Structure et fonction des immunoglobulines
Isotypie, allotypie et idiotypie
Fonctions associées

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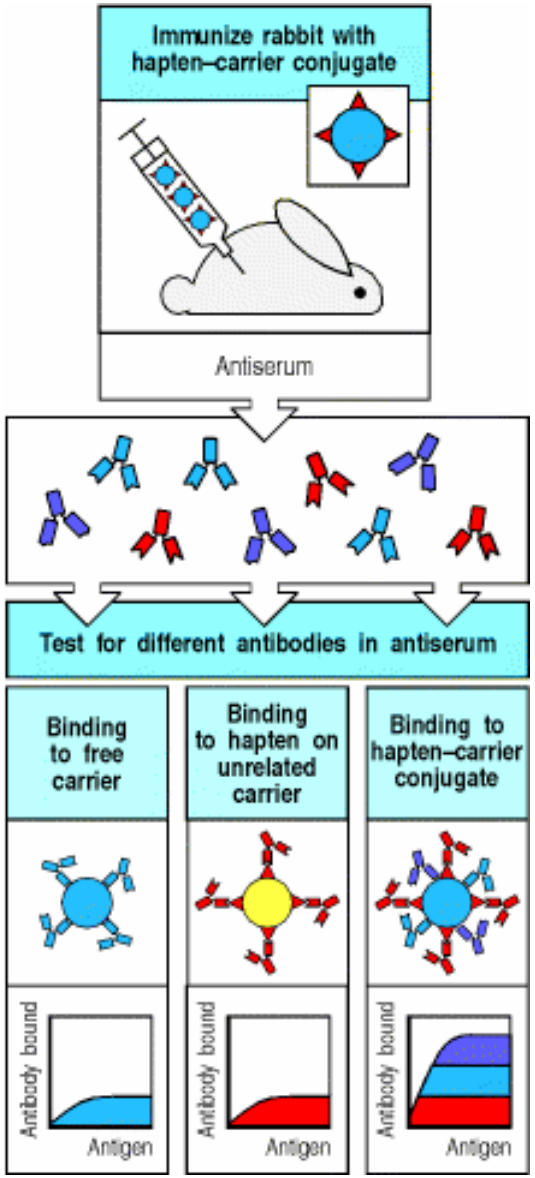
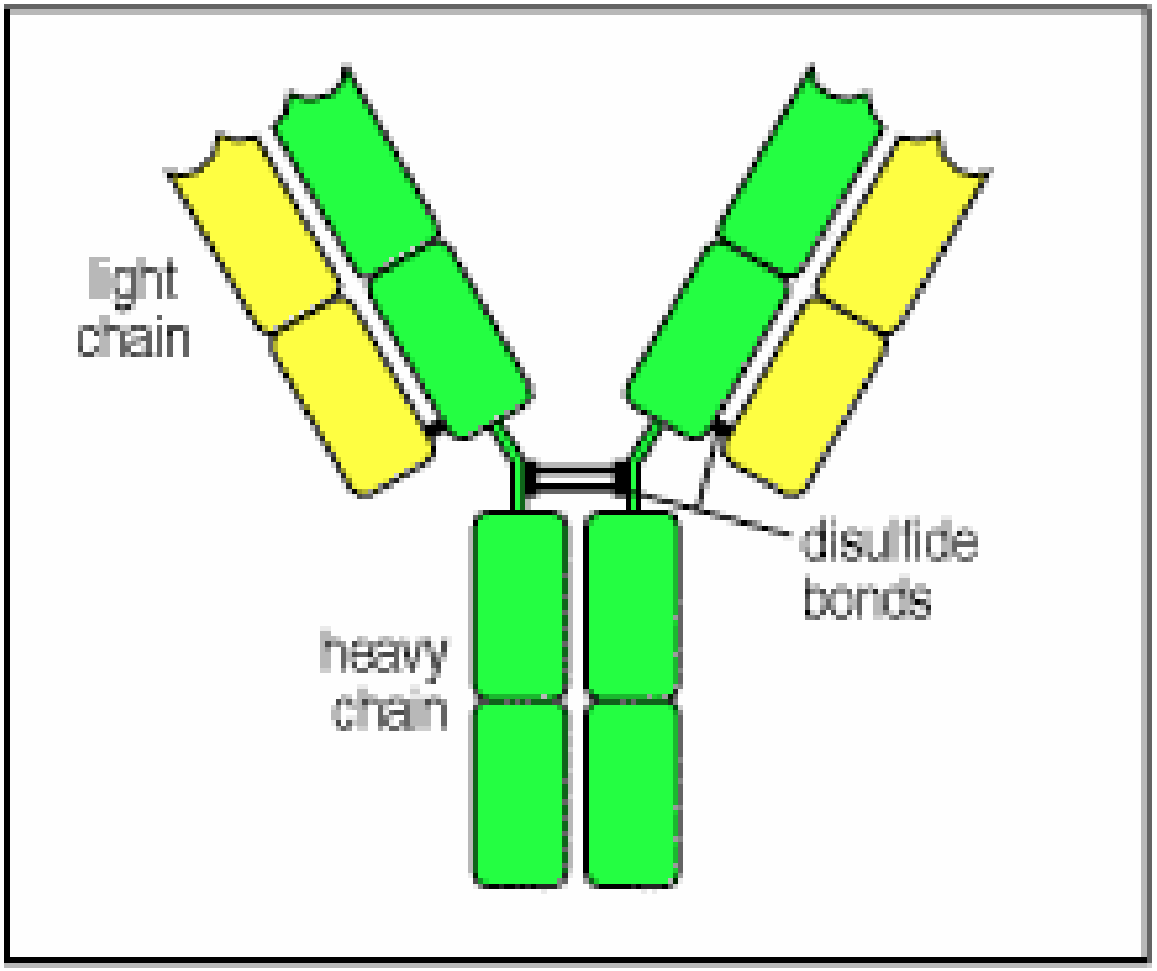
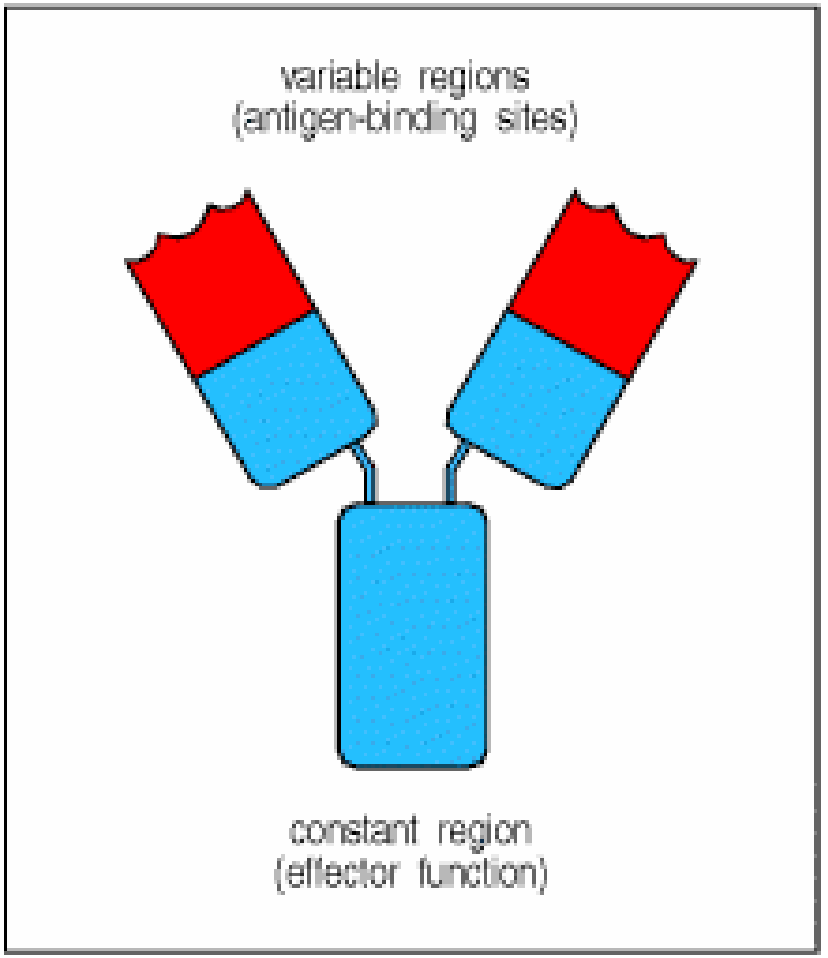
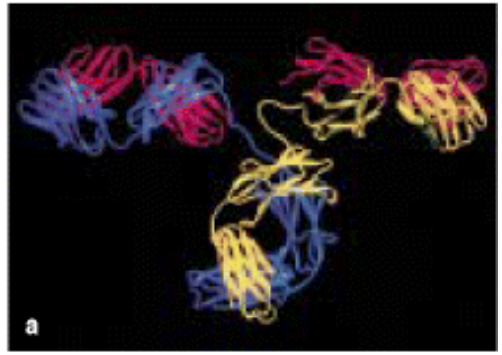
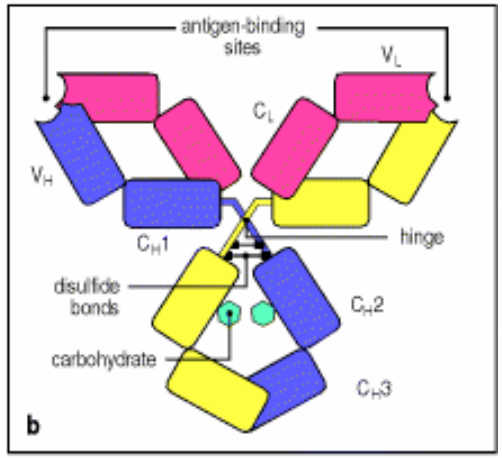
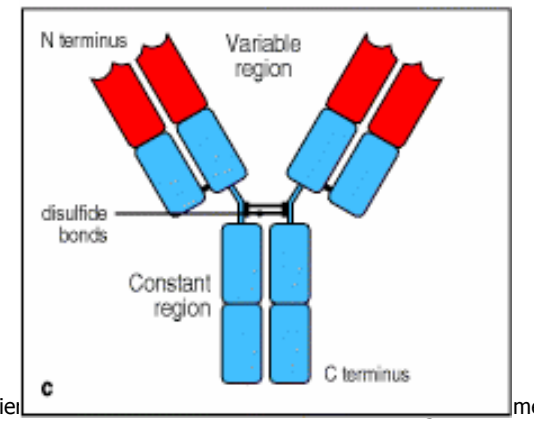

Immunize rabbit with hapten–carrier conjugate
Antiserum
Test for different antibodies in antiserum
Binding to free carrier
Binding to hapten on unrelated carrier
Binding to hapten–carrier conjugate
Antibody bound
Antigen
Antibody bound
Antigen
Antibody bound
Antigen

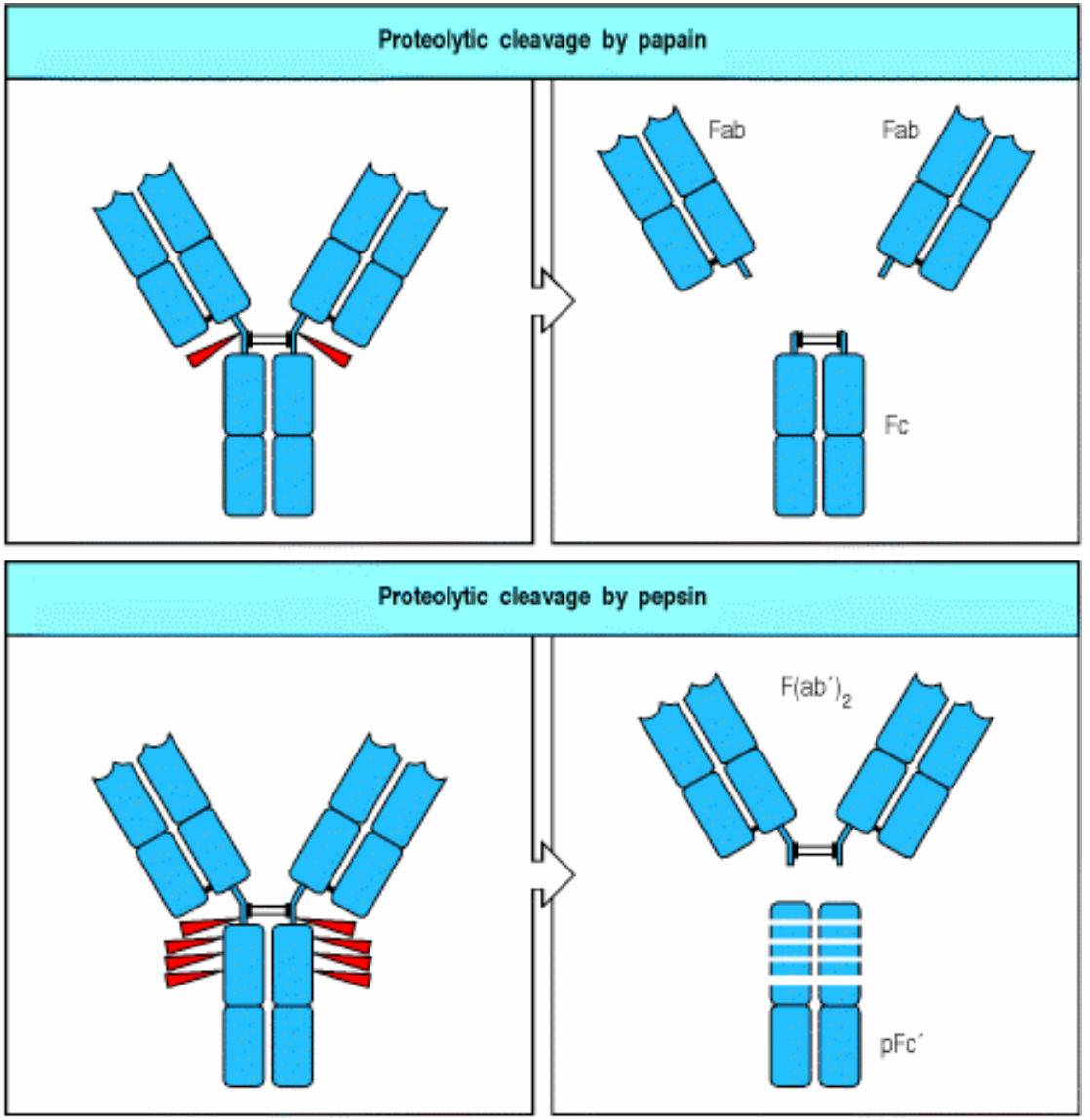

light
chain
disulfide
bonds
heavy
chain

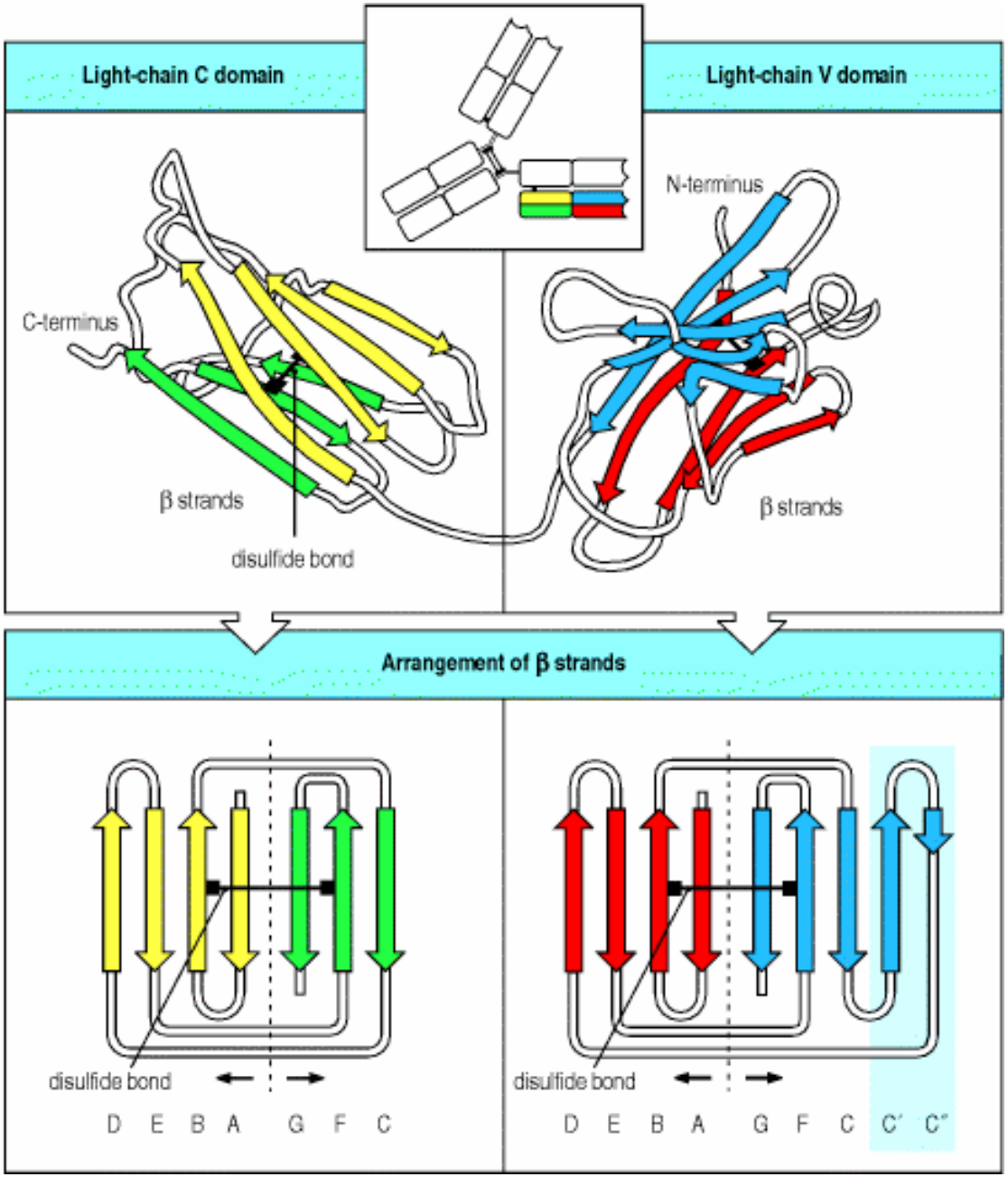

variable regions
(antigen-binding sites)
constant region
(effector function)

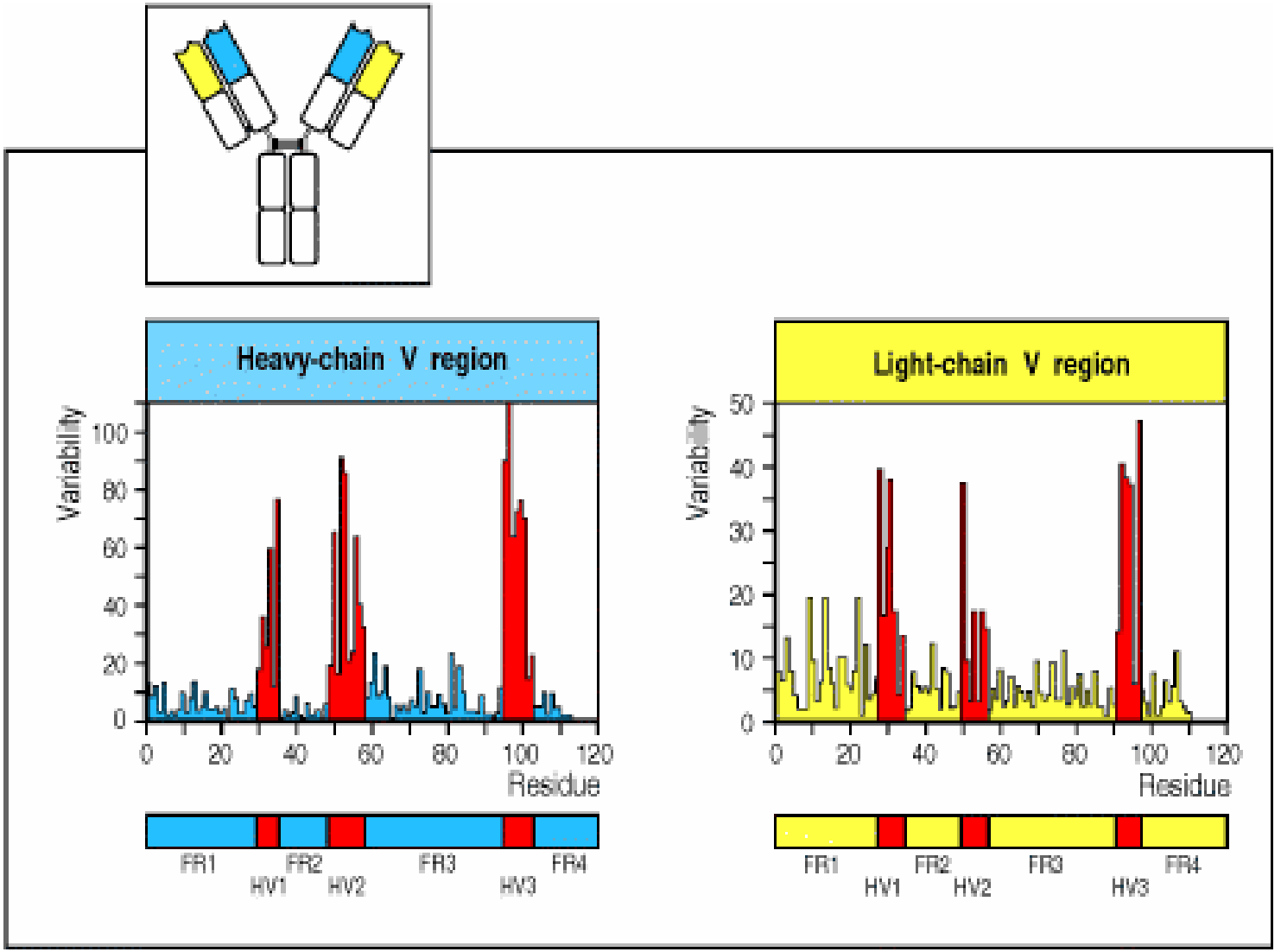

a

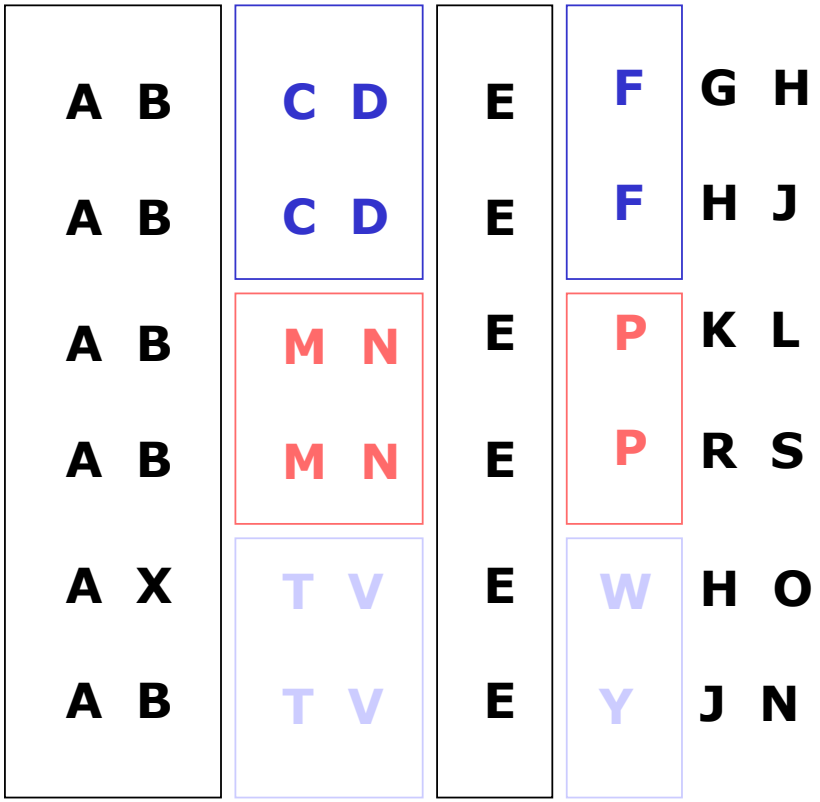

antigen-binding sites
V_L
C_L
V_H
hinge
C_H1
disulfide bonds
C_H2
carbohydrate
C_H3
b

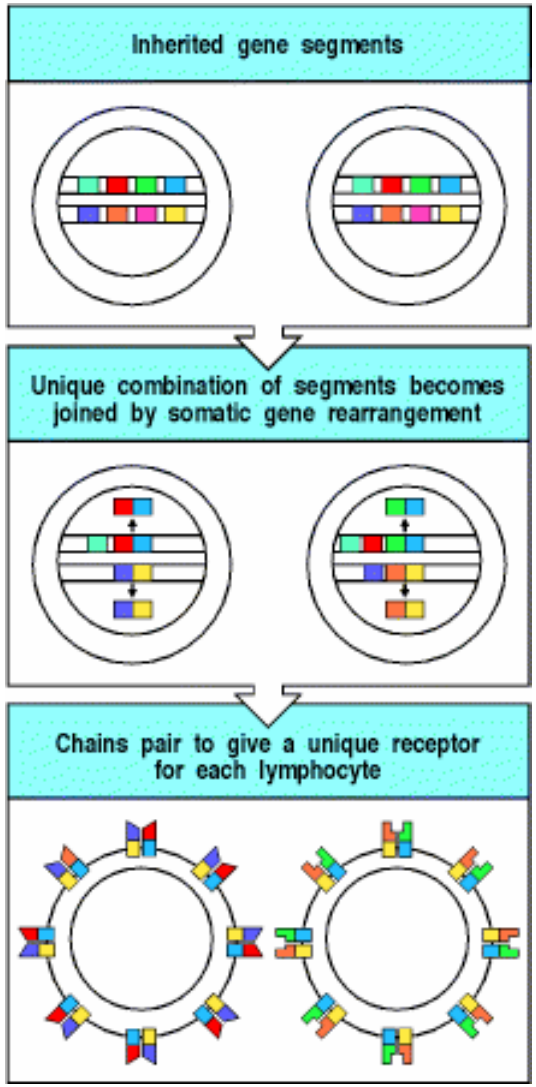

N terminus
Variable region
disulfide bonds
Constant region
C terminus
c

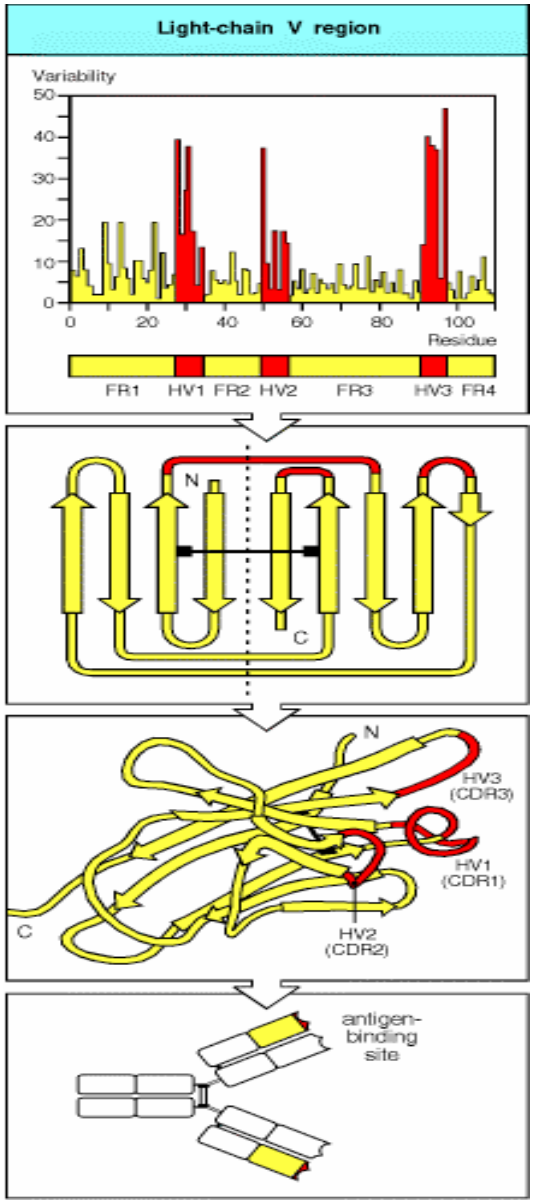

Proteolytic cleavage by papain
Fab
Fab
Fc
Proteolytic cleavage by pepsin
F(ab')2
pFc'

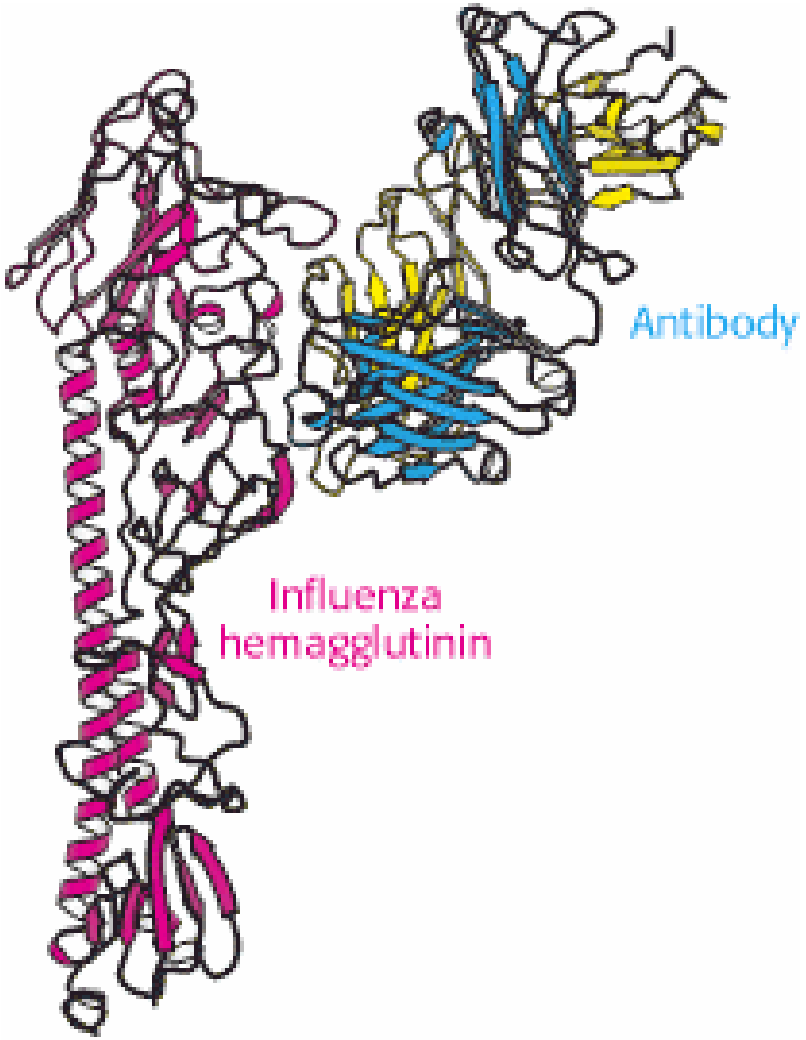

Light-chain C domain
Light-chain V domain
C-terminus
β strands
disulfide bond
N-terminus
β strands
Arrangement of β strands
disulfide bond
D E B A G F C
disulfide bond
D E B A G F C C′ C″

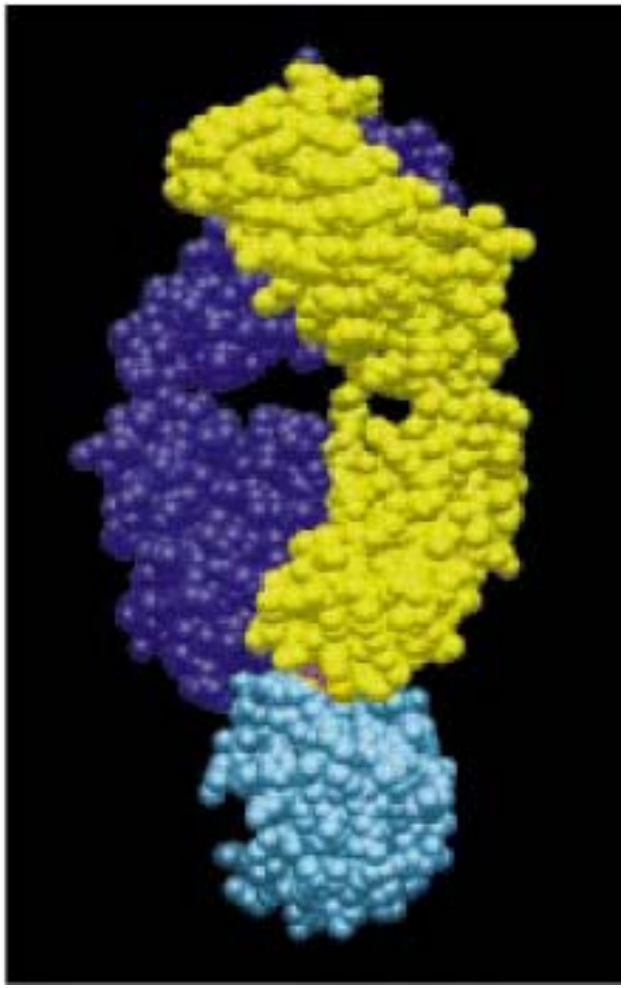

Heavy-chain V region
Variability
100
80
60
40
20
0
0
20
40
60
80
100
120
Residue
FR1
HV1
FR2
HV2
FR3
HV3
FR4
Light-chain V region
Variability
50
40
30
20
10
0
0
20
40
60
80
100
120
Residue
FR1
HV1
FR2
HV2
FR3
HV3
FR4

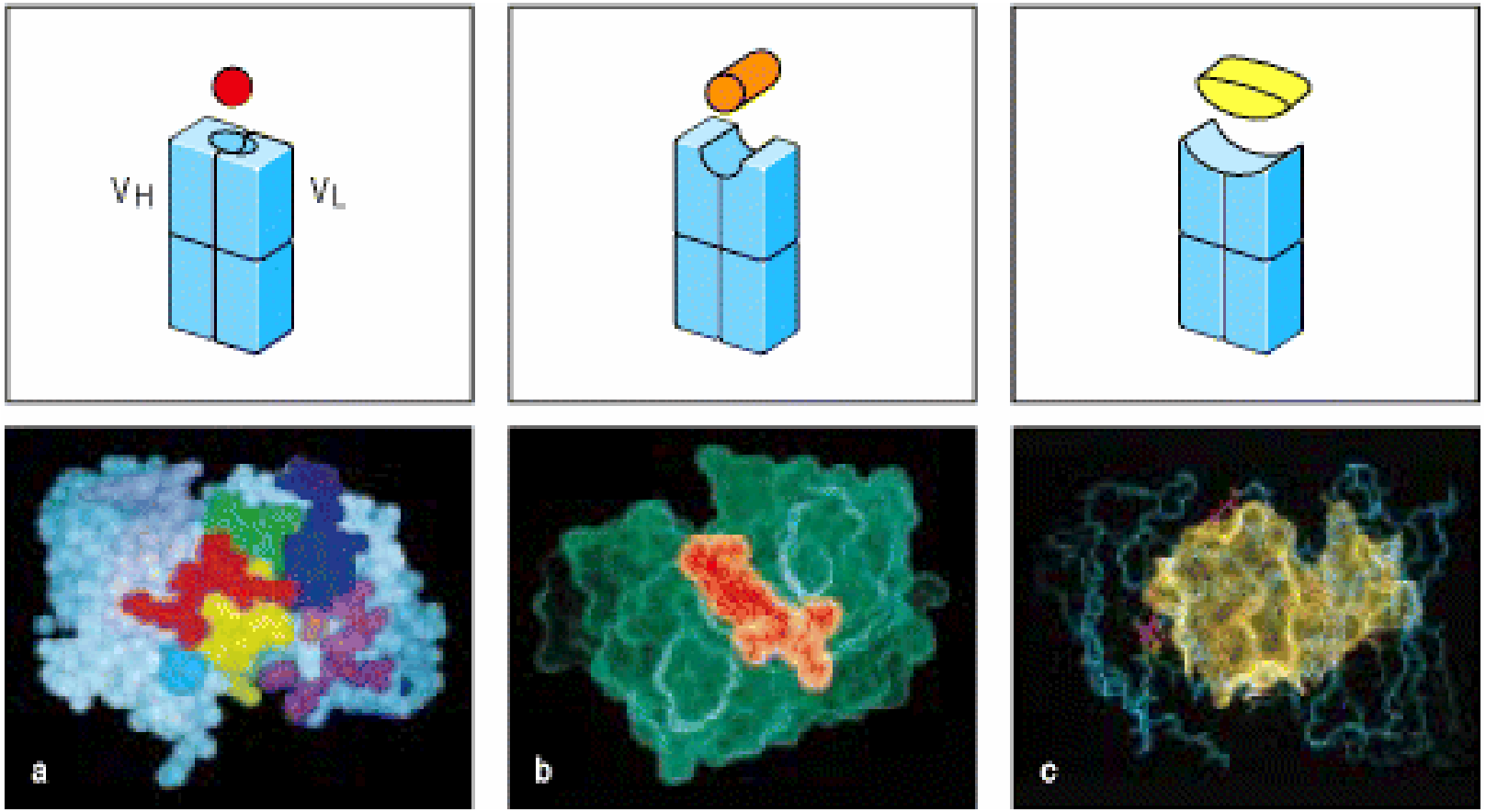

A B C D E F G H
A B C D E F H J
A B M N E P K L
A B M N E P R S
A X T V E W H O
A B T V E Y J N

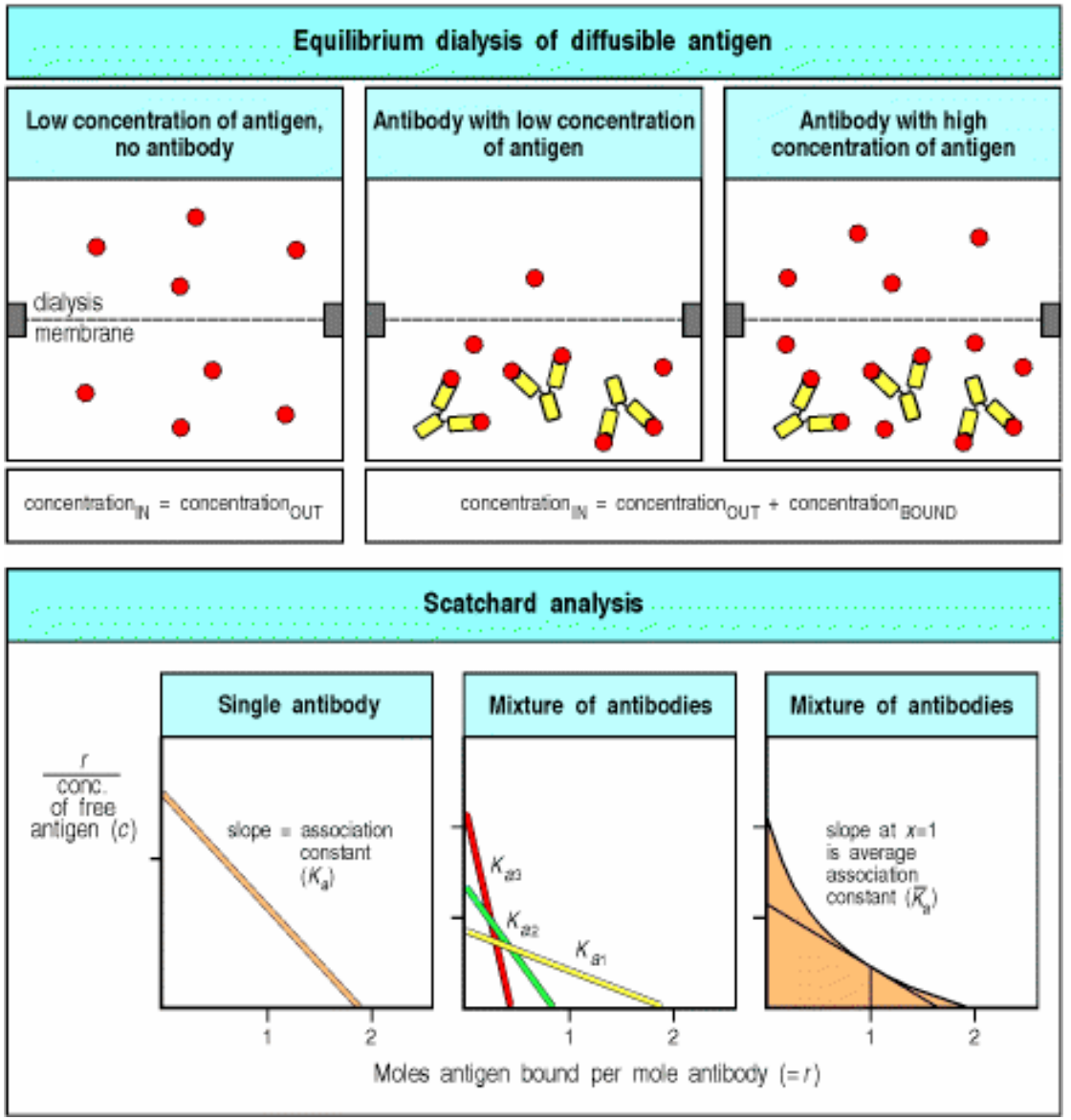

Inherited gene segments
Unique combination of segments becomes joined by somatic gene rearrangement
Chains pair to give a unique receptor for each lymphocyte

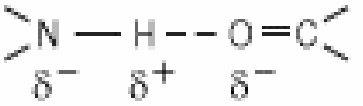
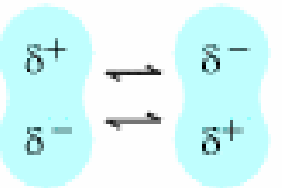
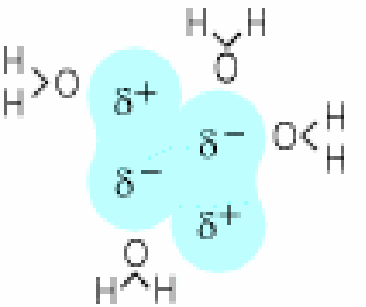

Light-chain V region
Variability
50
40
30
20
10
0
0
20
40
60
80
100
Residue
FR1
HV1
FR2
HV2
FR3
HV3
FR4
N
C
N
HV3
(CDR3)
HV1
(CDR1)
C
HV2
(CDR2)
antigen-
binding
site

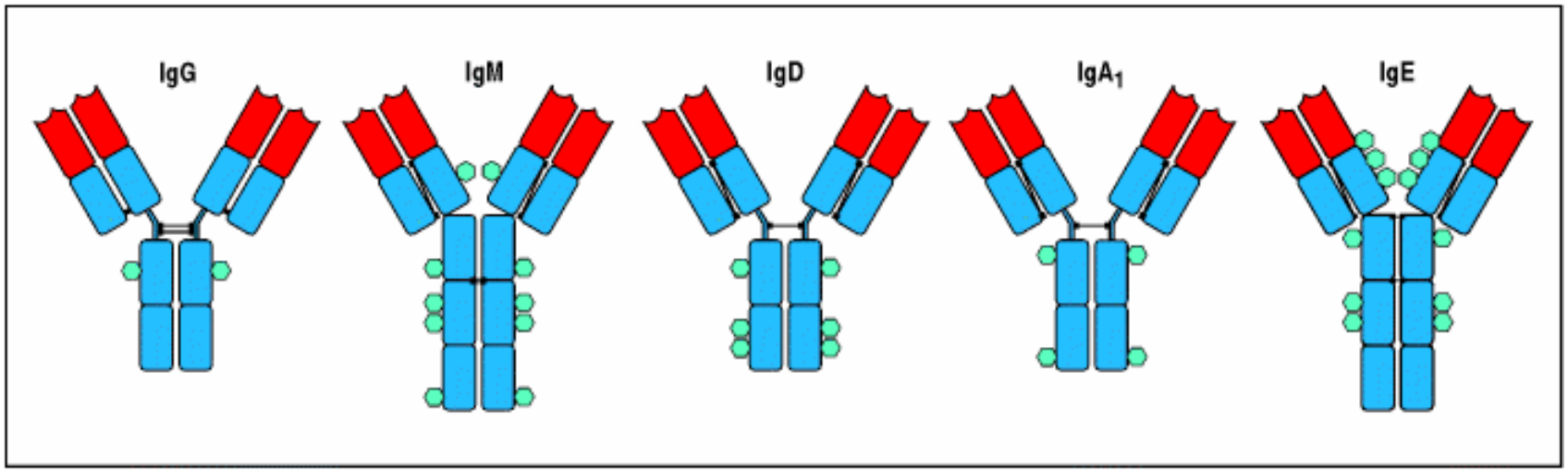

Antibody
Influenza
hemagglutinin

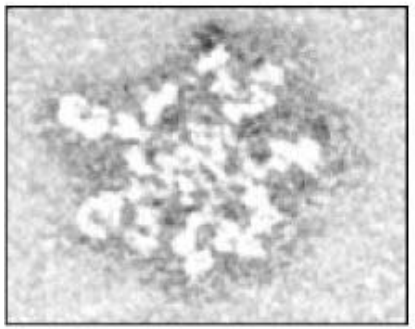


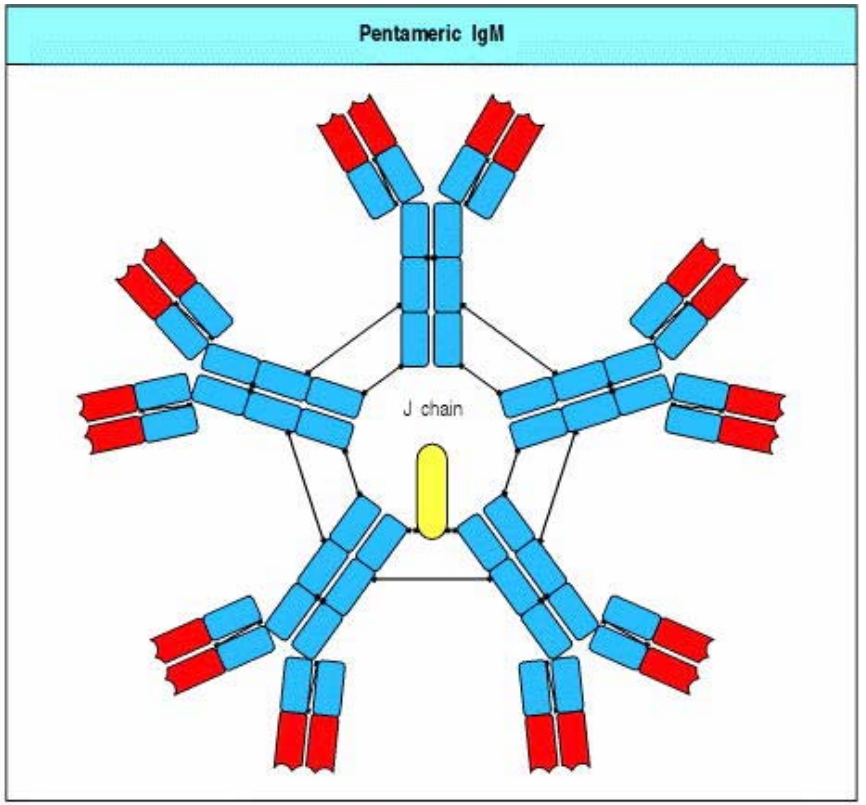

VH
VL
a
b
c

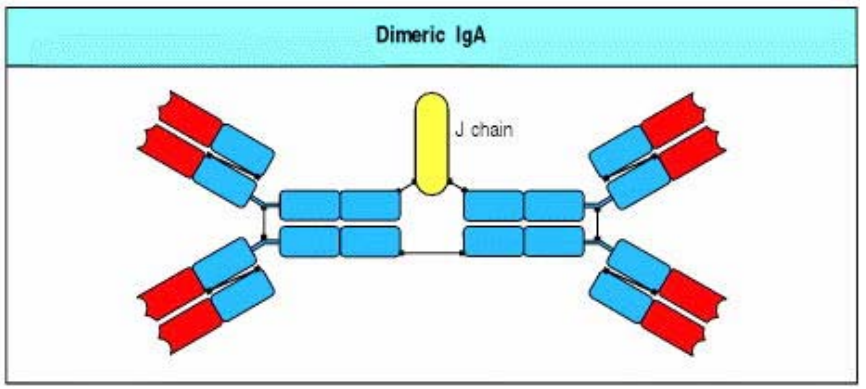

Equilibrium dialysis of diffusible antigen
Low concentration of antigen, no antibody
Antibody with low concentration of antigen
Antibody with high concentration of antigen
dialysis membrane
concentration$_{IN}$ = concentration$_{OUT}$
concentration$_{IN}$ = concentration$_{OUT}$ + concentration$_{BOUND}$
Scatchard analysis
Single antibody
Mixture of antibodies
Mixture of antibodies
$\frac{r}{\text{conc. of free antigen } (c)}$
slope = association constant (K_a)
K_{a3}
K_{a2}
K_{a1}
slope at x=1 is average association constant ($\overline{K}_a$)
1
2
Moles antigen bound per mole antibody (= r)

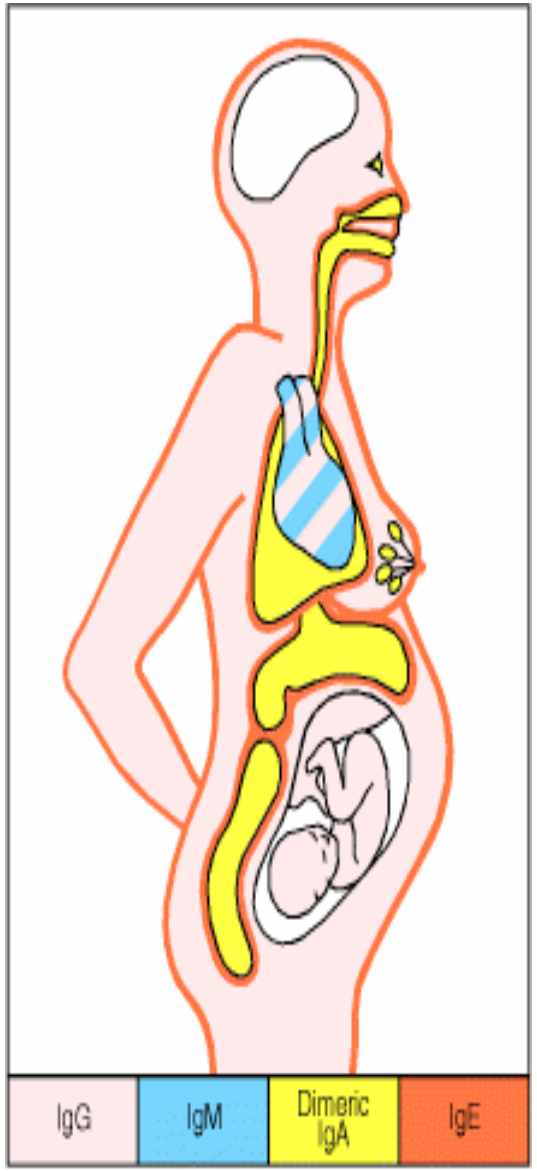
Noncovalent forces	Origin	
Electrostatic forces	Attraction between opposite charges	
Hydrogen bonds	Hydrogen shared between electronegative atoms (N,O)	
Van der Waals forces	Fluctuations in electron clouds around molecules oppositely polarize neighboring atoms	
Hydrophobic forces	Hydrophobic groups interact unfavorably with water and tend to pack together to exclude water molecules. The attraction also involves van der Waals forces	

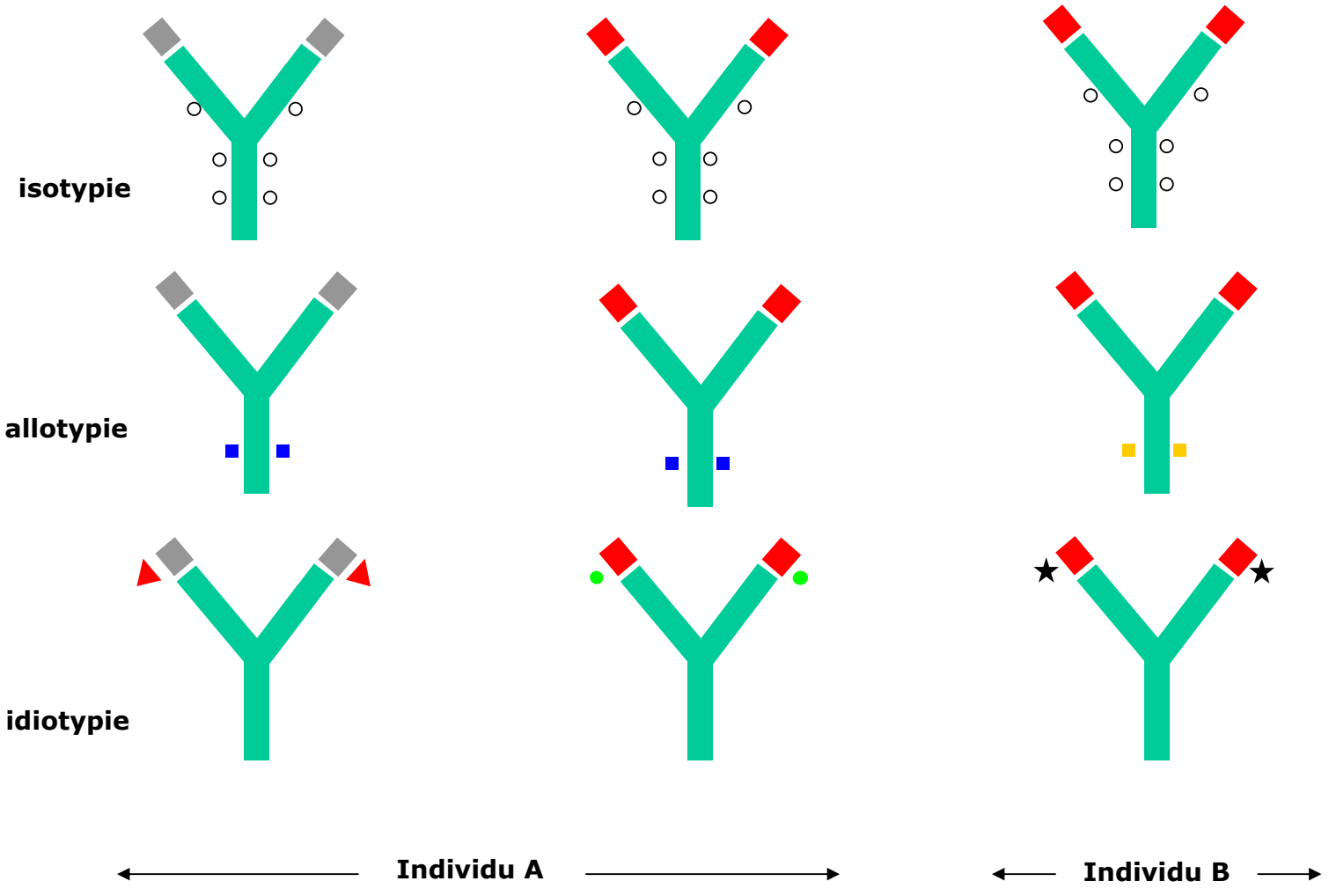

IgG
IgM
IgD
IgA1
IgE



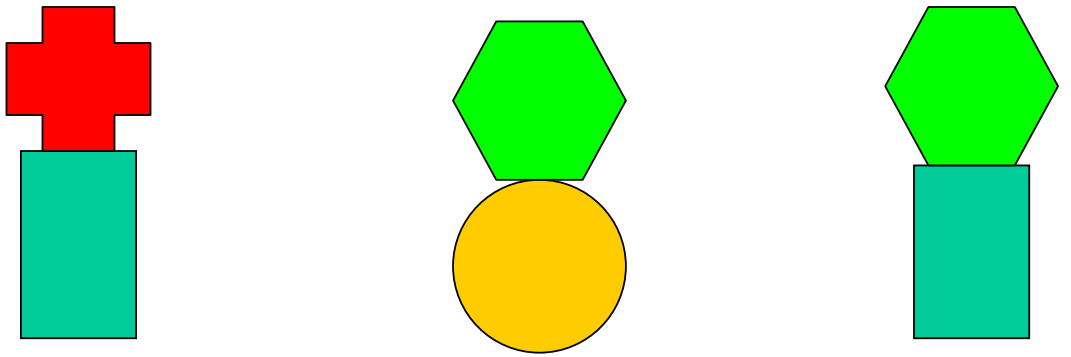

Pentameric IgM
J chain


Dimeric IgA
J chain


IgG
IgM
Dimeric IgA
IgE


isotypie
allotypie
idiotypie
Individu A
Individu B

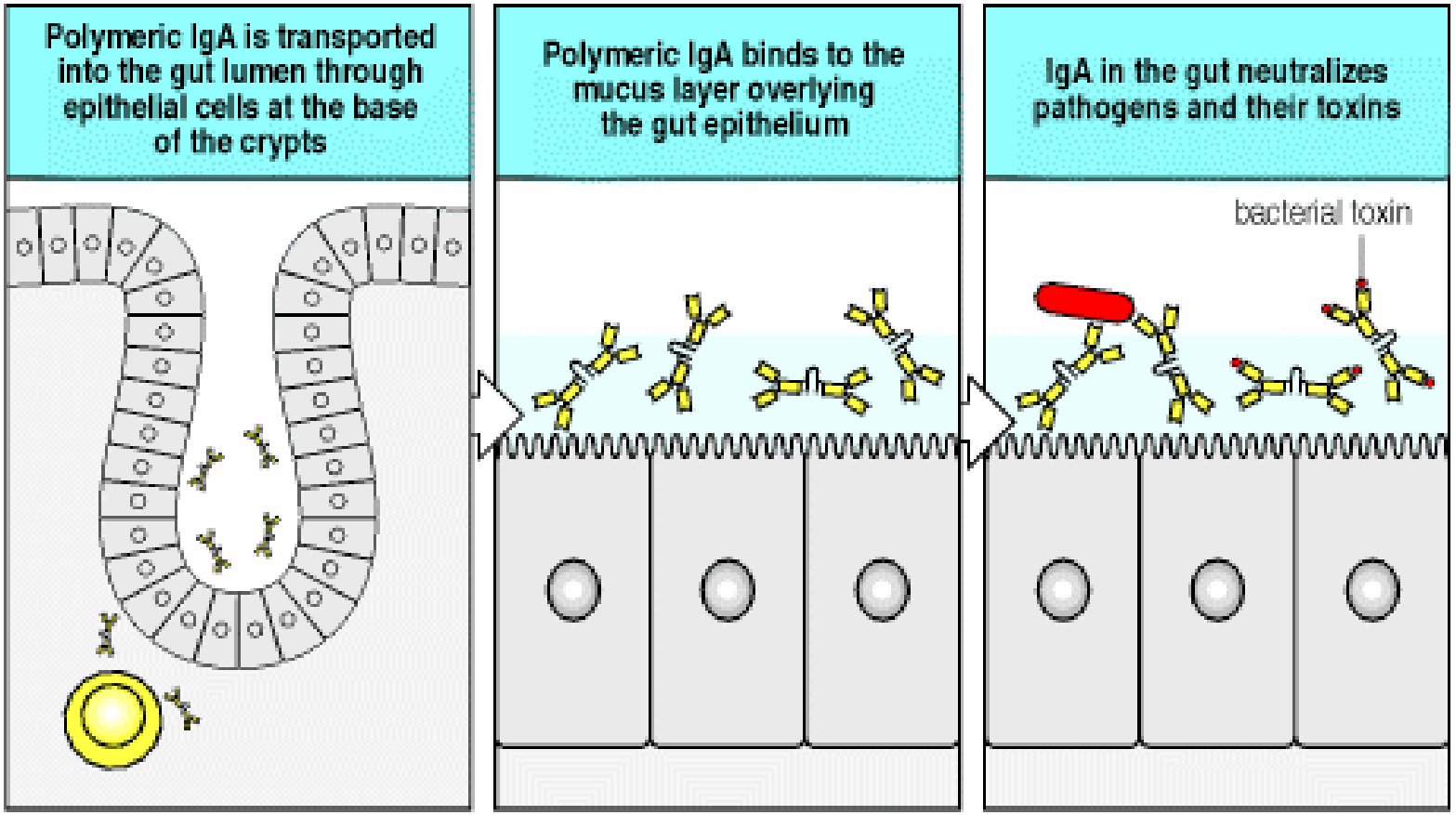
fonction spécifique = fonction anticorps

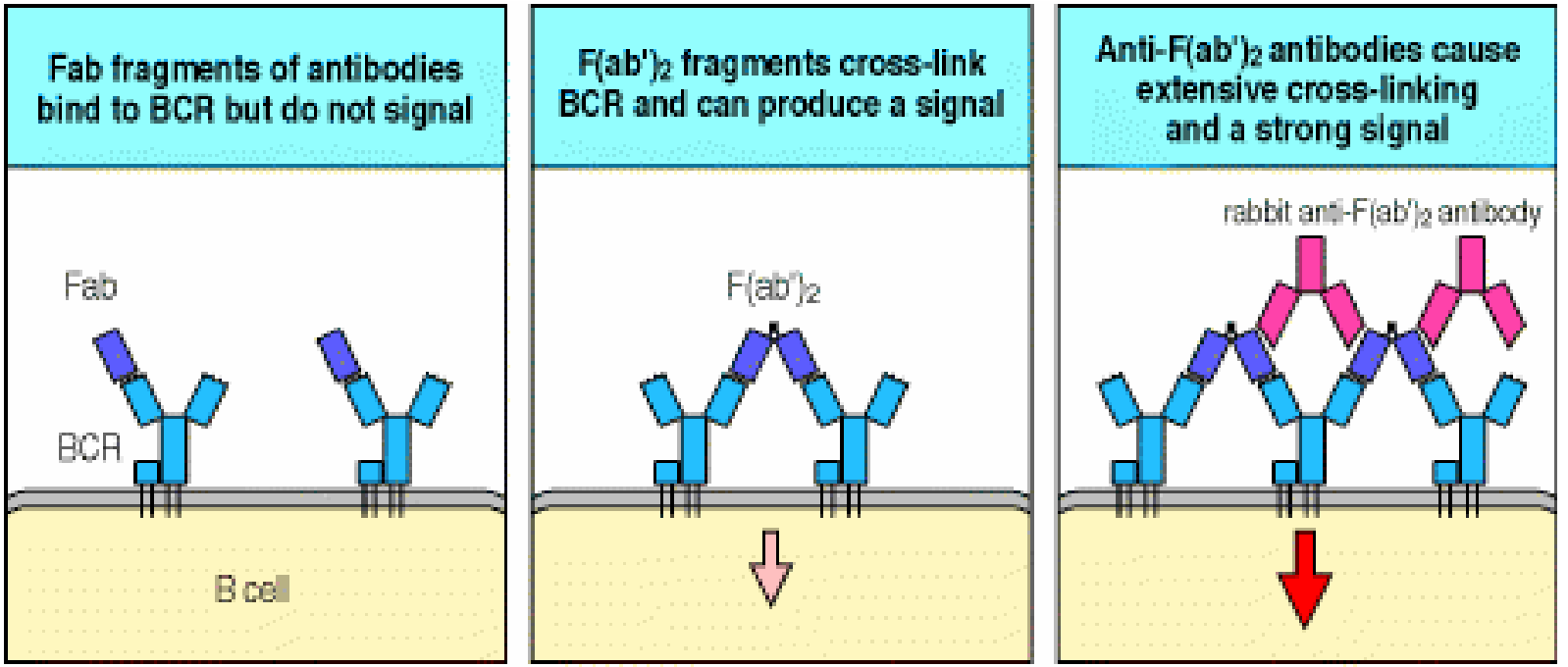


fonction non spécifique = fonction effectrice

Functional activity	IgM	IgD	IgG1	IgG2	IgG3	IgG4	IgA	IgE
Neutralization	+	–	++	++	++	++	++	–
Opsonization	–	–	+++	*	++	+	+	–
Sensitization for killing by NK cells	–	–	++	–	++	–	–	–
Sensitization of mast cells	–	–	+	–	+	–	–	+++
Activates complement system	+++	–	++	+	+++	–	+	–

Distribution	IgM	IgD	IgG1	IgG2	IgG3	IgG4	IgA	IgE
Transport across epithelium	+	–	–	–	–	–	+++ (dimer)	–
Transport across placenta	–	–	+++	+	++	+/–	–	–
Diffusion into extravascular sites	+/–	–	+++	+++	+++	+++	++ (monomer)	+
Mean serum level (mg ml^{-1})	1.5	0.04	9	3	1	0.5	2.1	$3x10^{-5}$


Polymeric IgA is transported into the gut lumen through epithelial cells at the base of the crypts
Polymeric IgA binds to the mucus layer overlying the gut epithelium
IgA in the gut neutralizes pathogens and their toxins
bacterial toxin


Fab fragments of antibodies bind to BCR but do not signal
Fab
BCR
B cell
F(ab')2 fragments cross-link BCR and can produce a signal
F(ab')2
Anti-F(ab')2 antibodies cause extensive cross-linking and a strong signal
rabbit anti-F(ab')2 antibody