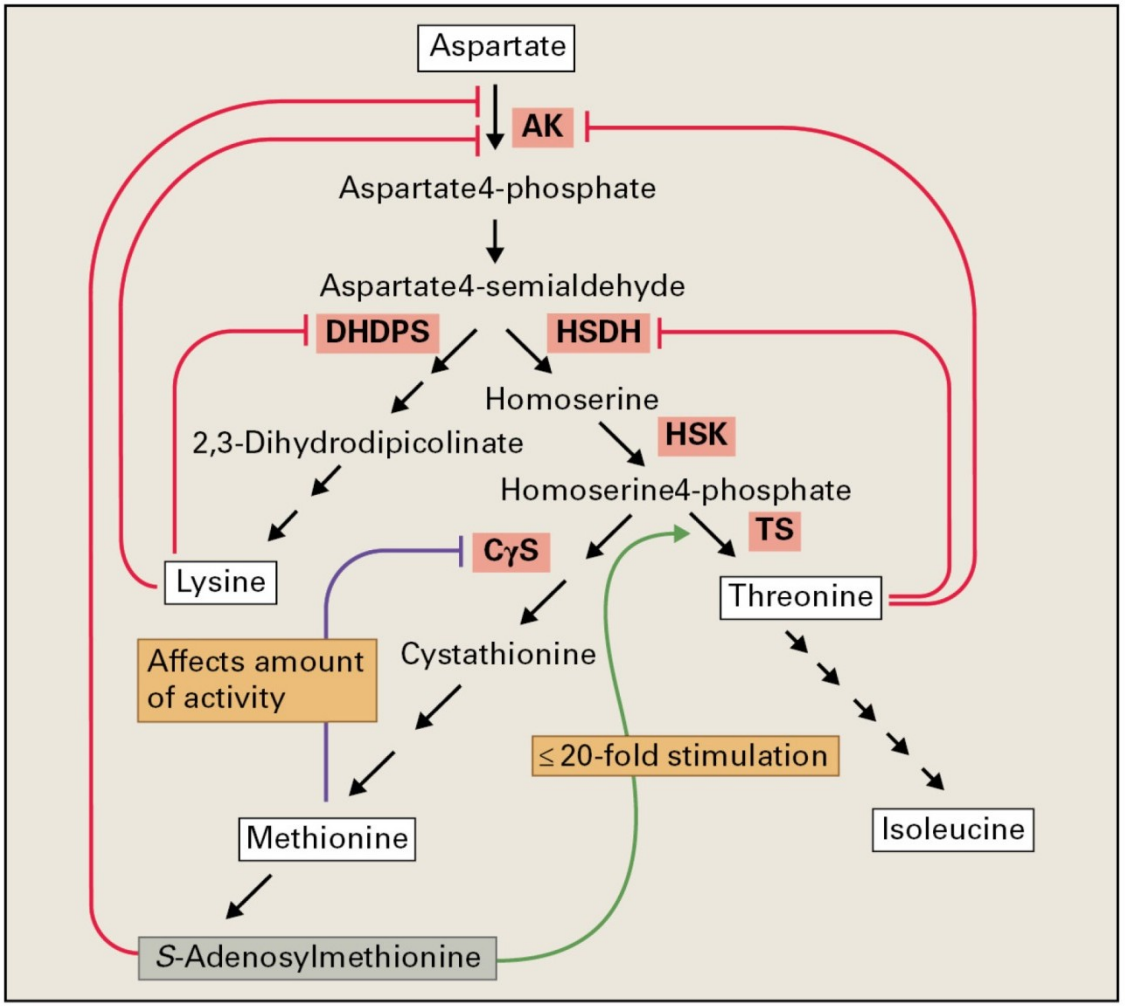


Synthesis of aromatic amino acids



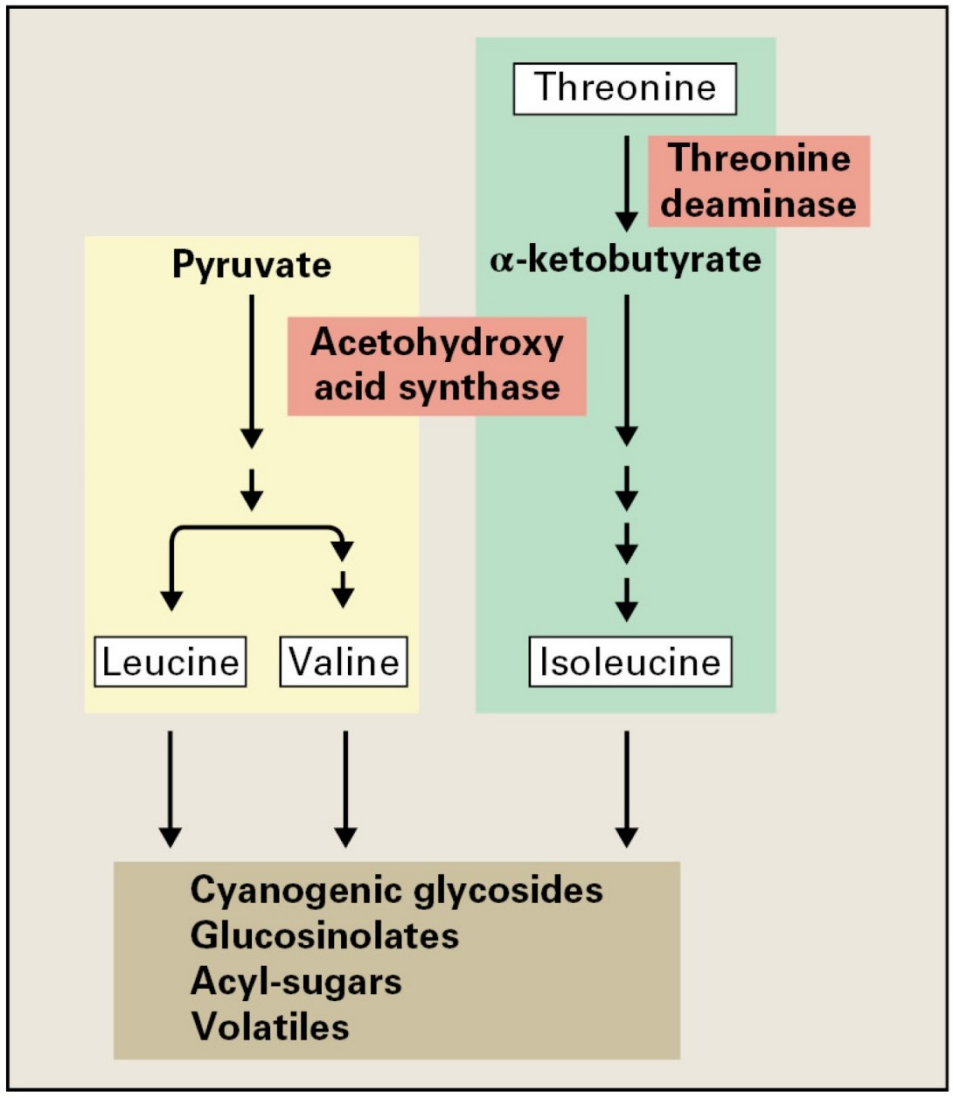
Aspartate-derived amino acids



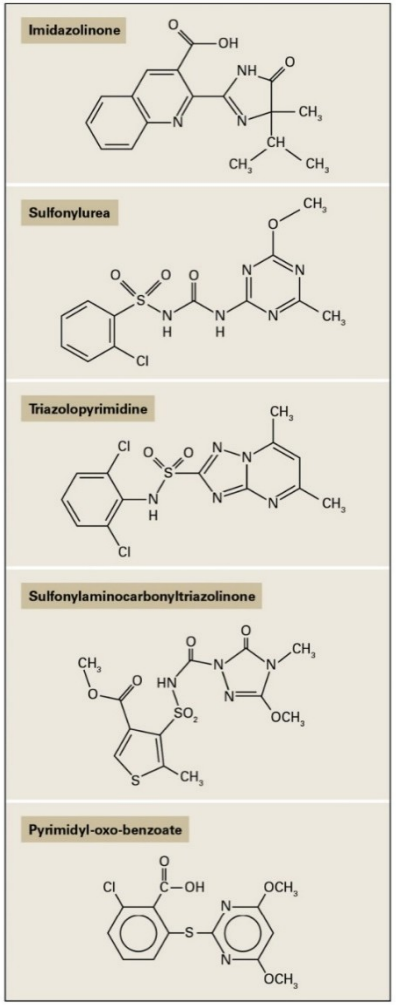


Regulation of threonine, lysine, and methionine synthesis

Branched-chain amino acids

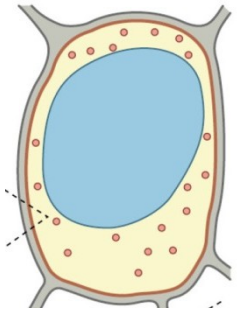


Examples of herbicides that inhibit acetohydroxyacid synthase

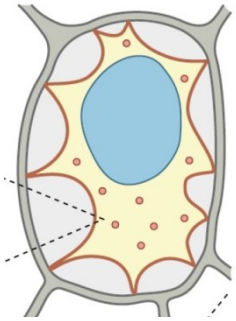


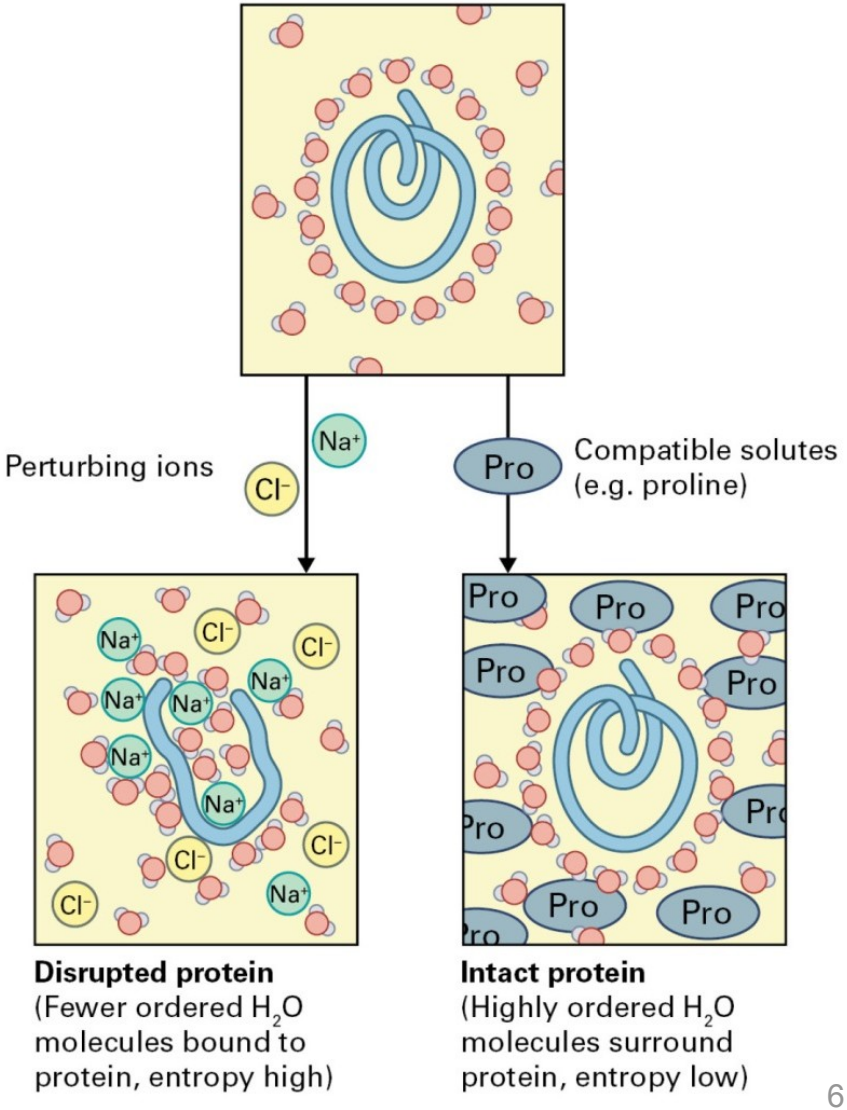
Glutamate-derived amino acids

Osmotic adjustment

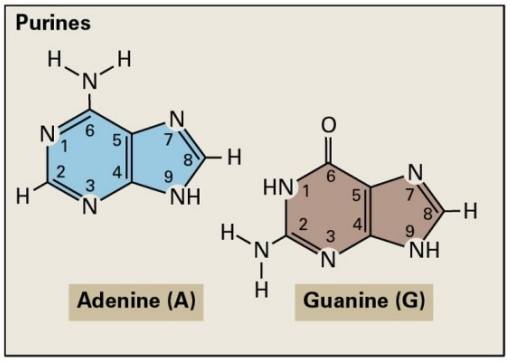


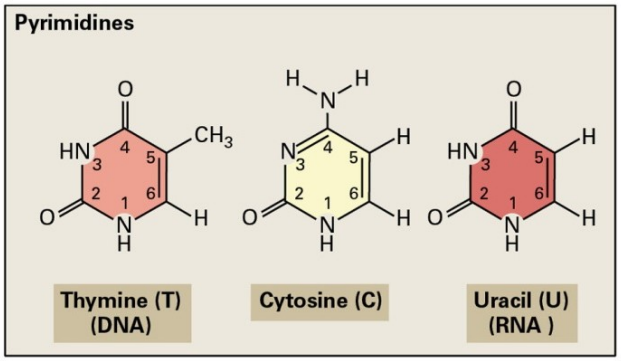
No osmotic adjustment



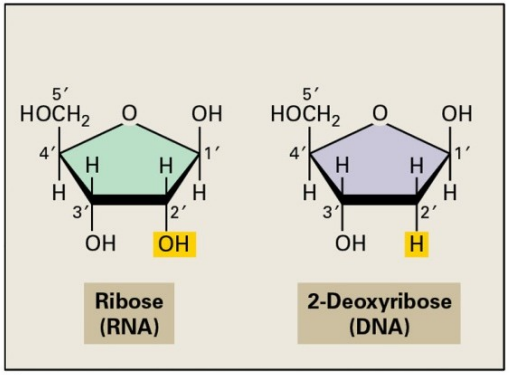


Nucleic acids

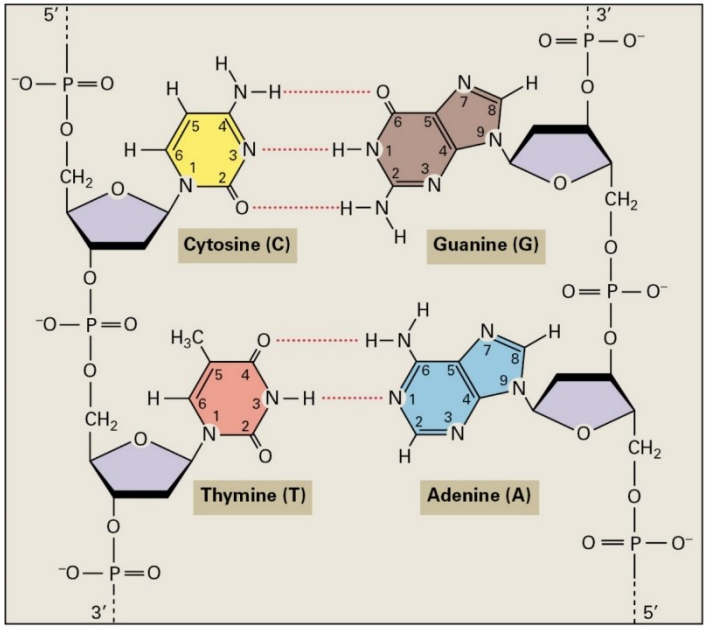


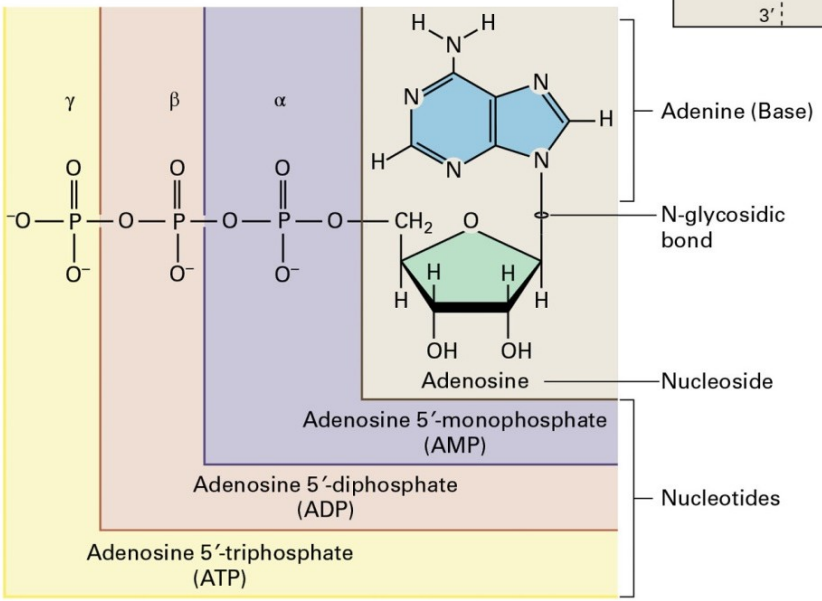


A Bases



B Pentose sugars

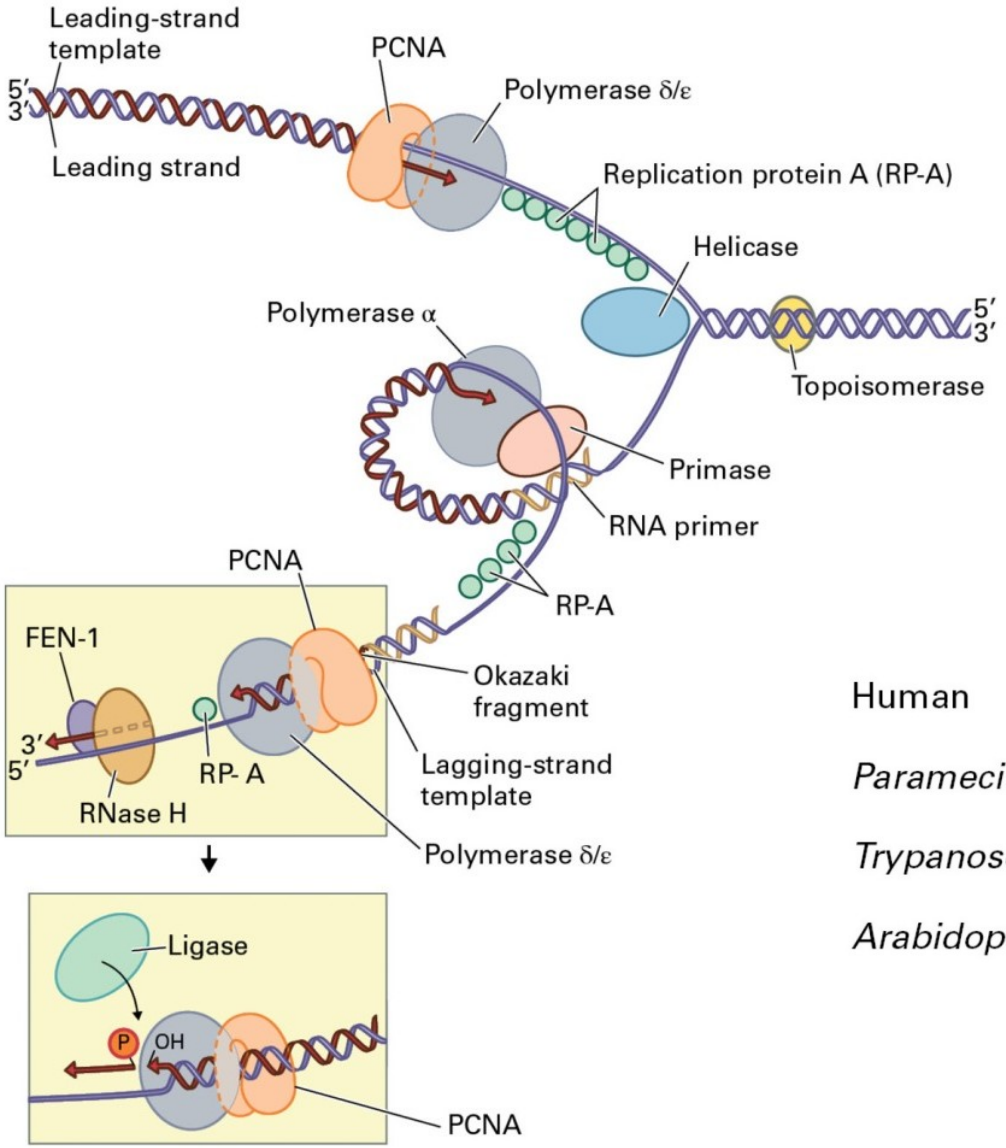




C A ribonucleotide (ribonucleoside phosphate)

The chemical composition of nucleic acids

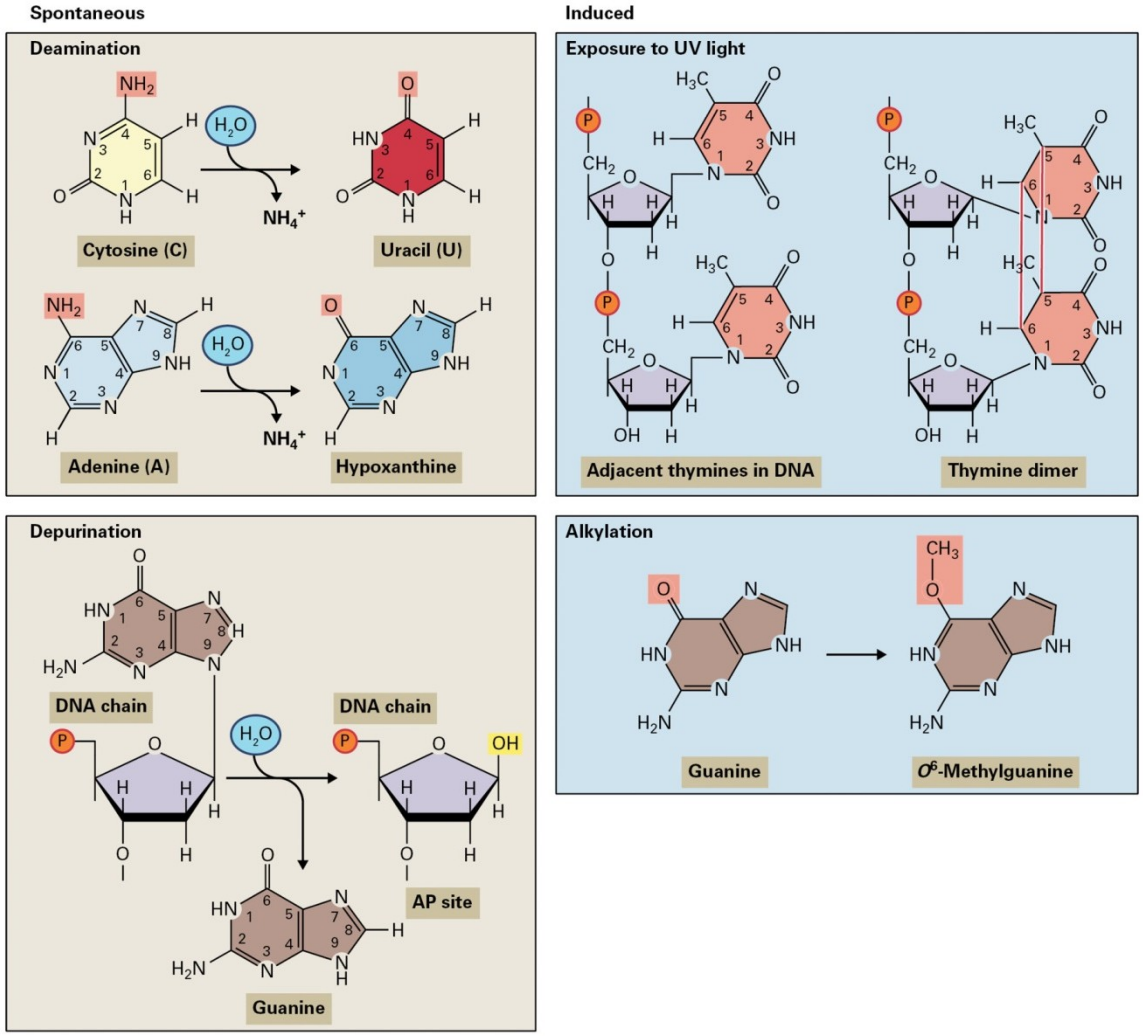
Replication of nuclear DNA

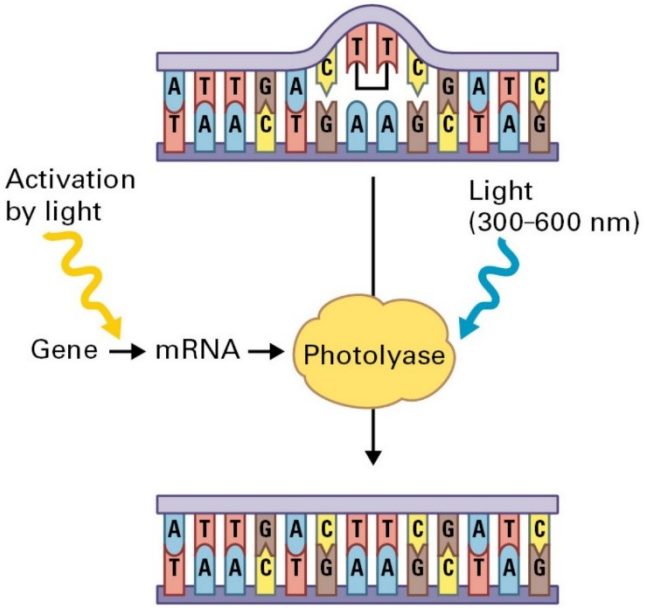


Telomere sequences are conserved

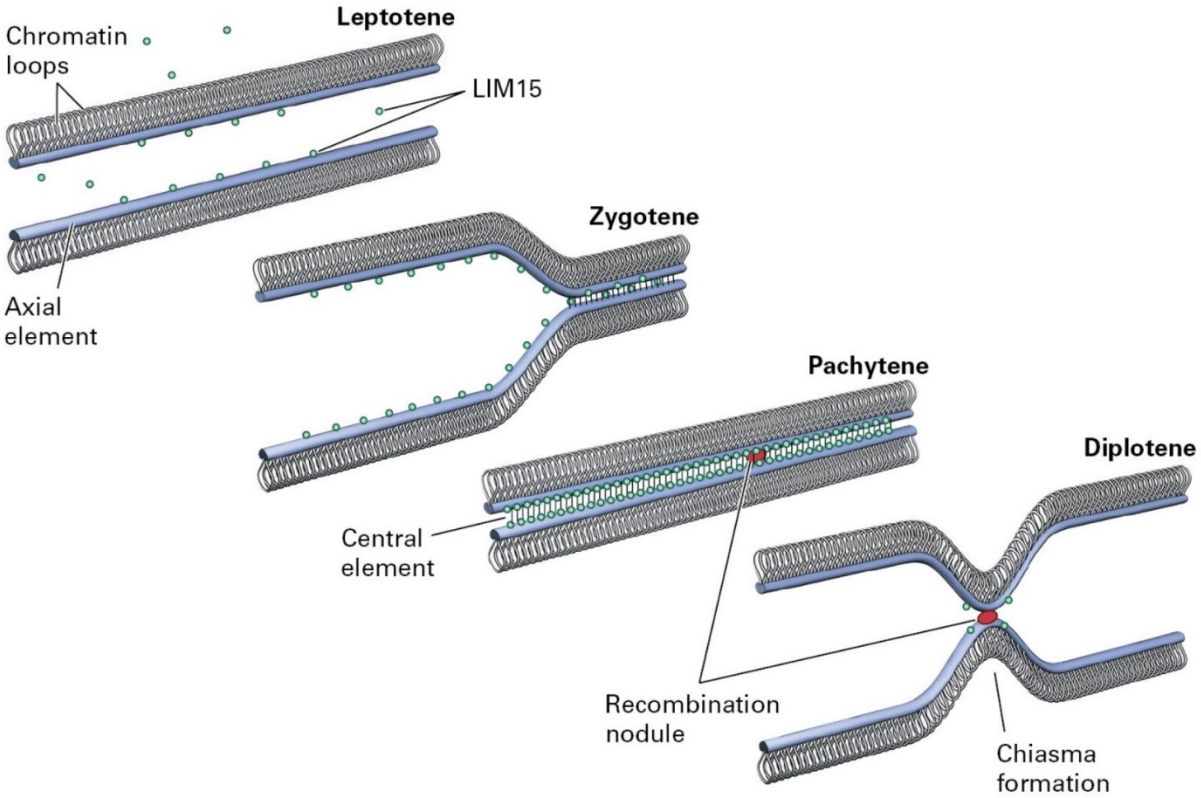
Human	TTAGGGTTAGGGTTAGGGTTAGGG
Paramecium	TTGGGGTTGGGGTTGGGGTTGGGG
Trypanosoma	TTAGGGTTAGGGTTAGGGTTAGGG
Arabidopsis	TTTAGGGTTTAGGGTTTAGGG

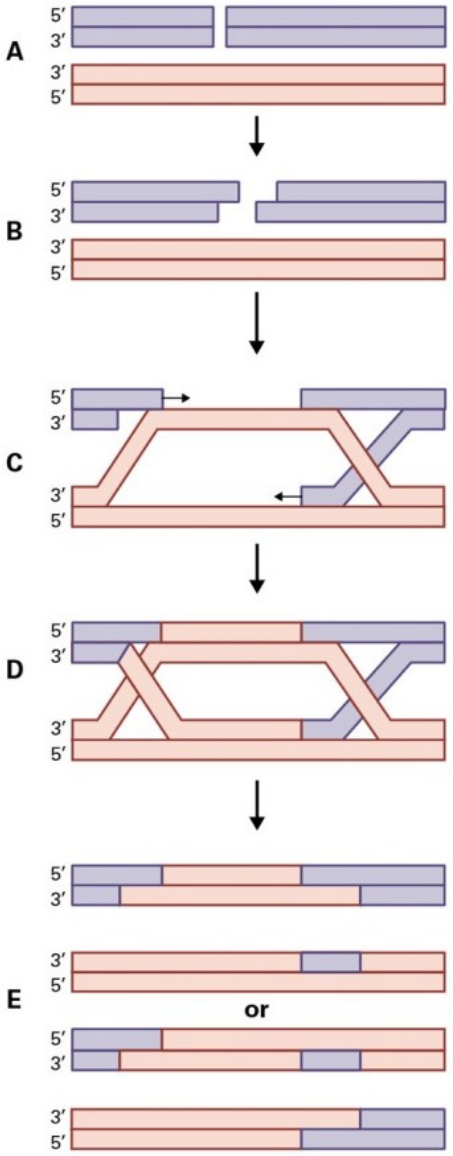
DNA repair


Spontaneous
Deamination
Cytosine (C)
Uracil (U)
Adenine (A)
Hypoxanthine
Depurination
DNA chain
DNA chain
AP site
Guanine
Induced
Exposure to UV light
Adjacent thymines in DNA
Thymine dimer
Alkylation
Guanine
O6-Methylguanine

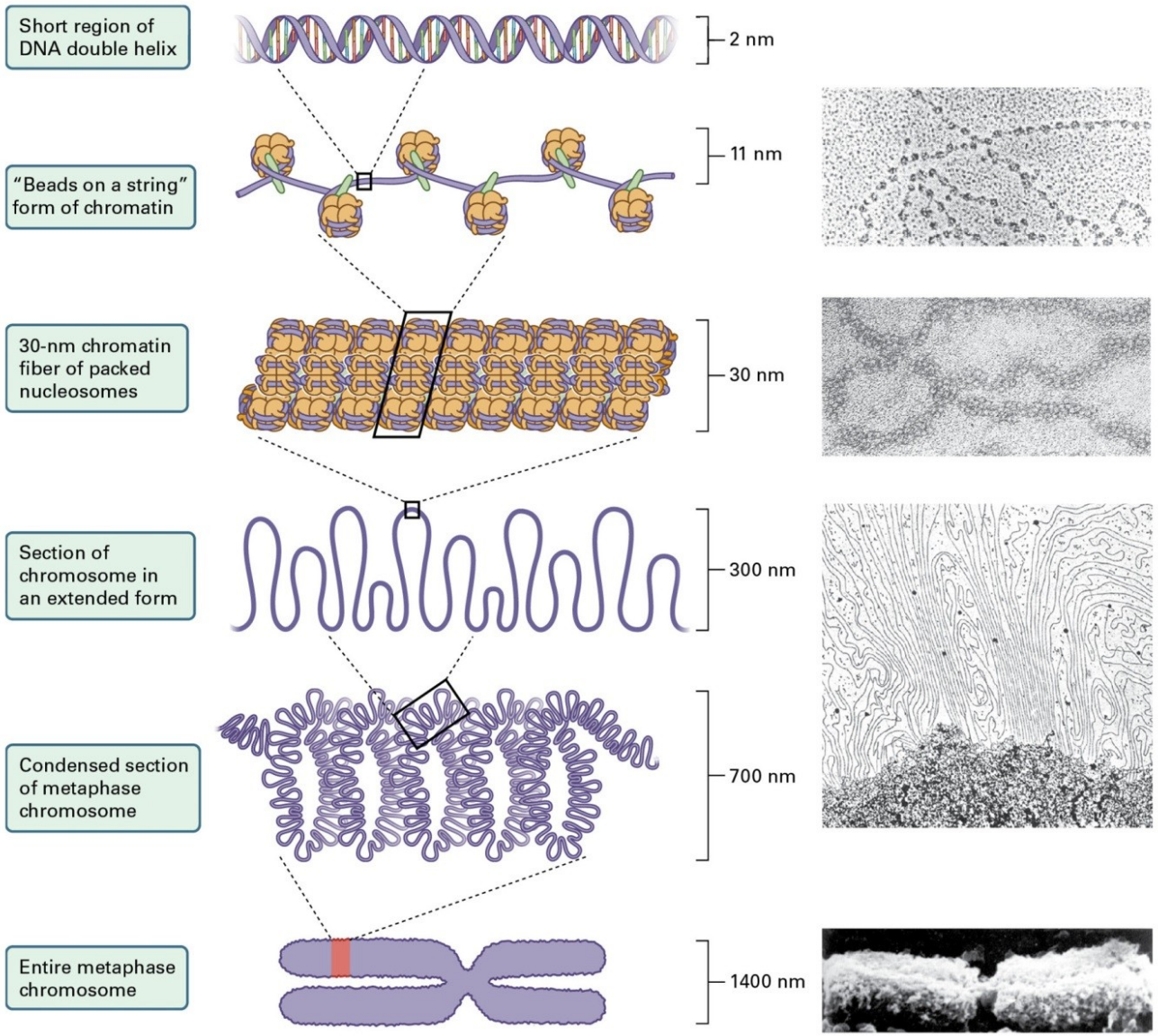

Activation by light
Light (300–600 nm)
Gene
mRNA
Photolyase

DNA recombination

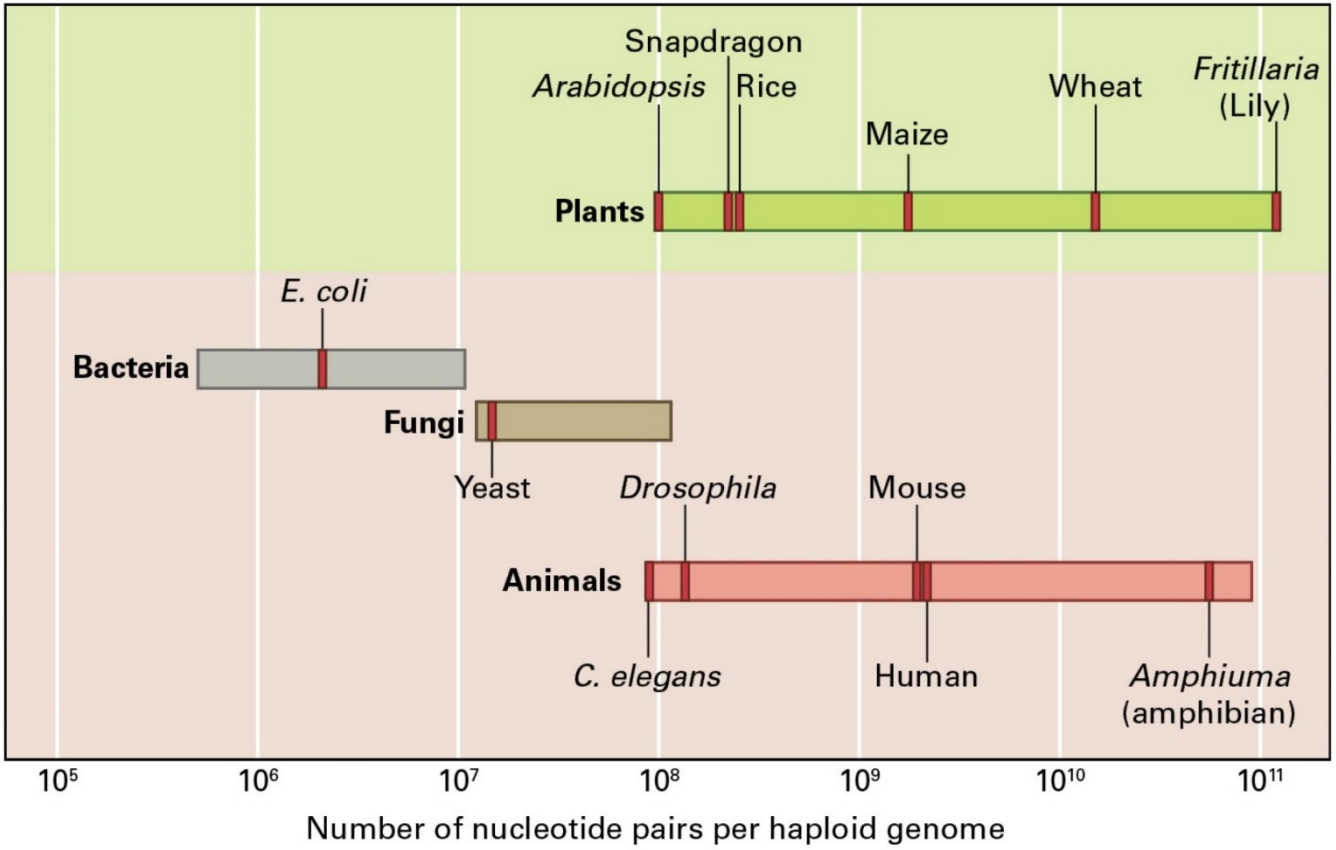


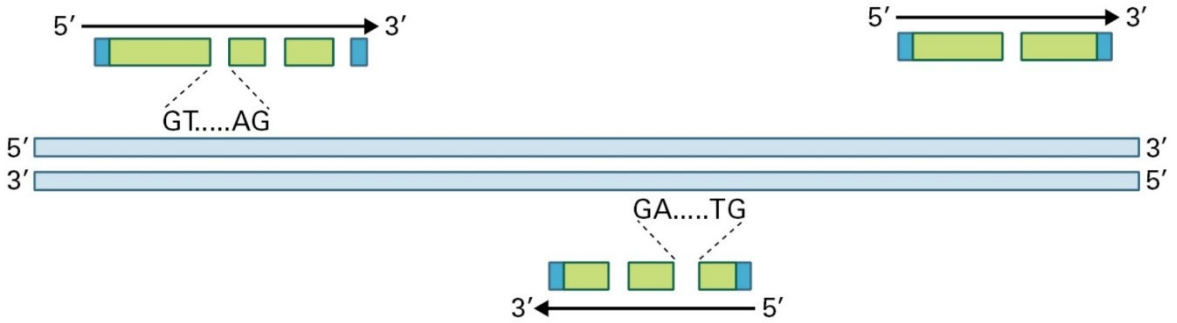


Structure and organization of nuclear genome



Structure and organization of nuclear genome

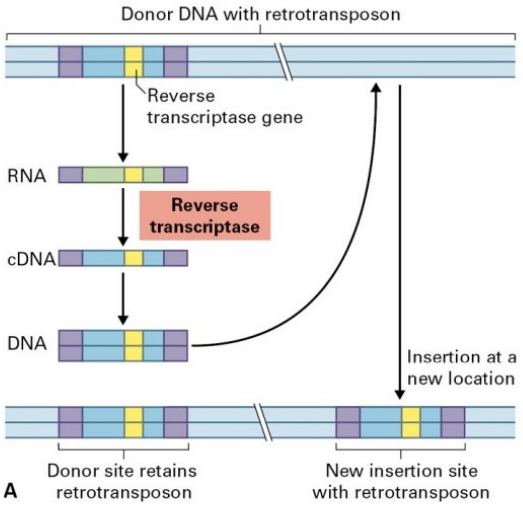




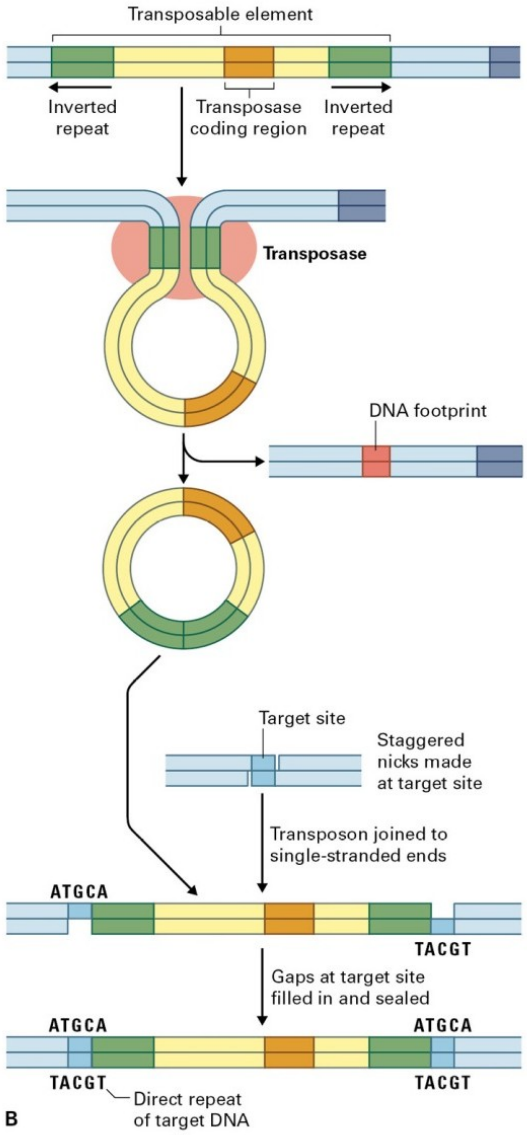
Genes are found on either DNA strand, but rarely in the same region on both strands.

Transposable elements

Mechanism of retrotransposon transposition



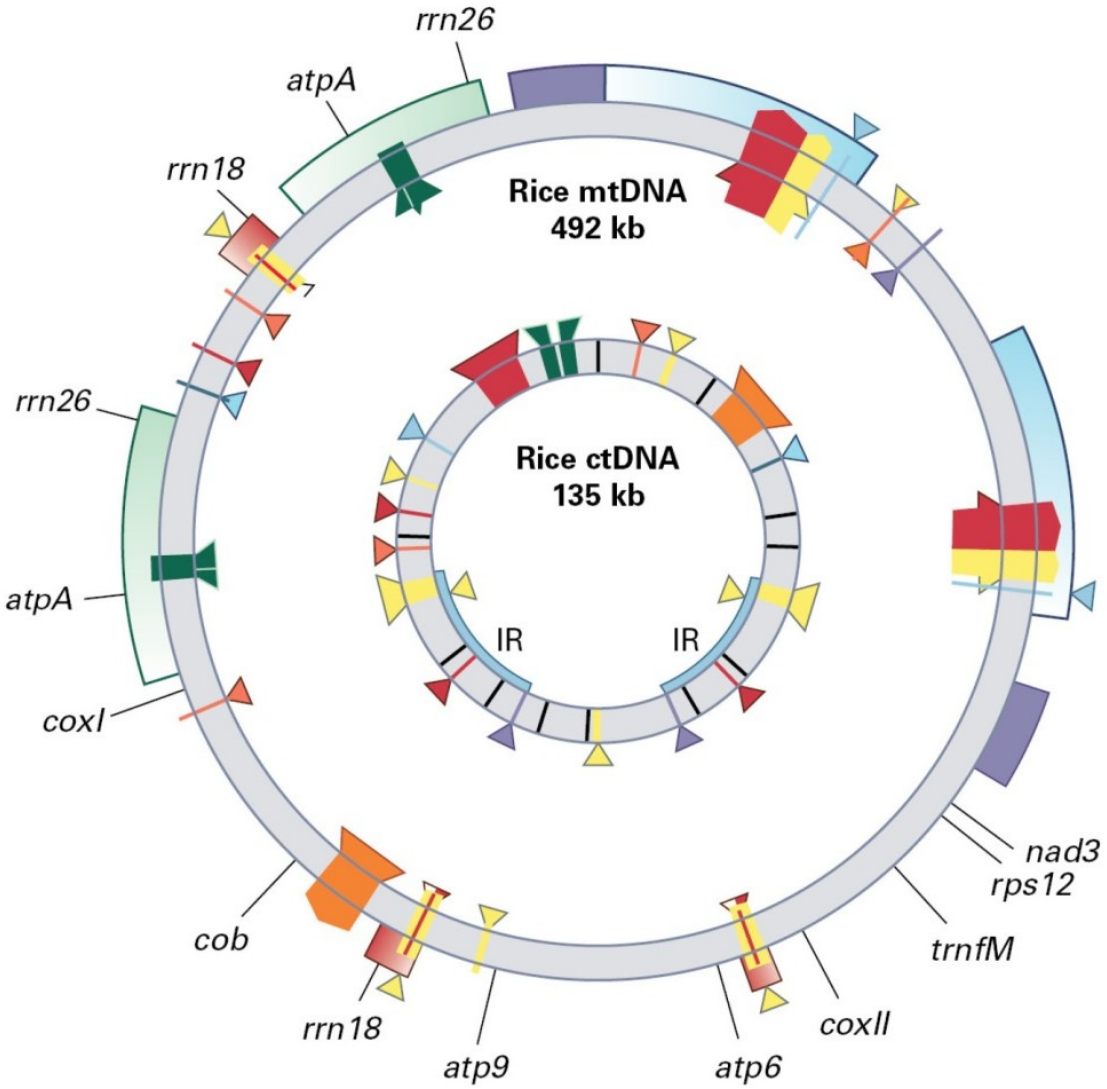
Structure and transposition of a class II transposable element



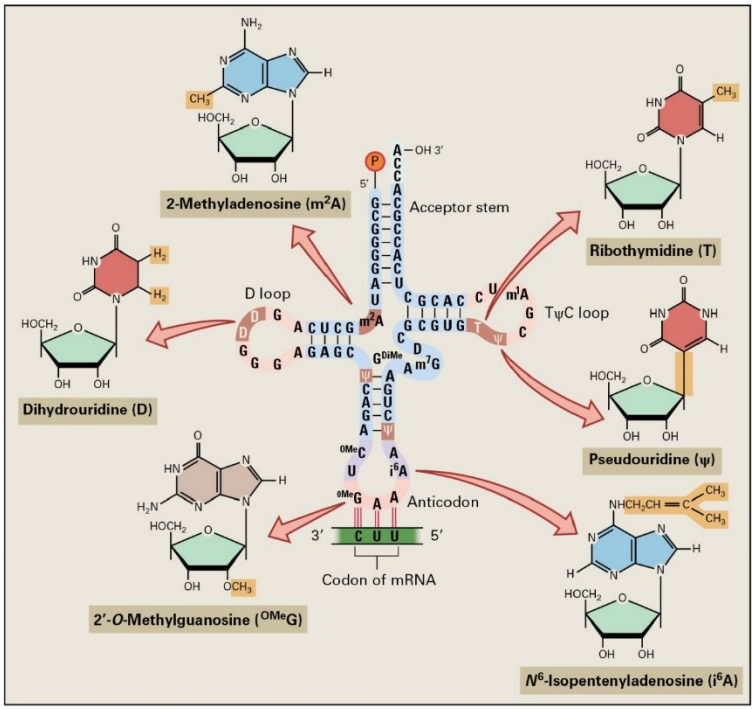
Organellar DNA

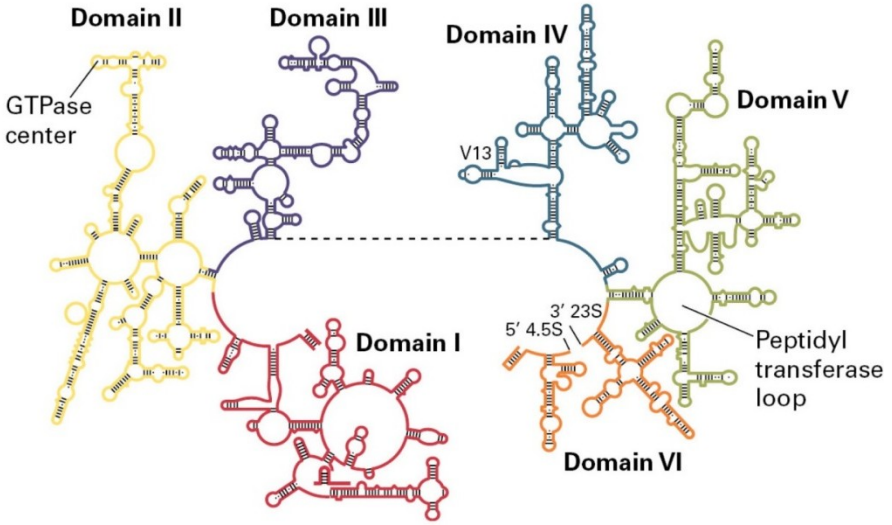
Comparison of mitochondrial and chloroplast DNA sequences from rice.

The colored boxes represent DNA sequences that have been transferred from chloroplast genome to the mitochondria.



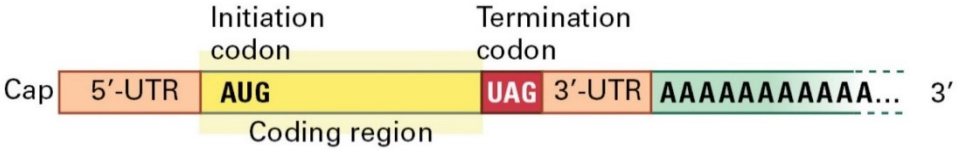
RNA

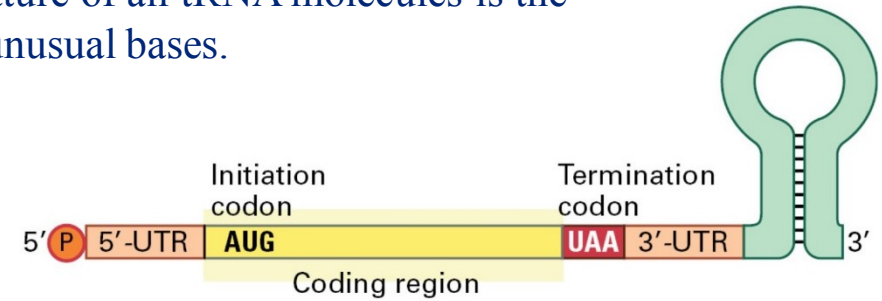




Ribosomal RNAs can fold into complex secondary structures by pairing of complementary sequences.

A notable feature of all tRNA molecules is the presence of unusual bases.

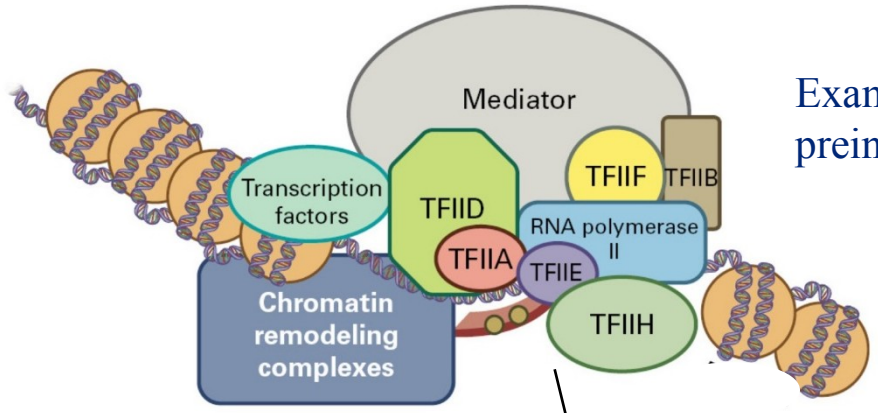


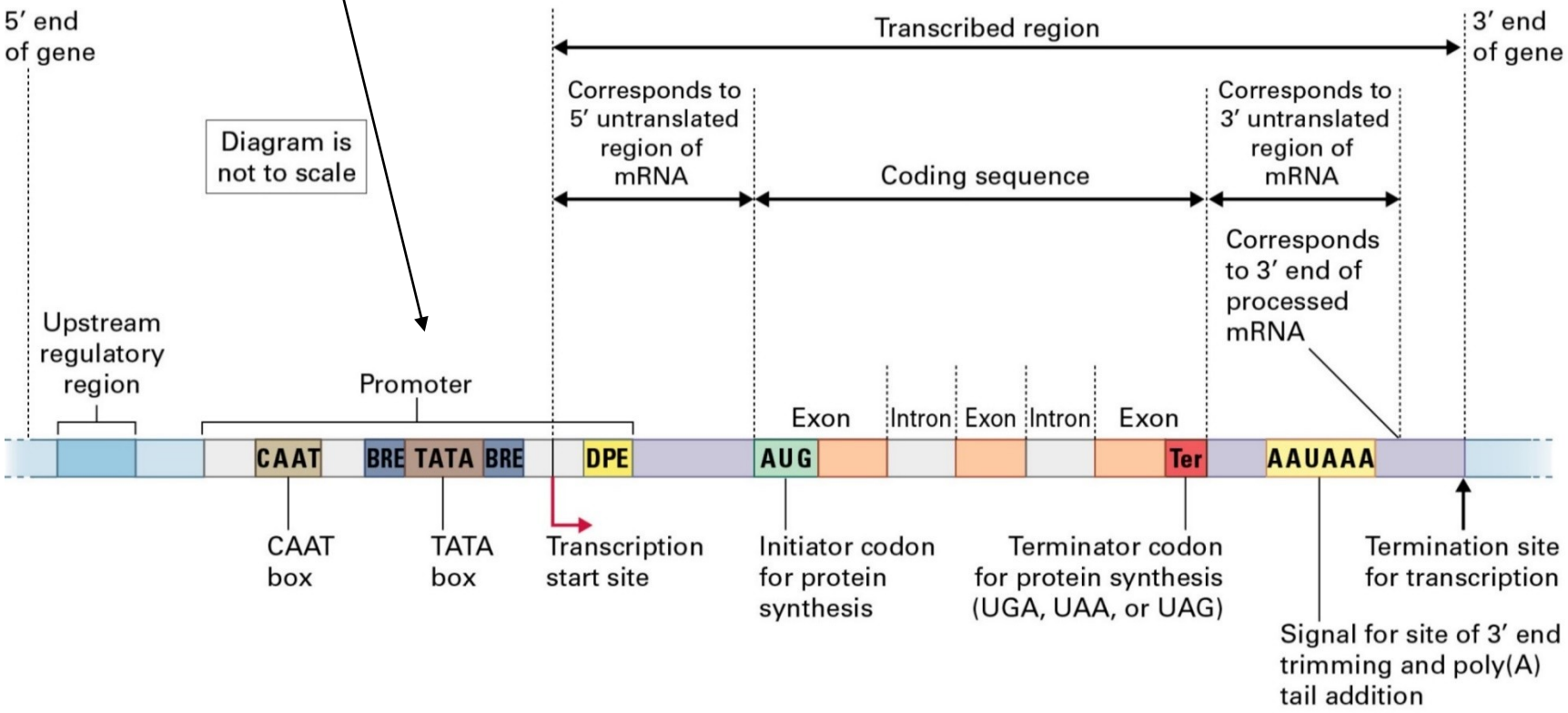


Structures of typical mature nuclear-encoded and chloroplast mRNAs differ.

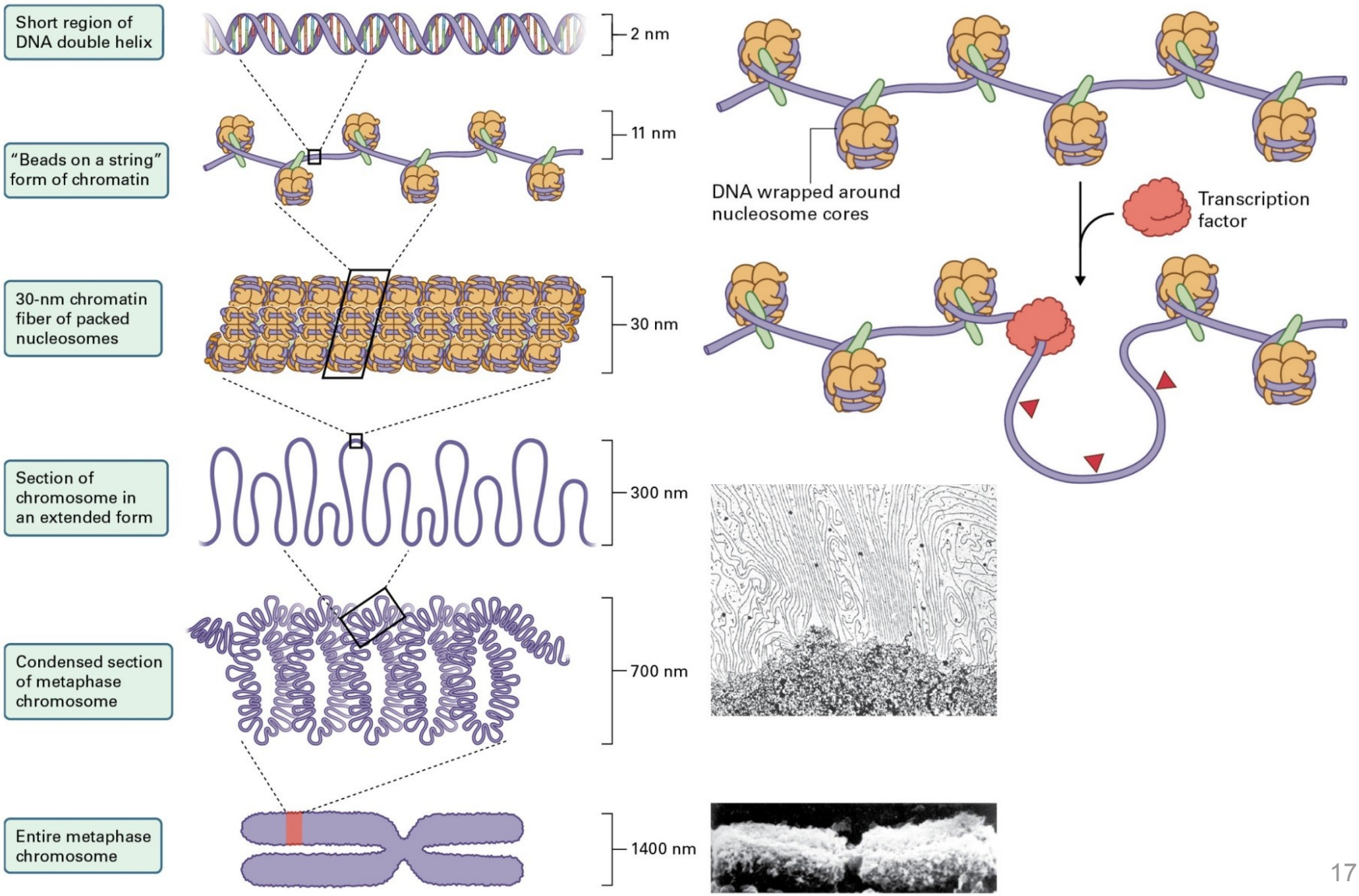
Gene expression

Example of a transcription preinitiation complex

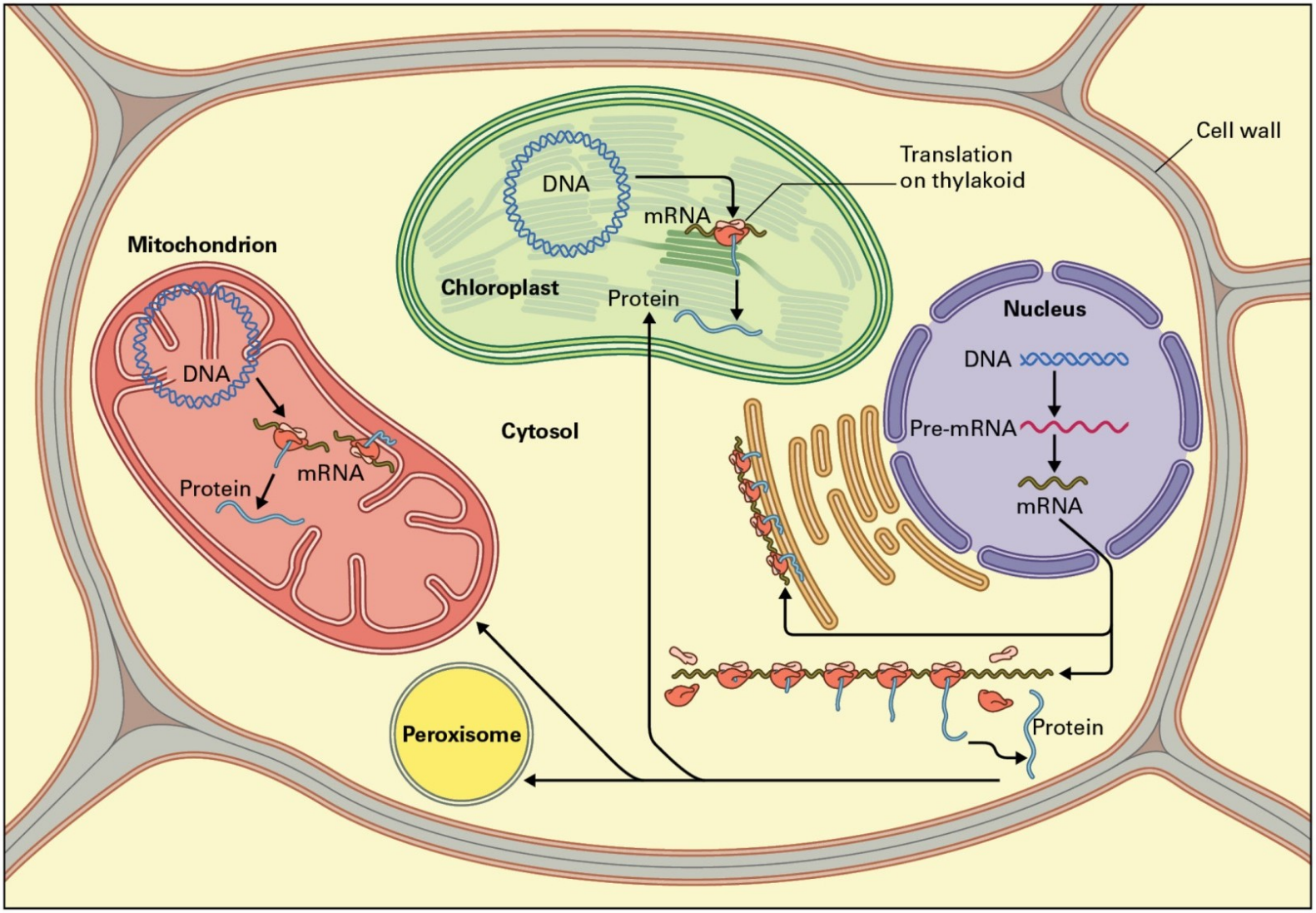




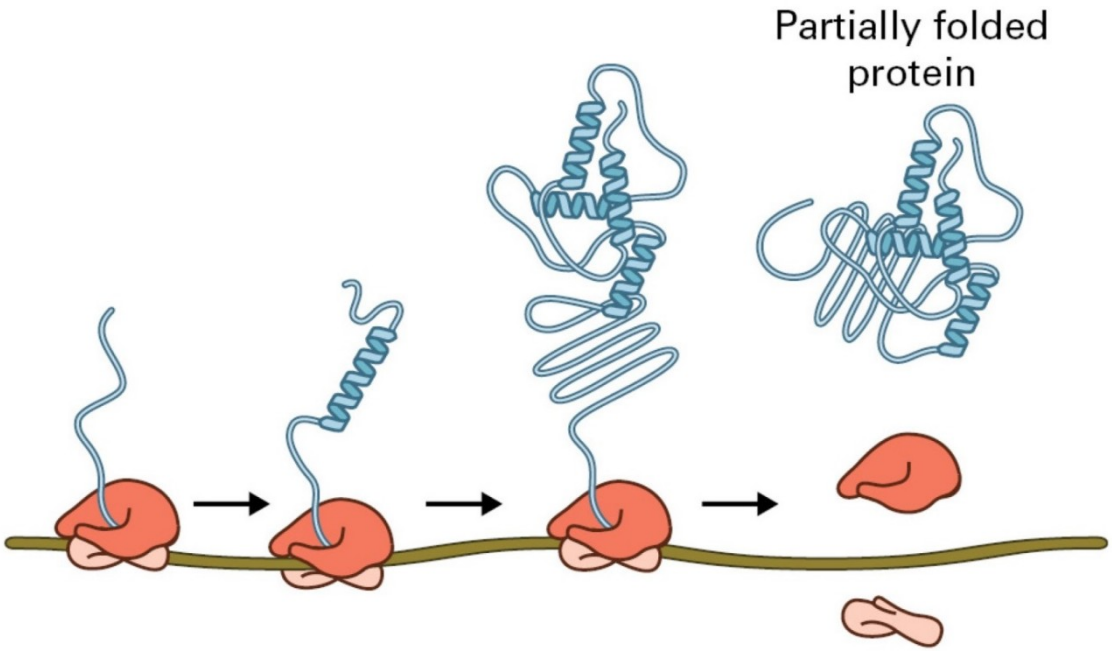
Chromatin and regulation of gene expression



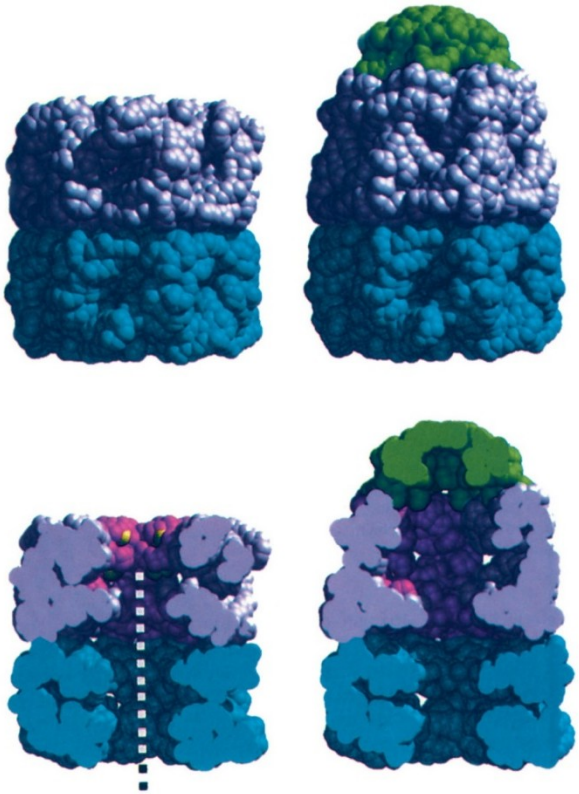
Protein synthesis



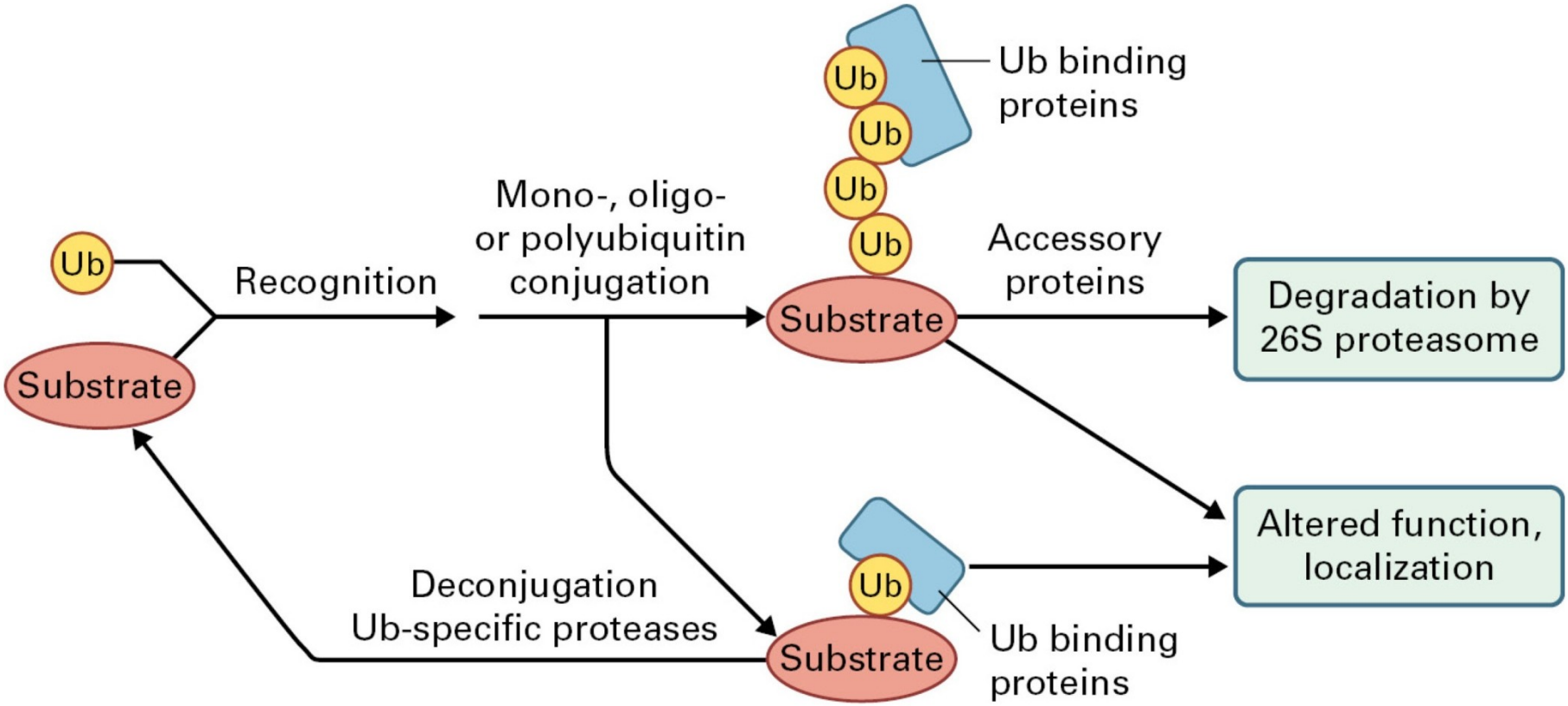
Post-translational modification of proteins



Structures of chaperonins illustrating the central cavity in which folding takes place



Protein degradation



Ubiquitin pathway