BIOCHIMIE STRUCTURALE: DES AA AUX PROTEINES

I. LES ACIDES AMINES

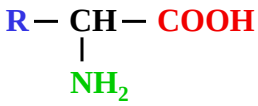
II. LES PEPTIDES

III. LES PROTEINES - STRUCTURES

IV. MODIFICATIONS POST-TRADUCTIONNELLES

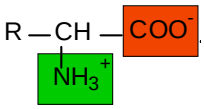
CHAPITRE I:
LES AMINO-ACIDES

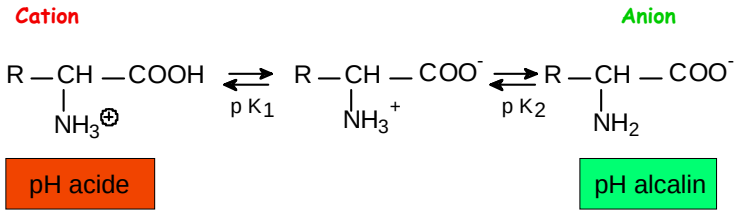
I. DEFINITION



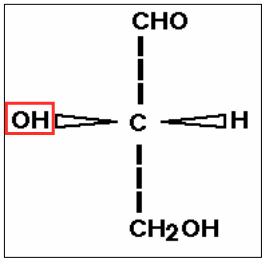
II. PROPRIETES PHYSIQUES

A. CARATÈRE AMPHOTERE

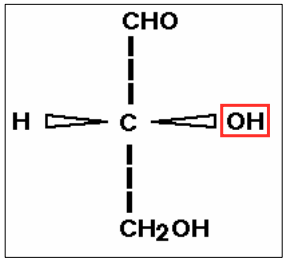




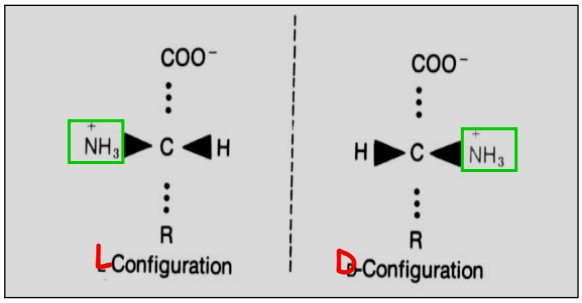
B. STEREO-ISOMERIE: géométrie dans l'espace



L - glycéraldehyde



D - glycéraldehyde



C. HYDROPHOBICITE

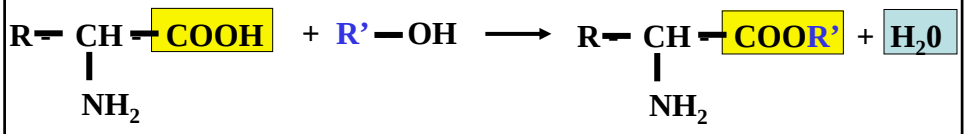
HYDROPHOBES	HYDROPHYLES
ALANINE LEUCINE ISOLEUCINE VALINE METHIONINE PHENYLALANINE PROLINE TRYPTOPHANE TYROSINE	ARGININE ASPARAGINE Ac ASPARTIQUE CYSTEINE Ac glutamique GLUTAMINE GLYCINE HISTIDINE LYSINE SERINE THREONINE

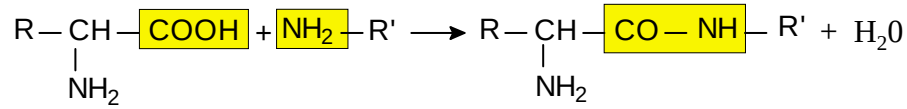
D. ABREVIATIONS

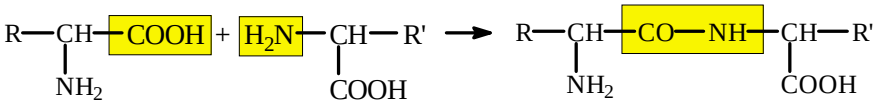
Aminoacide	Abréviation à trois lettres	Symbole à une lettre
Alanine	Ala	A
Arginine	Arg	R
Asparagine	Asn	N
Acide aspartique	Asp	D
Cystéine	Cys	C

III. PROPRIETES CHIMIQUES

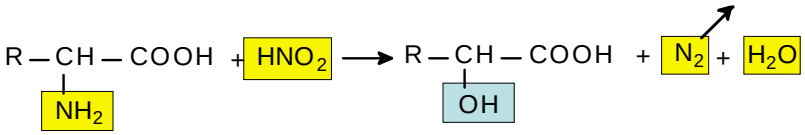
A. PROPRIETES LIEES AU GROUPEMENT COOH

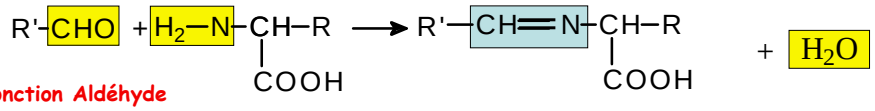




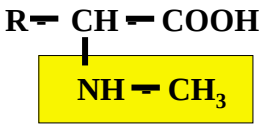


B. PROPRIETES LIEES AU GROUPEMENT NH2





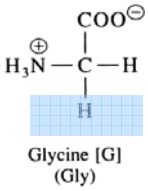
Fonction Aldéhyde



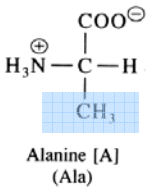
IV. PRINCIPAUX AA

- Valine
- Leucine
- Isoleucine
- Threonine
- Methionine
- Lysine
- Tryptophane
- Phenylalanine

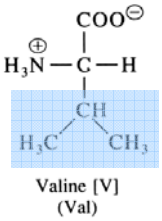
ACIDES AMINES ALIPHATIQUES



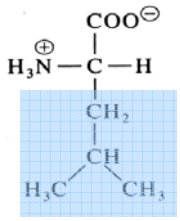
Glycine [G]
(Gly)



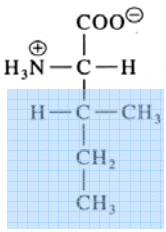
Alanine [A]
(Ala)



Valine [V]
(Val)



Leucine [L]
(Leu)

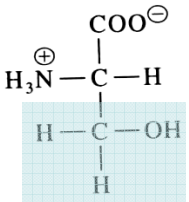


Isoleucine [I]
(Ile)

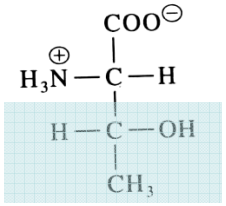
Glycocolle

AA Ramifiés

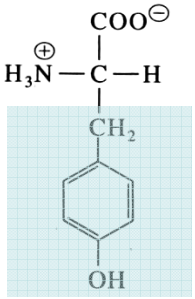
ACIDES AMINES HYDROXYLES



Serine [S]
(Ser)



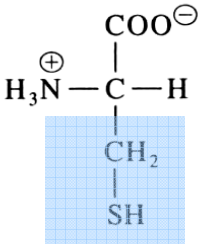
Threonine [T]
(Thr)



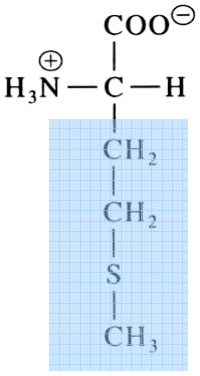
Tyrosine [Y]
(Tyr)

AA Aromatique

ACIDES AMINES SOUFRES

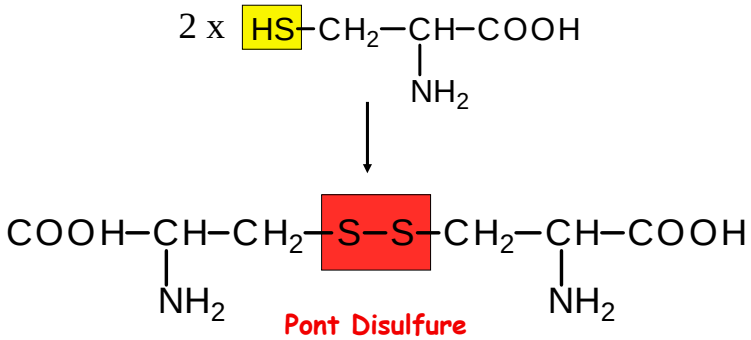


Cysteine [C]
(Cys)



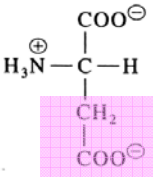
Methionine [M]
(Met)

Fonction Thiol R-S-H

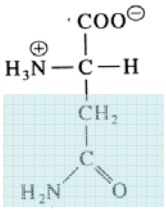


Pont Disulfure

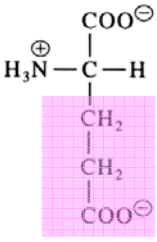
ACIDES AMINES DICARBOXYLIQUES ET LEURS AMIDES



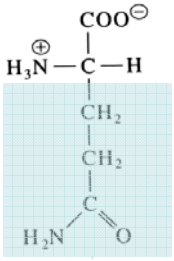
Aspartate [D]
(Asp)



Asparagine [N]
(Asn)

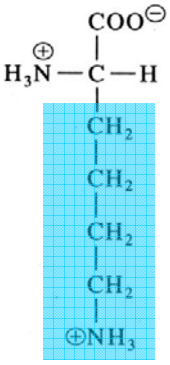


Glutamate [E]
(Glu)

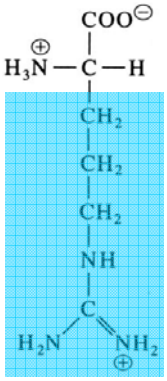


Glutamine [Q]
(Gln)

ACIDES AMINES DIBASIQUES

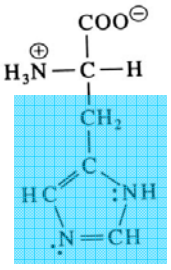


Lysine [K]
(Lys)



Arginine [R]
(Arg)

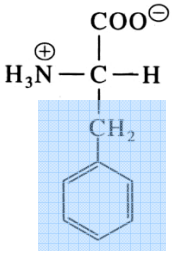
Groupement Guanidine



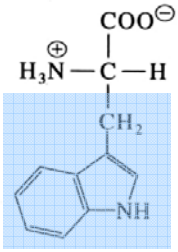
Histidine [H]
(His)

Noyau Imidazole

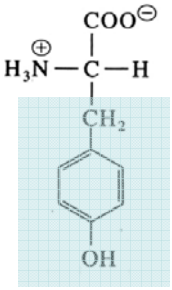
ACIDES AMINES AROMATIQUES



Phenylalanine [F]
(Phe)



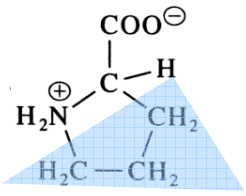
Tryptophan [W]
(Trp)



Tyrosine [Y]
(Tyr)

AA Hydroxylé
Parahydroxyphenylalanine

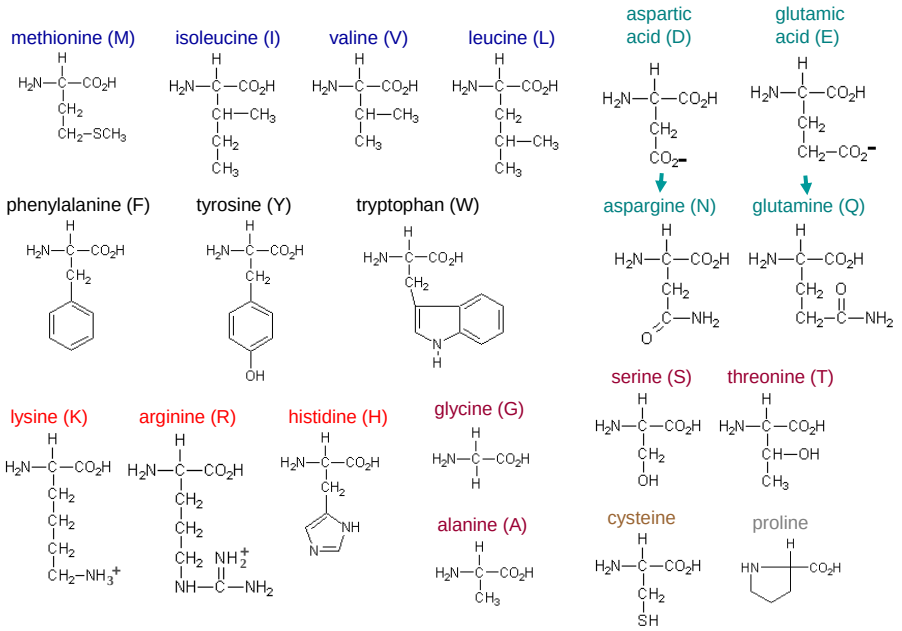
IMINO ACIDES



Proline [P]
(Pro)

Noyau Pyrrol

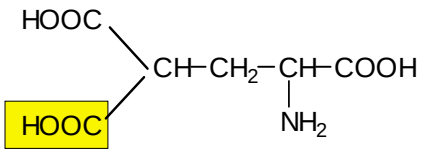
Structures Amino Acids



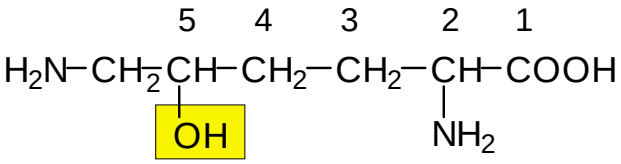
V. DERIVES D'ACIDES AMINES

A. Exemples de Dérivés

γ Carboxyglutamate :



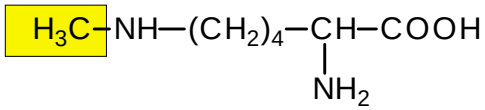
5 Hydroxylysine :



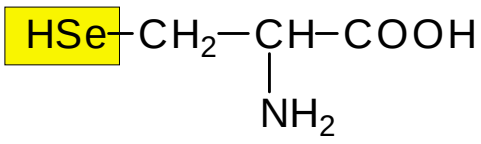
Proline [P]
(Pro)

Hydroxyproline

6 N Methyllysine :

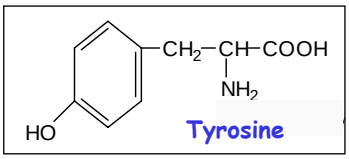


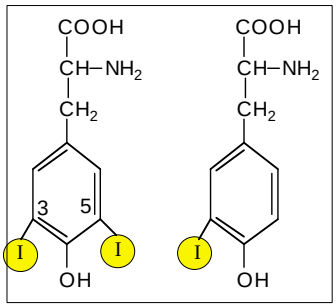
Sélénocystéine :



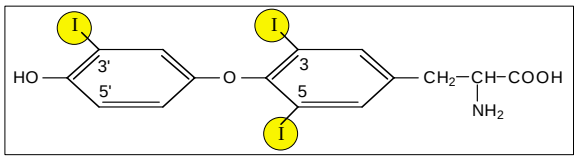
B. AA sont les précurseurs de molécules biologiquement actives
=> Molécules Informatives

Tyrosine - Mono et Diiodotyrosine - Hormones Thyroïdiennes T3 et T4

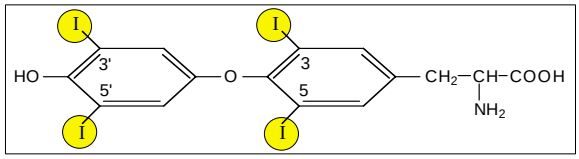




Mono et Diiodotyrosine



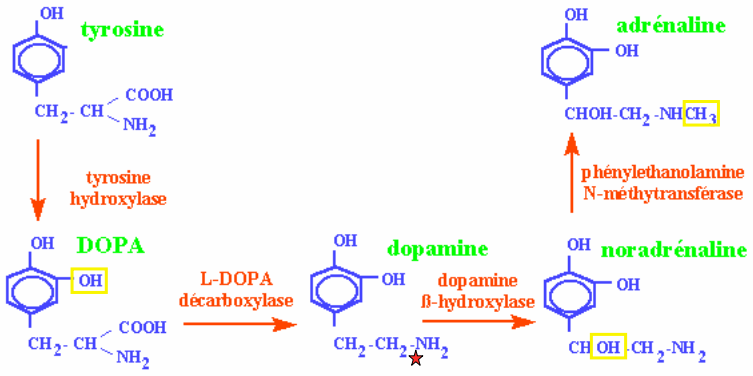
T3 = 33'5 Triiodothyronine



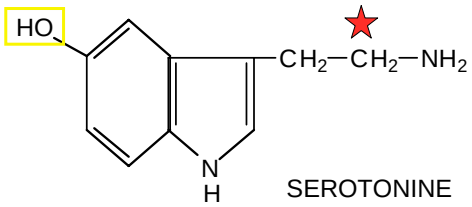
T4 = 33'55' tetraiodothyronine

Tyrosine => Adrénaline

Poursuite de la Biosynthèse:
Neurones Adrénergiques
Glandes Surrénales

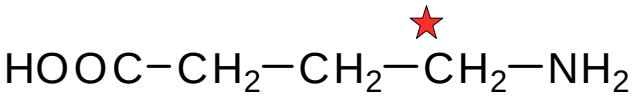


Neurones Dopaminergiques:
Arrêt au stade Dopamine

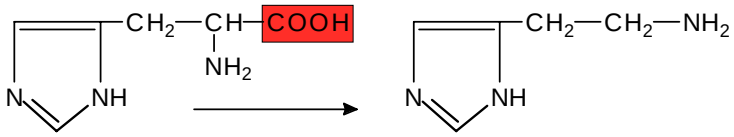


SEROTONINE

Noyau Indol



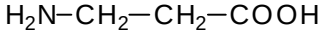
GABA



Histidine

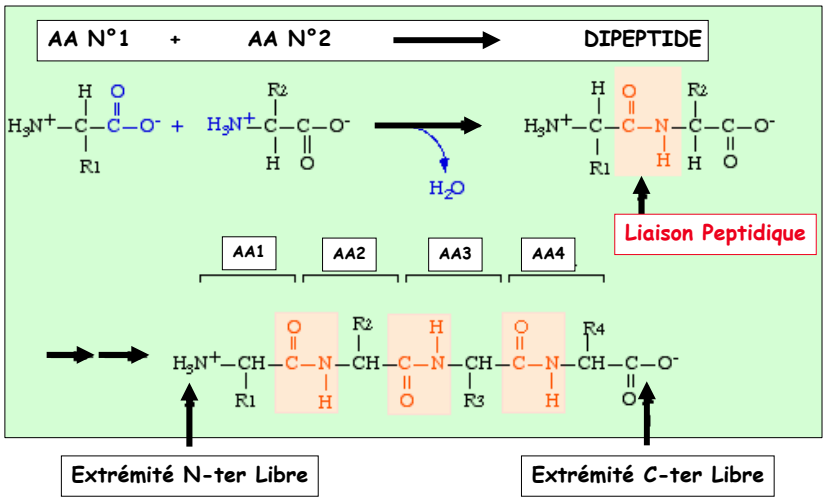
Histamine

β ALANINE

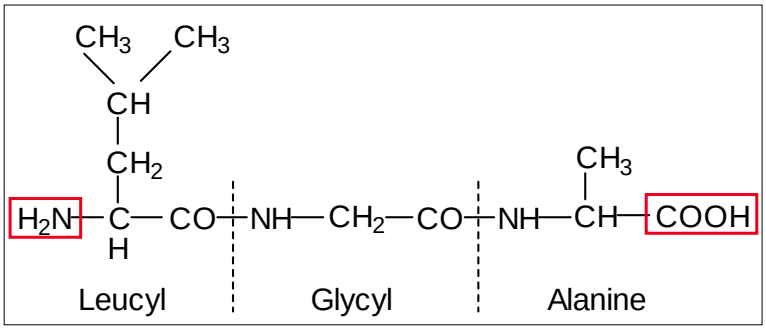


CHAPITRE II:
LES PEPTIDES

I. DEFINITION



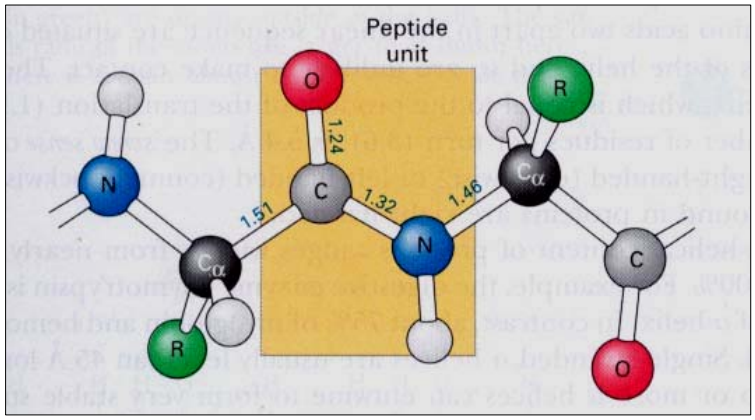
Ex : LEUCYL-GLYCYL-ALANINE



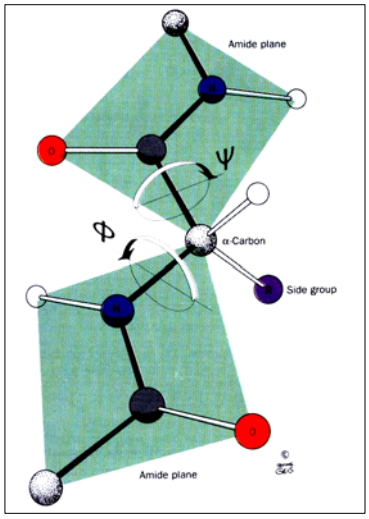
Extrémité N-ter Libre

Extrémité C-ter Libre

Liaison Peptidique



Rotations possibles

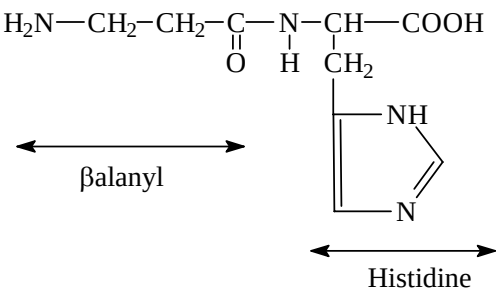


II. PROPRIETES PHYSIQUES ET CHIMIQUES

III. ETUDE DE QUELQUES PEPTIDES

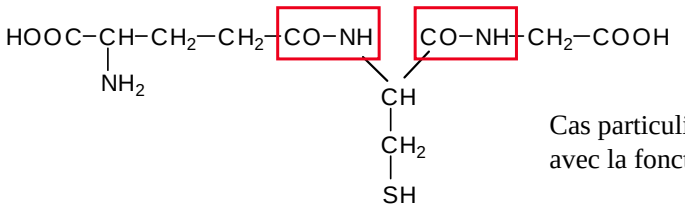
A. Dipeptide

Carnosine : β alanyl histidine (constituant du muscle)



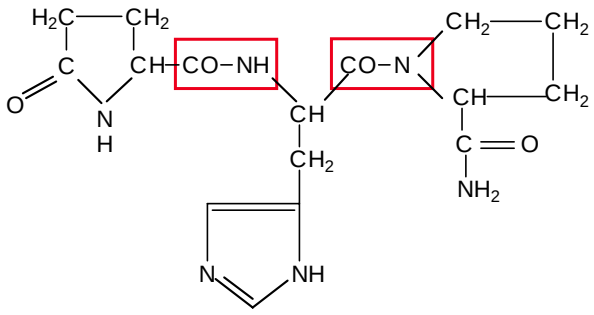
B. Tripeptide

Glutathion : γ glutamyl cysteinyl glycocolle



Cas particulier : la liaison se fai
avec la fonction γ carboxylique.

TRF ou TRH : Thyrotropin-Releasing Factor/ Hormone
=> pyroglutamyl histidylprolinamide

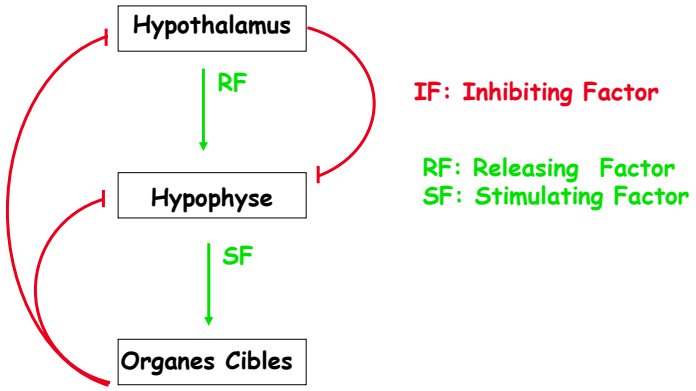


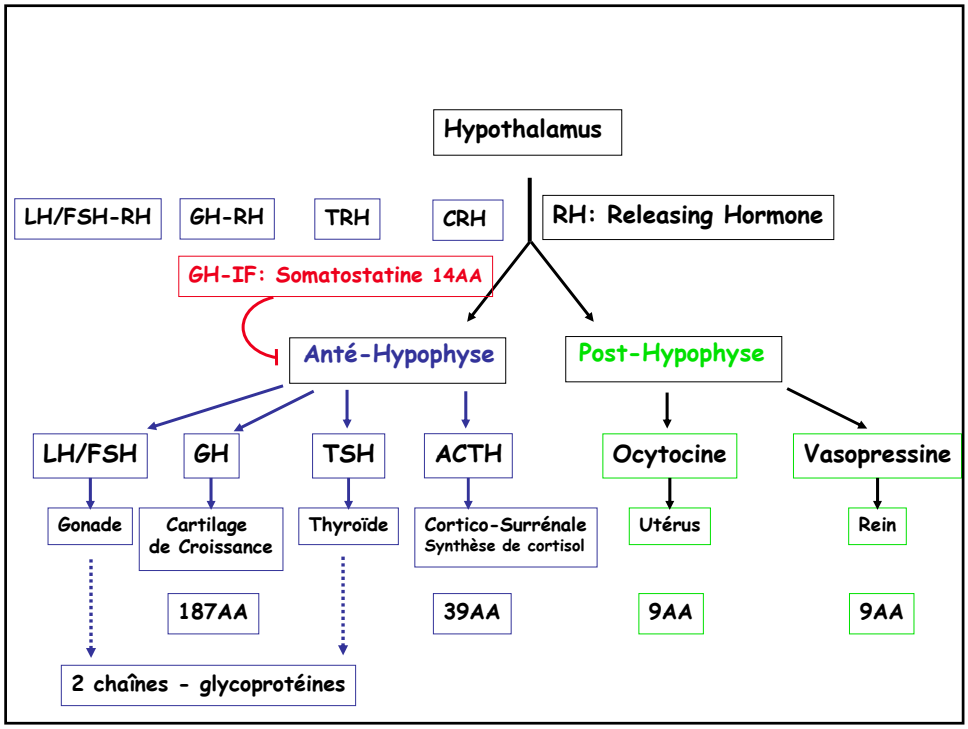
C. Oligopeptide

Enképhalines : 5 AA
=> Tyr-Gly-Gly-Phe-Met
=> Tyr-Gly-Gly-Phe-Leu

D. Polypeptides

1. Axe Hypothalamo-Hypophysaire





Hormones Hypothalamique

Thyrotrophin Releasing Hormone	(TRH)
Corticotrophin Releasing Hormone	(CRH)
Gonadotrophin Releasing Hormone	(GnRH) / (LH-FSHRH)
Growth Hormone Releasing Hormone	(GHRH)
Somatostatin ou Growth Hormone-Inhibitory Hormone	(GH-IH)

Hormones Ante-Hypophysaire

Thyroïde-Stimulating Hormone	(TSH)
Adrenocorticotrophic Hormone	(ACTH)
Luteinizing Hormone	(LH)
Follicle-Stimulating Hormone	(FSH)
Somatotrophin/Growth Hormone	(GH)
Melanocyte-Stimulating Hormone	(MSH)

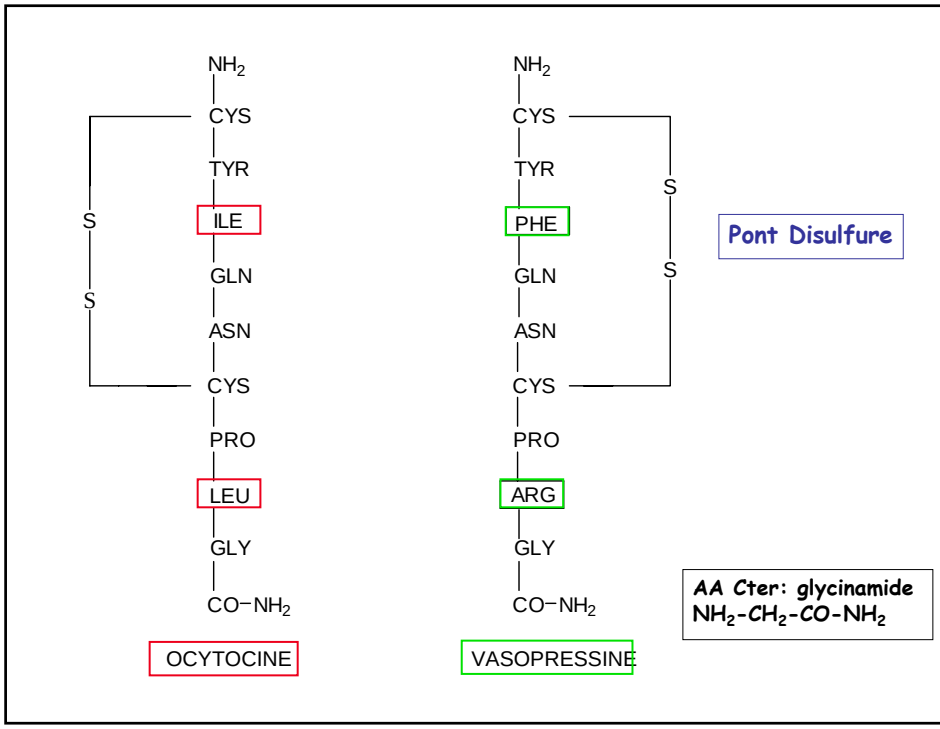
Hormones Post-Hypophysaire

Ocytocine

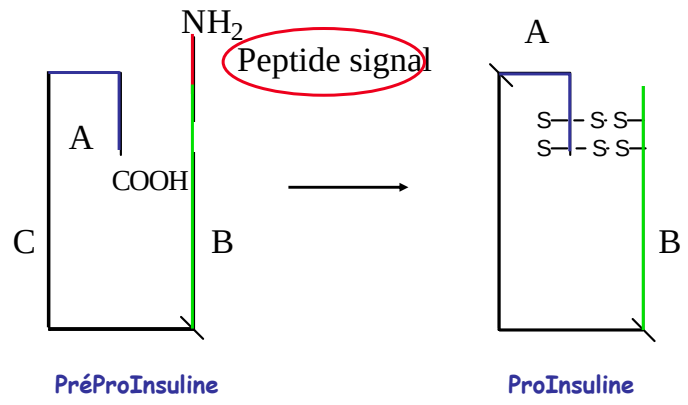
Arginine vasopressine

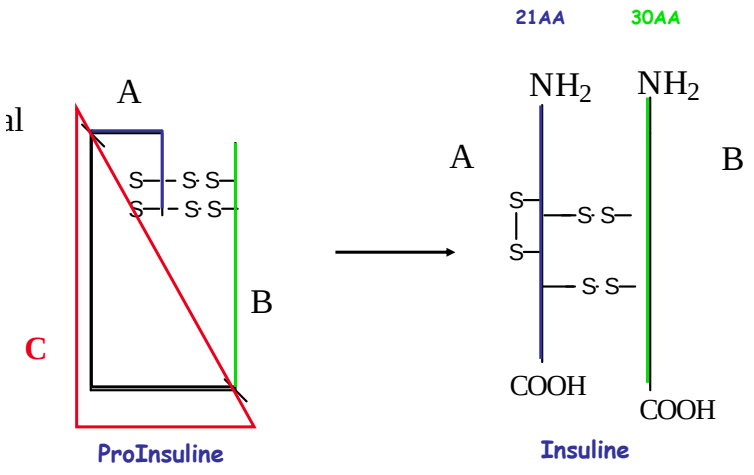
Hormones Thyroïdienne

Thyroxine	(T_4)
Triiodothyronine	(T_3)



2. Hormones Pancréatiques





3. Hormones Du Métabolisme Phosphocalcique

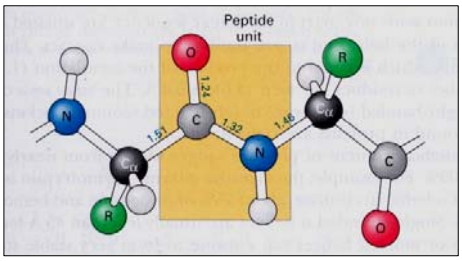
FIN

CHAPITRE III:
STRUCTURES DES PROTEINES

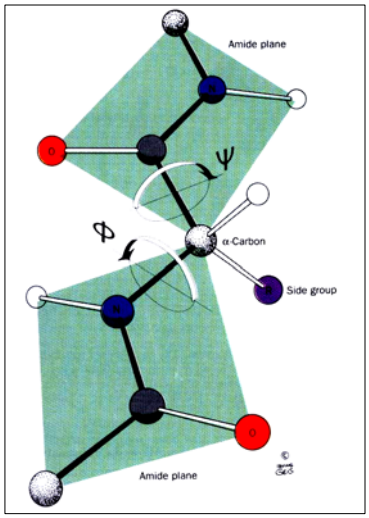
I. GENERALITES

II. STRUCTURES DES PROTEINES

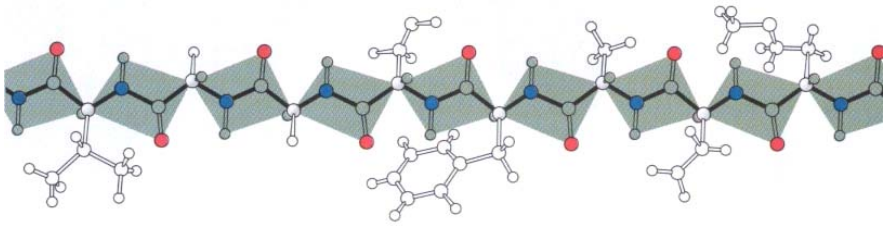
-1/ la structure primaire :



<u>Rotations possibles</u> : degré de liberté autour des Carbones α



Structure I: Chaîne Principale



N-ter Libre

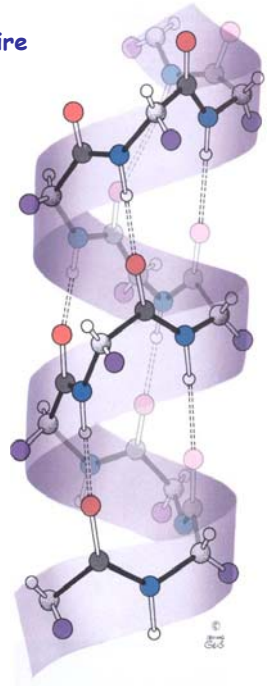
Chaîne Latérale : R

C-ter Libre

Cα C N O

-2/ la structure secondaire

Hélice Alpha



Liaison H: CO-NH

Cα

C

N

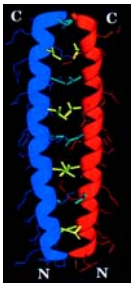
O

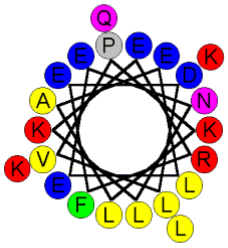
R

H

Protéine « Leucine-Zipper »

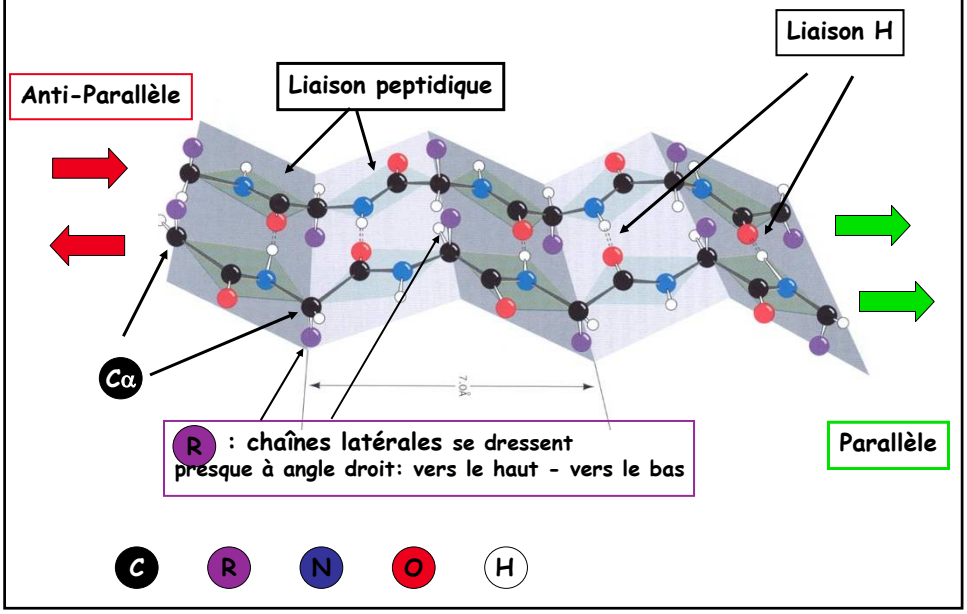
2 Hélice α:
Leucines

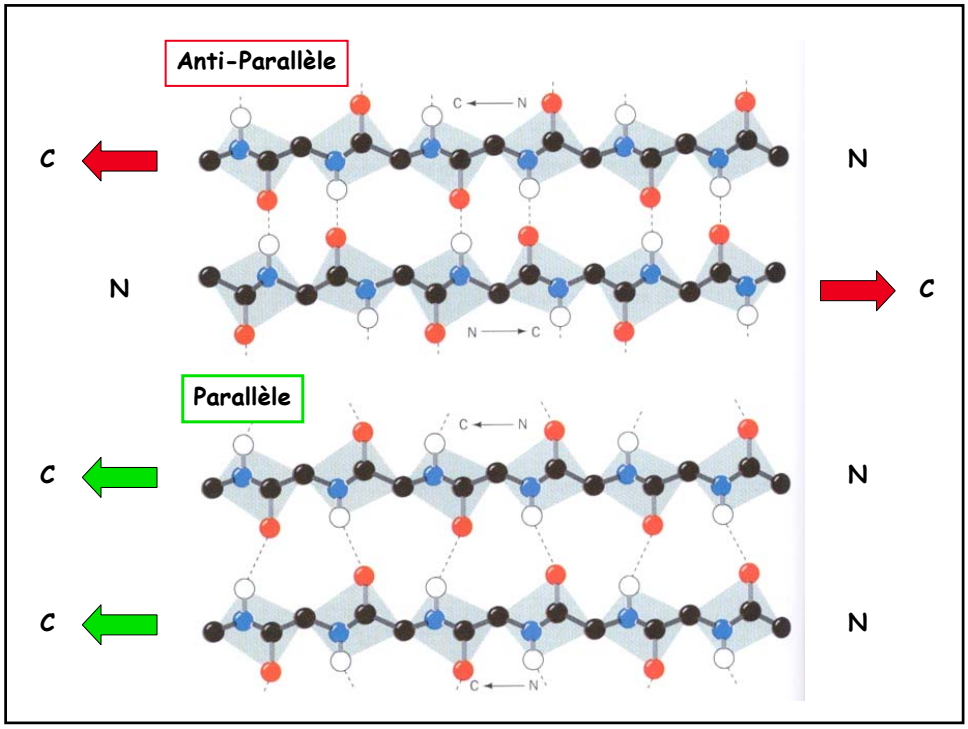


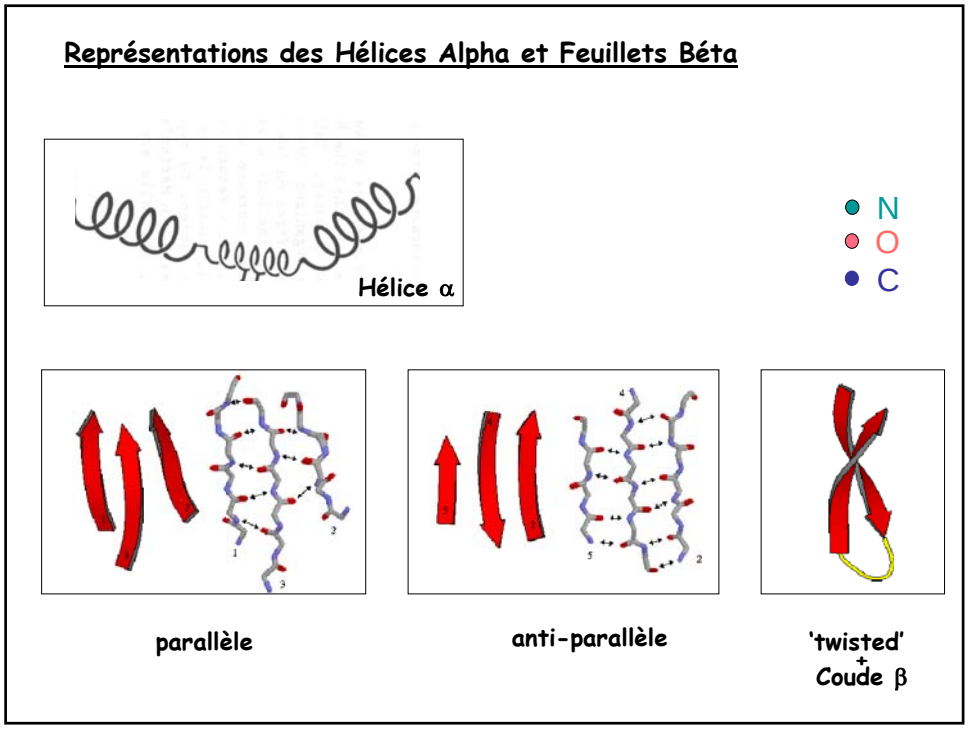


Résidus Hydrophobes
=> Zone d'interaction
avec une protéine identique

Le feuillet plissé β

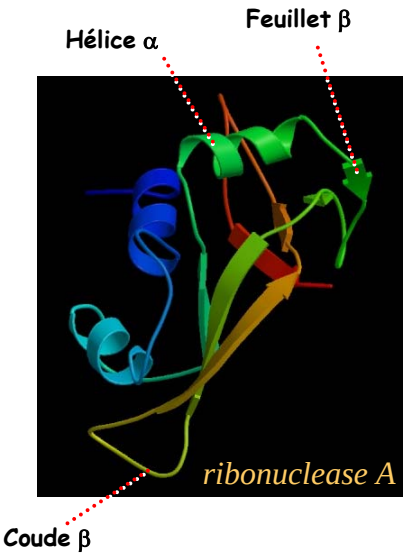



Anti-Parallèle
C
N
N
C
Parallèle
C
C
N
N
N

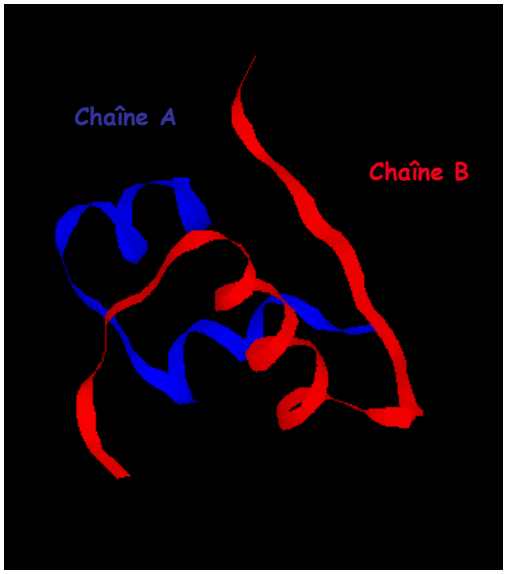

Représentations des Hélices Alpha et Feuillets Béta
Hélice α
N
O
C
parallèle
anti-parallèle
'twisted'
+
Coude β

-3/ La structure tertiaire

Structure 3D de la Ribonuclease A

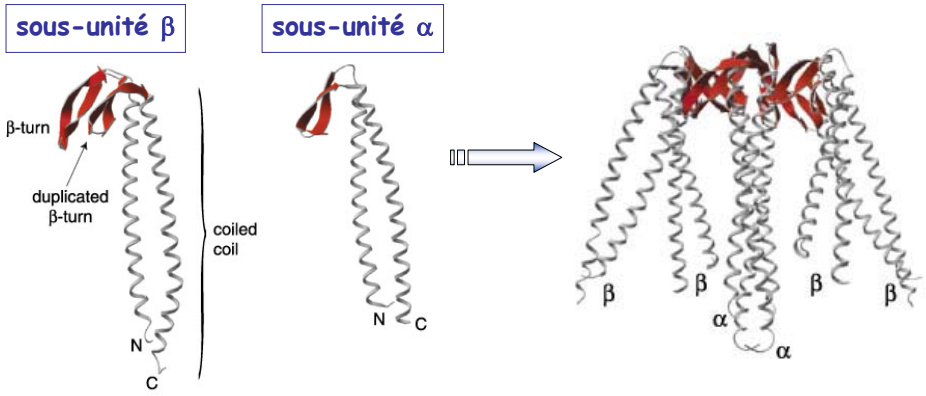


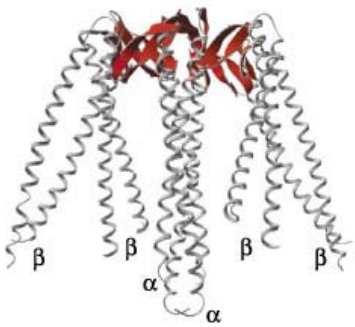
Structure 3D de l'Insuline: Chaîne A + Chaîne B



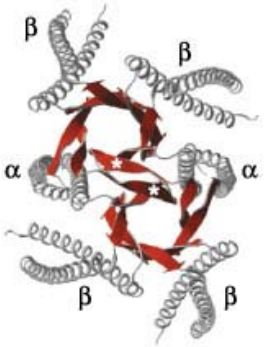
-4/ La structure quaternaire

EX: 2 sous-unités α et β => Héxamère 2α + 4β : *Prefoldin*



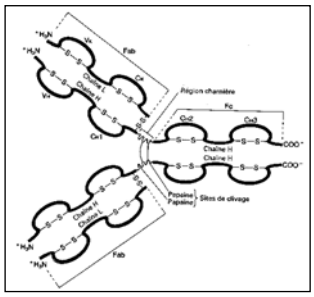


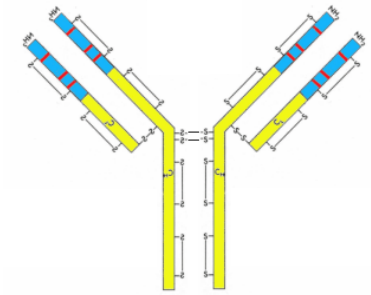
Vue de Coté

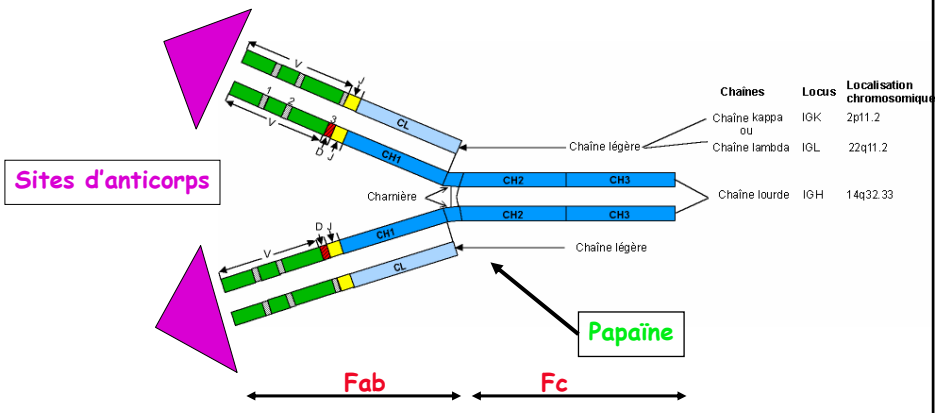


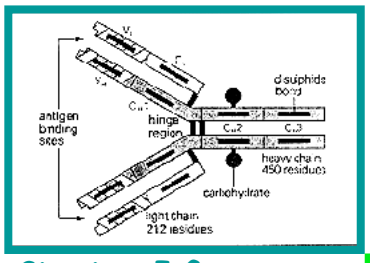
Vue du Dessus

EX: Immunoglobulines (Ig)



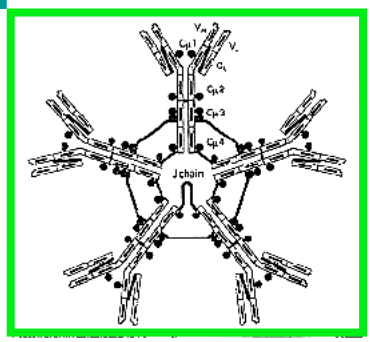


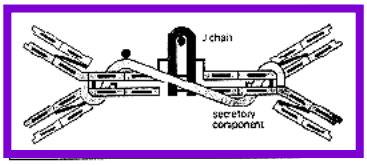




Structure IgG

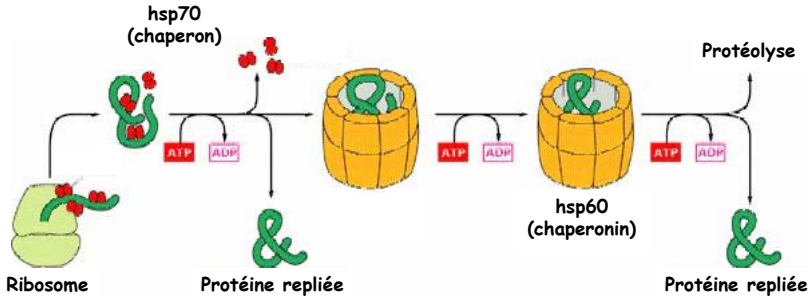
Structure IgM





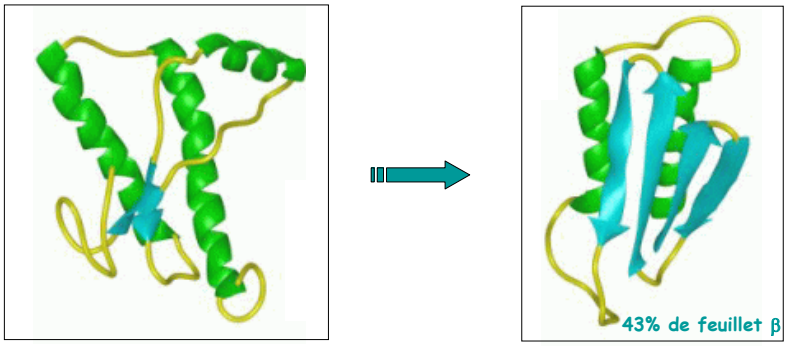
Structure IgA

EX: Les Protéines Chaperon



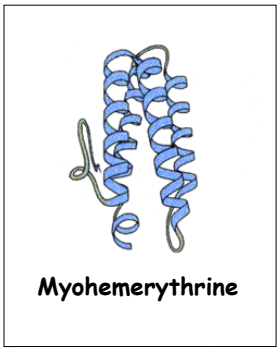
Les PRIONS

PrP^{c} PrP^{sc}

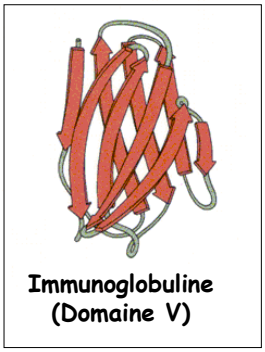


=> Mutations Asp 178 >Asn
=> contact

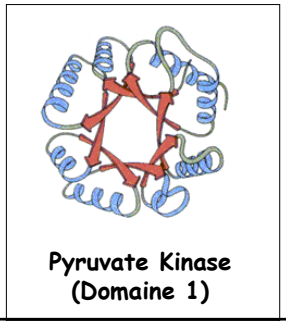
les protéines globulaires:



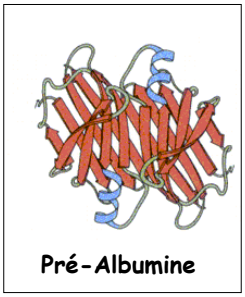
Myohemerythrine



Immunoglobuline (Domaine V)

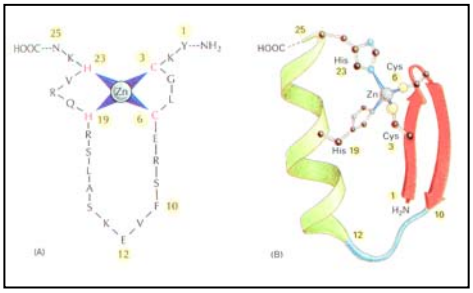


Pyruvate Kinase (Domaine 1)



Pré-Albumine

Doigts de Zinc

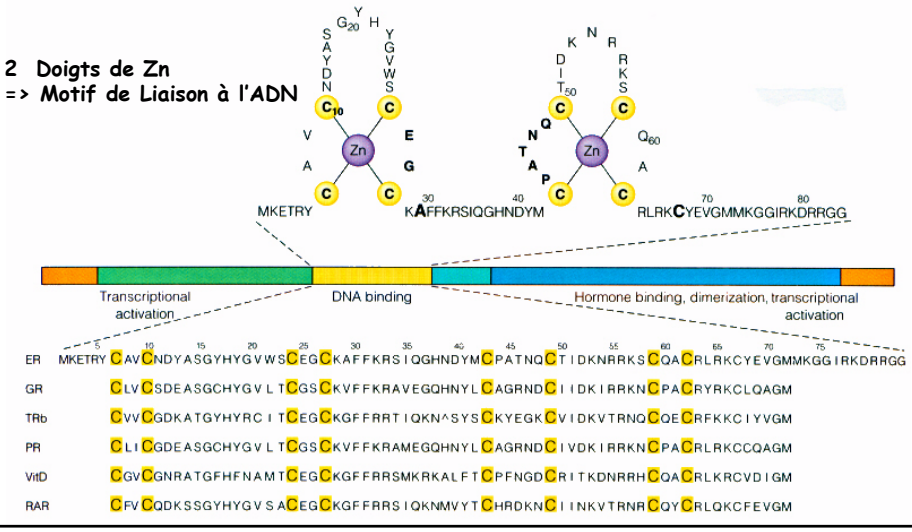


- 25 AA stabilisés par un ion Zn^{2+}:
  - 2Cys + 2His
  - 4Cys
- Eléments Répétitifs:
  - 2-3 Doigts de Zn
  - => Liaison ADN

Famille des Récepteurs Stéroïdiens : Motif commun de Liaison à l'ADN

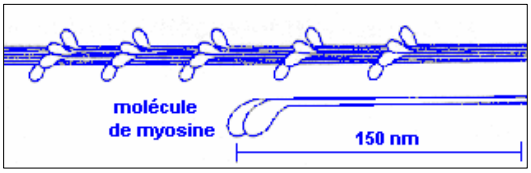
Estrogènes - Glucocorticoïdes - H. Thyroïdes - Progestérone - Vit D.- Ac. Rétinoïques

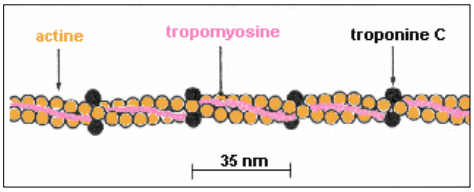
2 Doigts de Zn
=> Motif de Liaison à l'ADN



les protéines fibrillaires

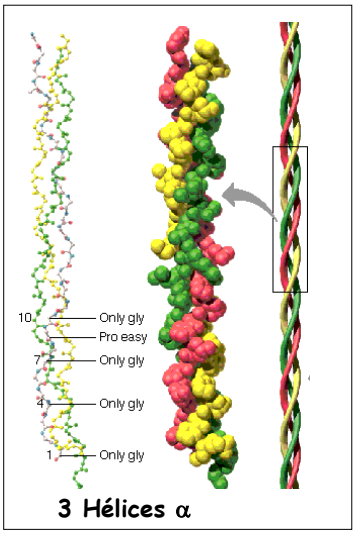
Myosine et la Tropomyosine du muscle : 2 hélices





Enroulements super hélicoïdaux : le Collagène

Enroulement Hélicoïdal

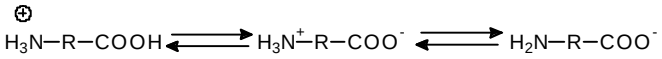


3 Hélices α

III. PROPRIETES PHYSICO-CHIMIQUES DES PROTEINES

A. Masses moléculaires

B. Caractère Amphotère



Cation	ion amphotere point isolectrique	anion
pH < pHi	pHi	pH > pHi

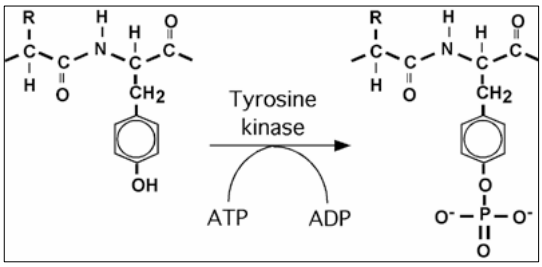
C. Solubilité

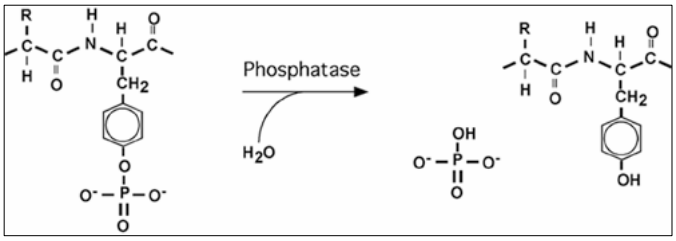
D. Réactions colorées des protéines

E. Propriété antigénique des protéines

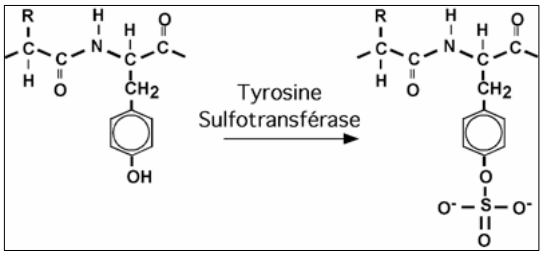
CHAPITRE IV: MODIFICATIONS POST-TRADUCTIONNELLES

I - PHOSPHOPROTEINES

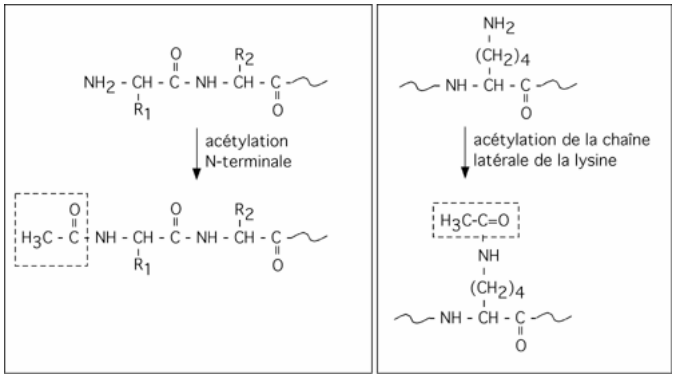




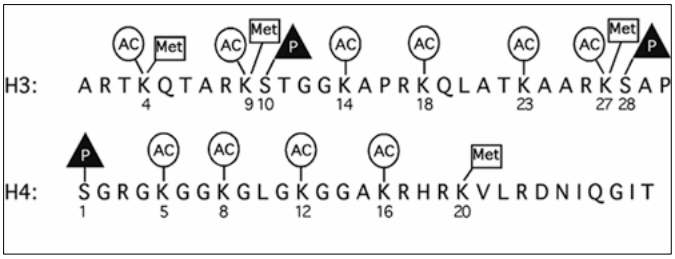
II - SULFOPROTEINES



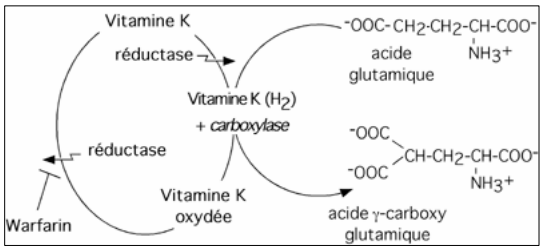
III - ACETYLATION



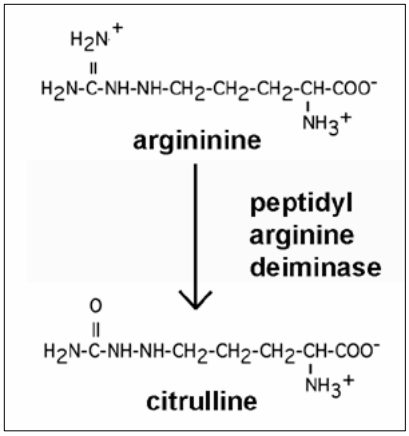
IV - METHYLATION



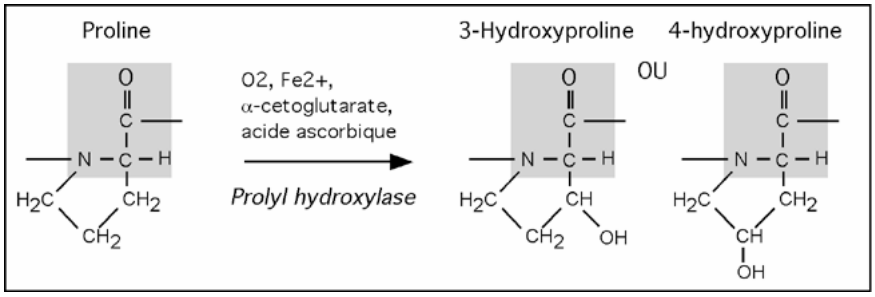
V - CARBOXYLATION



VI - DEIMINATION



VII - HYDROXYLATION

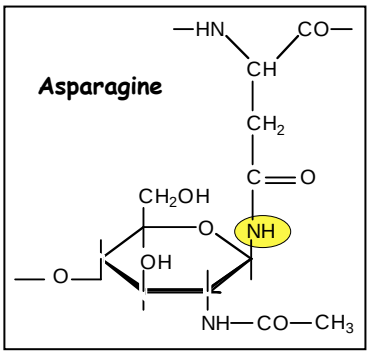


VIII - UBIQUITINATION

IX - LES GLYCOPROTEINES/ GLYCOSILATIONS

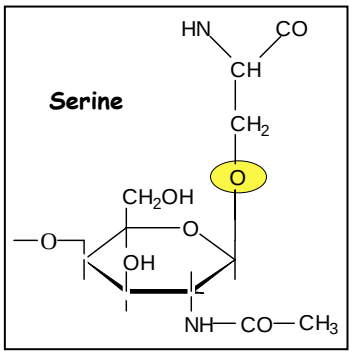
A. Fixation des chaînes glycaniques

Liaison N-Glycosidique



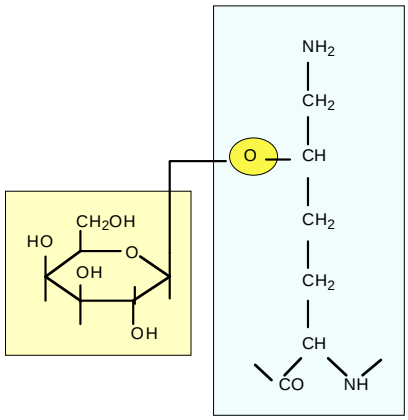
N-Acétyl Glucosamine

Liaison O-Glycosidique



N-Acétyl Galactosamine

Résidu 1β-Galactosyl-Hydroxylysyl d'une molécule de collagène

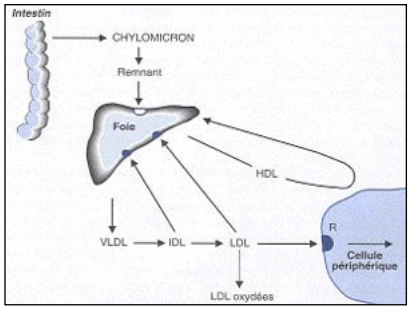


Hydroxylysine

B. Nature des oses et structure des glycanes

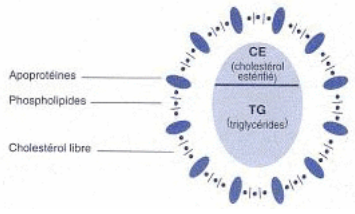
X - LES LIPOPROTEINES

A. DIFFERENTES CATEGORIES DE LIPOPROTEINES PLASMATIQUES



B. COMPOSITION DES LIPOPROTEINES PLASMATIQUES

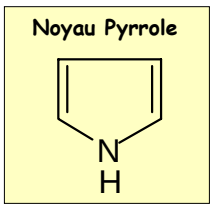
Structure de la lipoprotéine

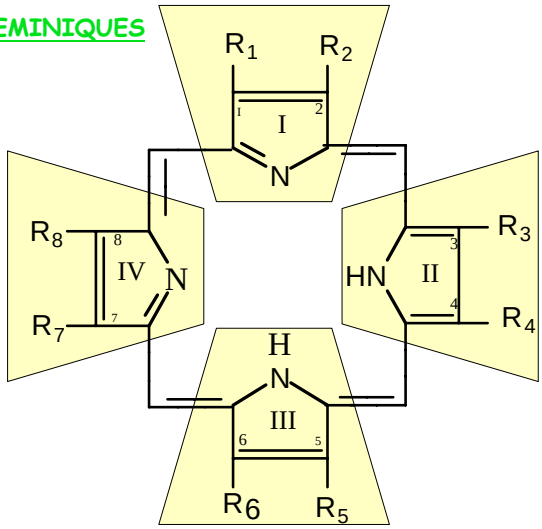


XI - HEMOPROTEINES

A. LES GROUPEMENTS HEMINIQUES

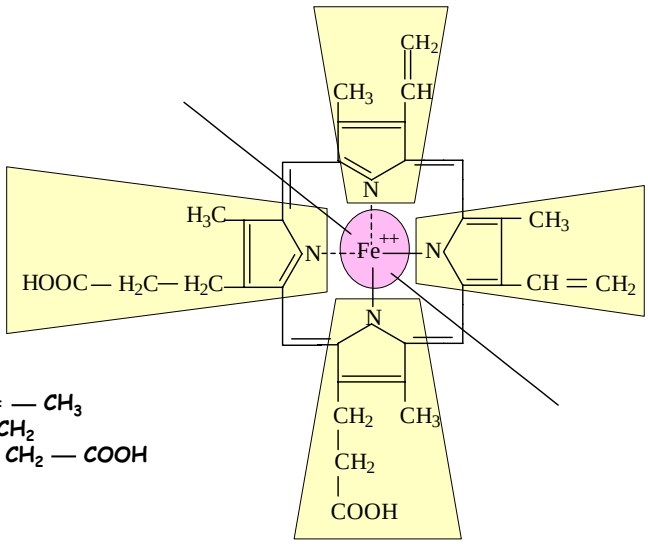
Noyau Pyrrole





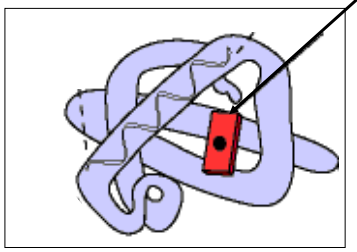
Noyau Porphyre

Hème => groupement prosthétique de **l'hémoglobine**

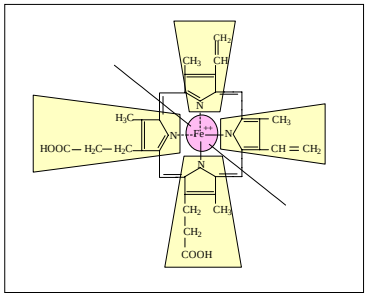


$R_1 = R_3 = R_5 = R_8 = — CH_3$
$R_2 = R_4 = — CH = CH_2$
$R_6 = R_7 = — CH_2 - CH_2 — COOH$

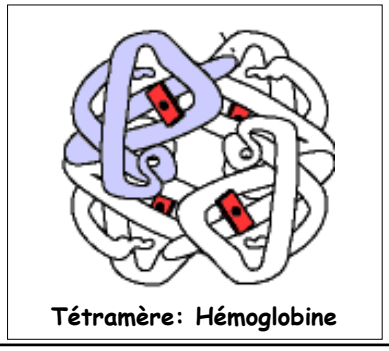
B. LES HEMOGLOBINES



Hème

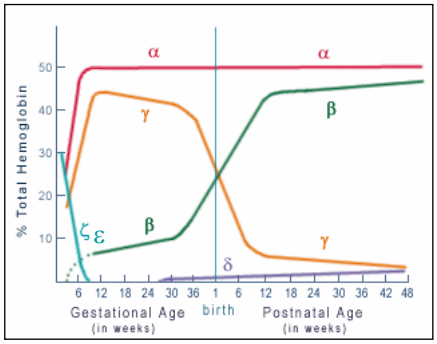


Monomère: Globine (hélice α) + Hème



Tétramère: Hémoglobine

4 chaînes polypeptidiques identiques deux à deux

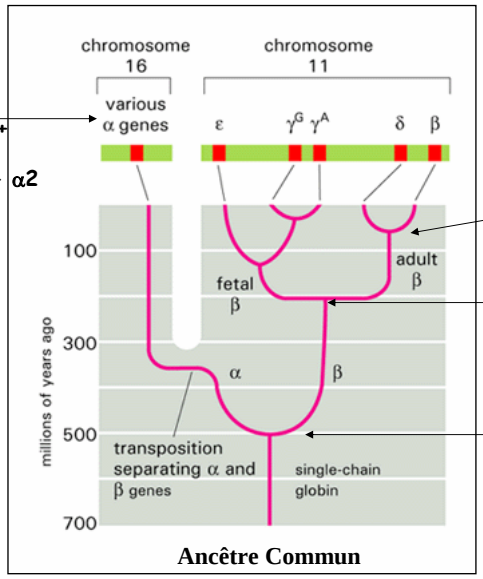


Expression spécifique des chaînes de la globine

C. STRUCTURE DES HEMOGLOBINES

1°) La structure primaire :

Présence de Speudogènes+ Duplication récente α1 + α2

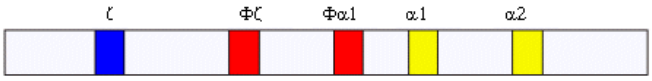


Duplication + mutations

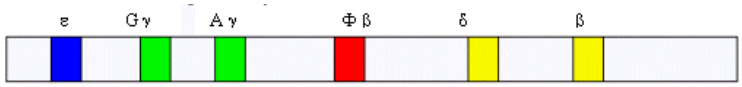
Duplication + mutations

Transposition + Mutations

Chromosome 16: Chaînes de type α



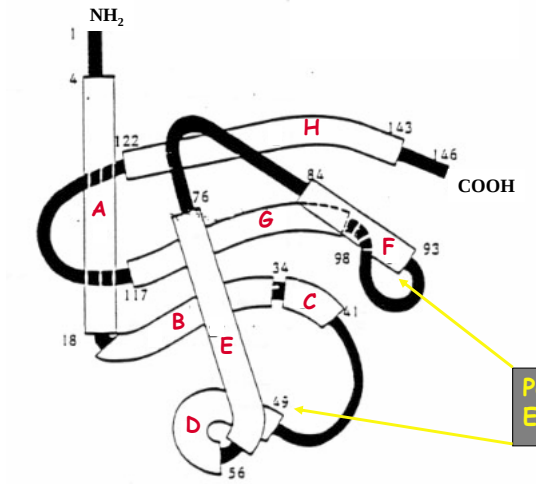
Chromosome 11: Chaînes de type β



- Formes embryonnaires
- Formes foetales
- Pseudogènes
- Formes adultes

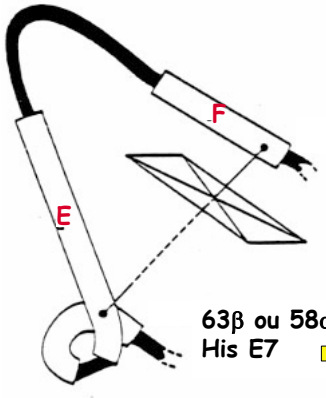
2°) Structure secondaire et tertiaire :

Configuration spatiale de la chaîne β de l'Hémoglobine



Poche de l'Hème:
Entre E et F

3°) Liaison de l'Hème à la globine



92β ou 87α
His F8

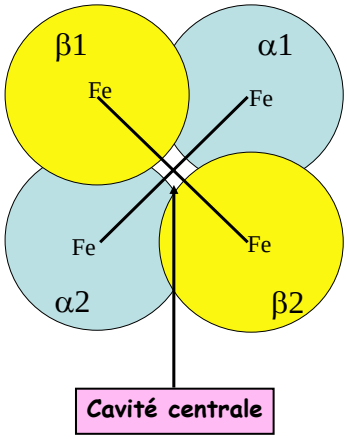
liaison F 8 est forte
PROXIMALE

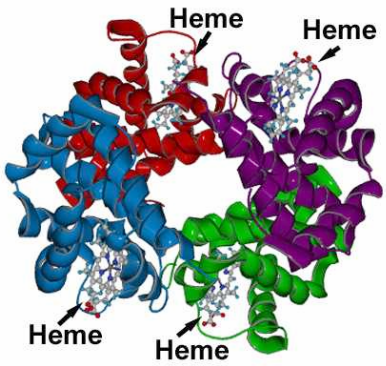
Hème

63β ou 58α
His E7

liaison E 7 , plus lâche, DISTALE
=> pour admettre une molécule d'oxygène
entre His E 7 et l'anneau tétrapyrrolique

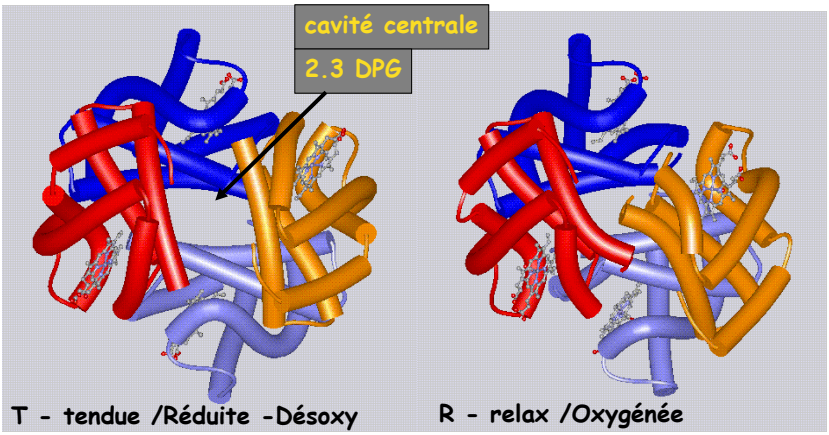
4°) Structure Quaternaire

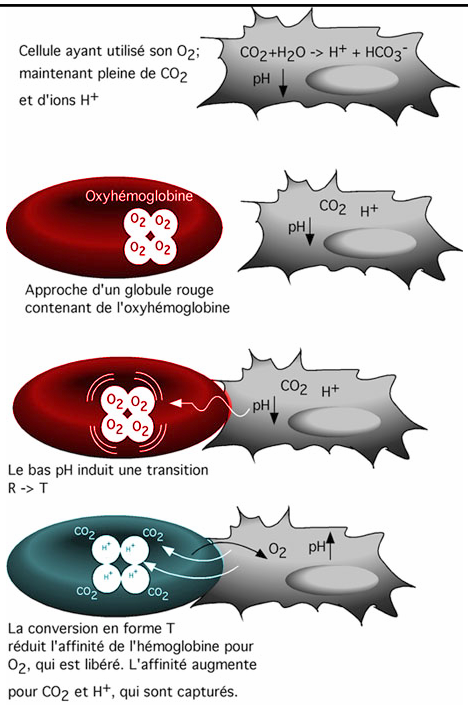




5°/ La modification post-traductionnelle la plus importante

6°) Interprétation allostérique

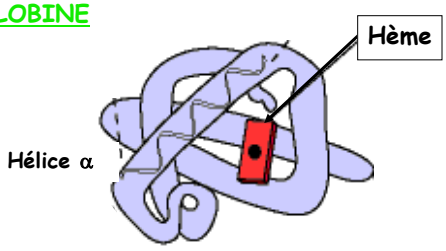




La liaison de l'O_2 par l'Hb est
- **coopérative**
- **régulée par H+, CO_2 , 2,3-DPG**

D. PATHOLOGIES DE L'HEMOGLOBINE et Anomalies de structure

F. LA MYOGLOBINE



MyoGglobine: 1 chaîne polypeptidique + Hème

FIN