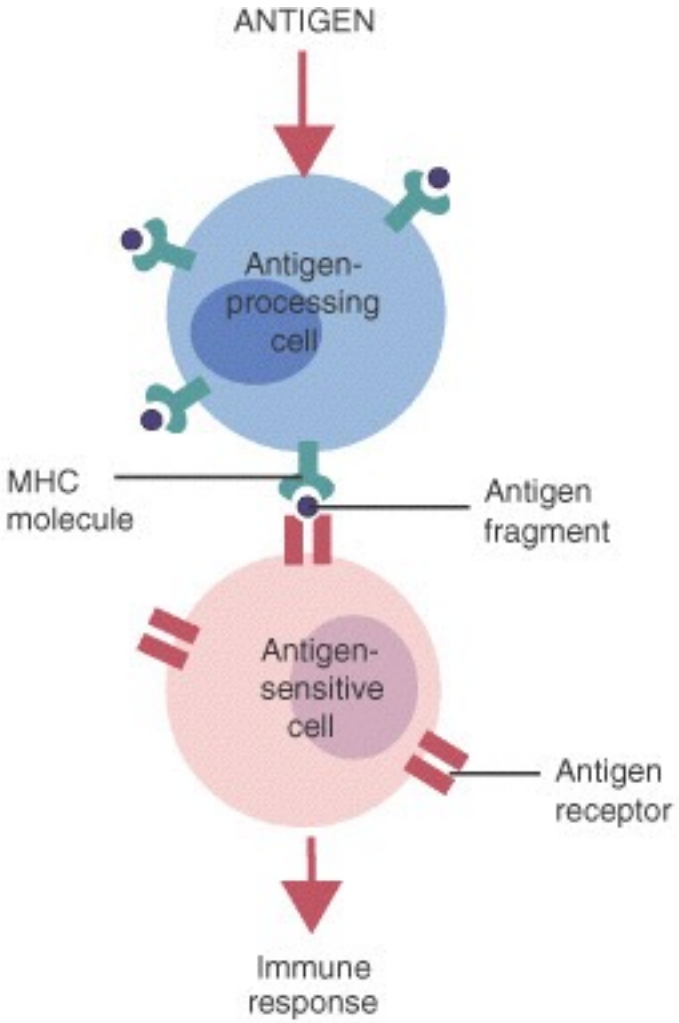


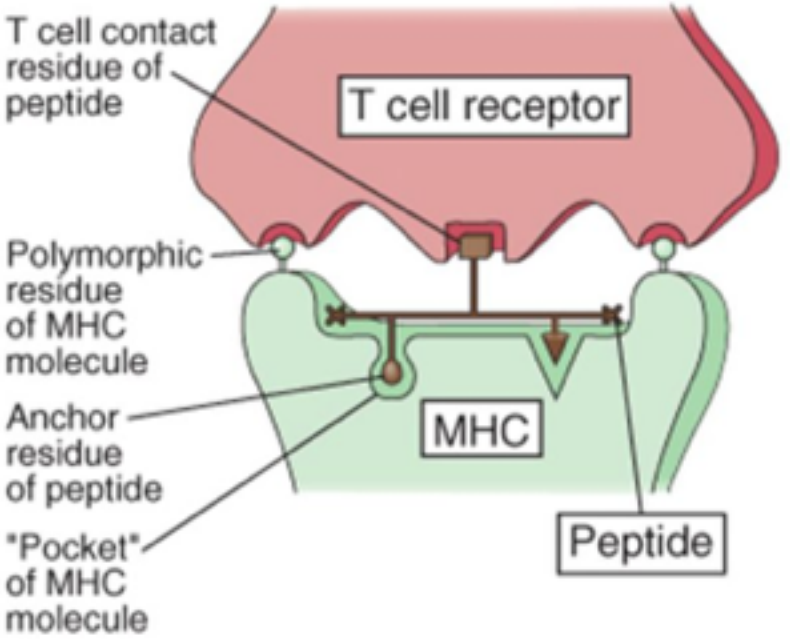


FIGURE 9-1 The key initial step in any immune response is the presentation of antigens by antigen-processing cells to antigen-sensitive cells. This step is performed by major histocompatibility complex *(MHC)* molecules located on the surface of antigen-processing cells.

As moléculas de MHC são polimórficas e poligênicas

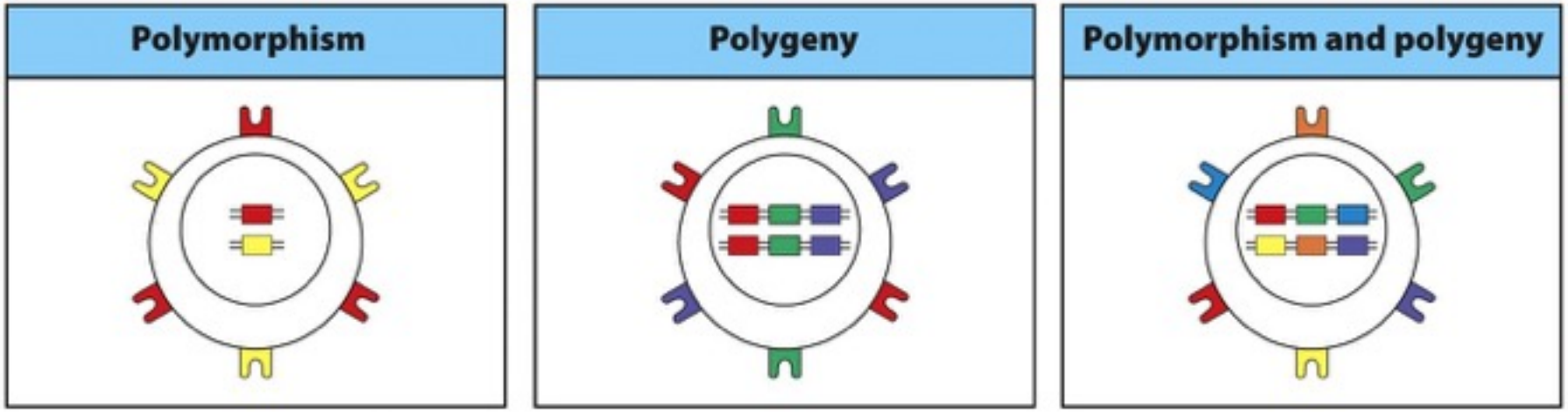


Figure 6.17 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Este indivíduo consegue apresentar um número maior de moléculas diferentes por ser heterozigoto.

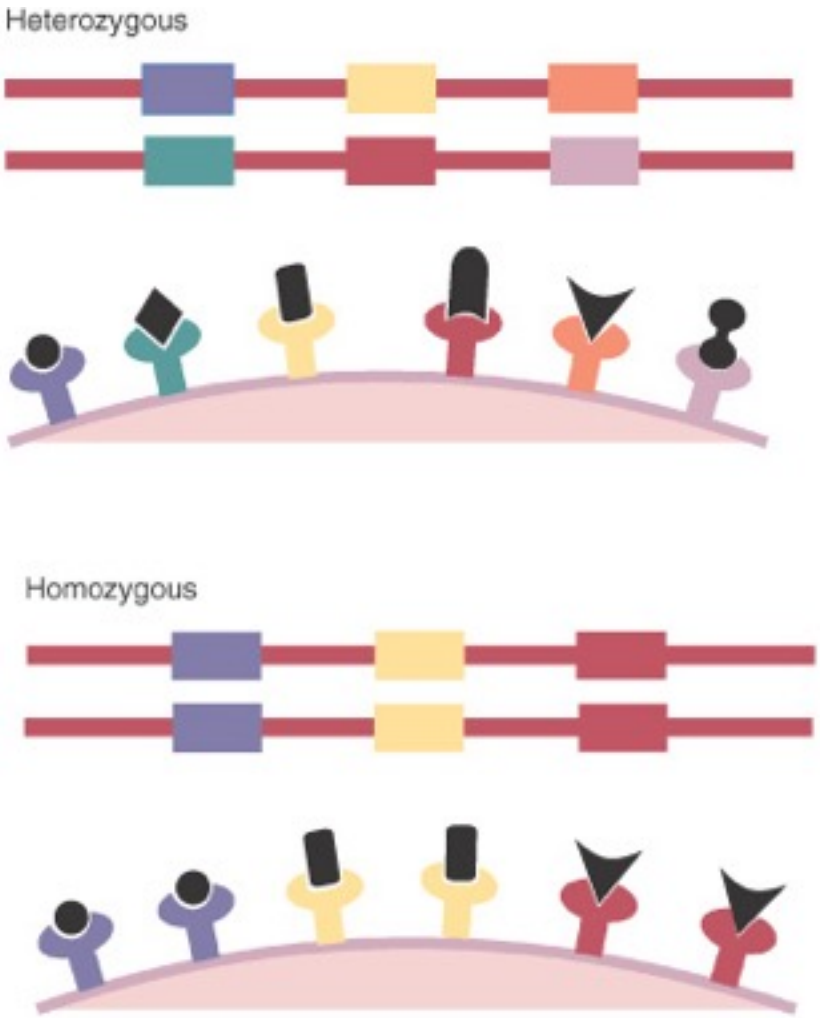


FIGURE 9-13 Heterozygous animals with two types of major histocompatibility complex (MHC) molecule coded for at each locus express six different antigen-presenting molecules on the cell surface. Therefore they generate a more diverse and effective immune response than homozygous animals with only one MHC molecule coded for at each locus. An example of heterozygote advantage.

1,7 x 10^{18} combinações gênicas possíveis para MHC (humanos)

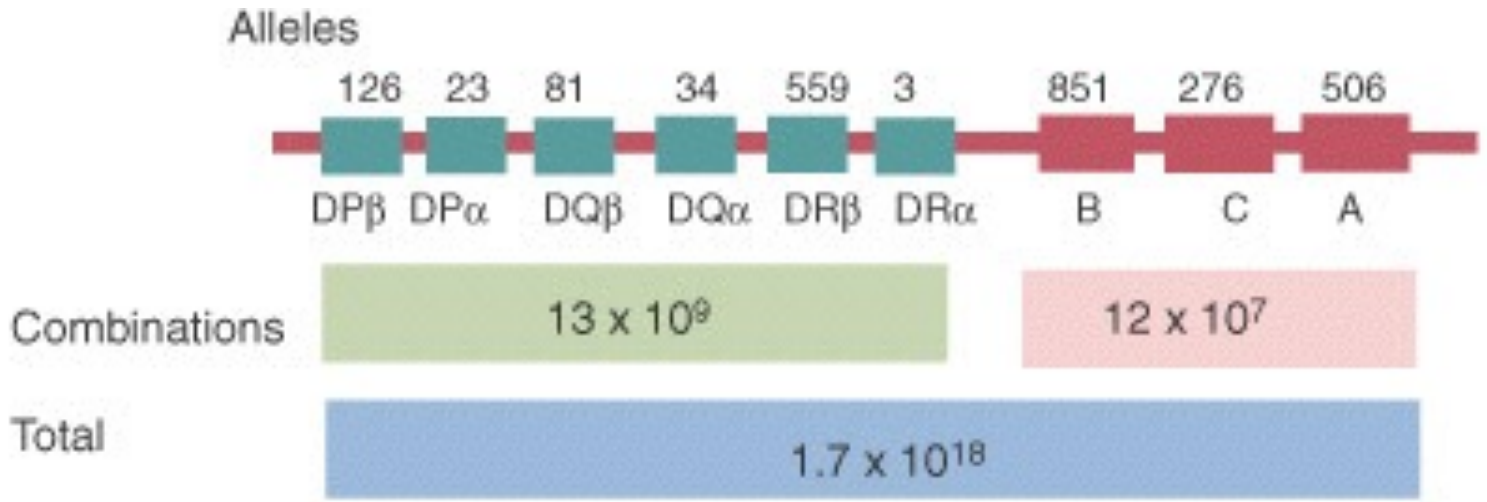
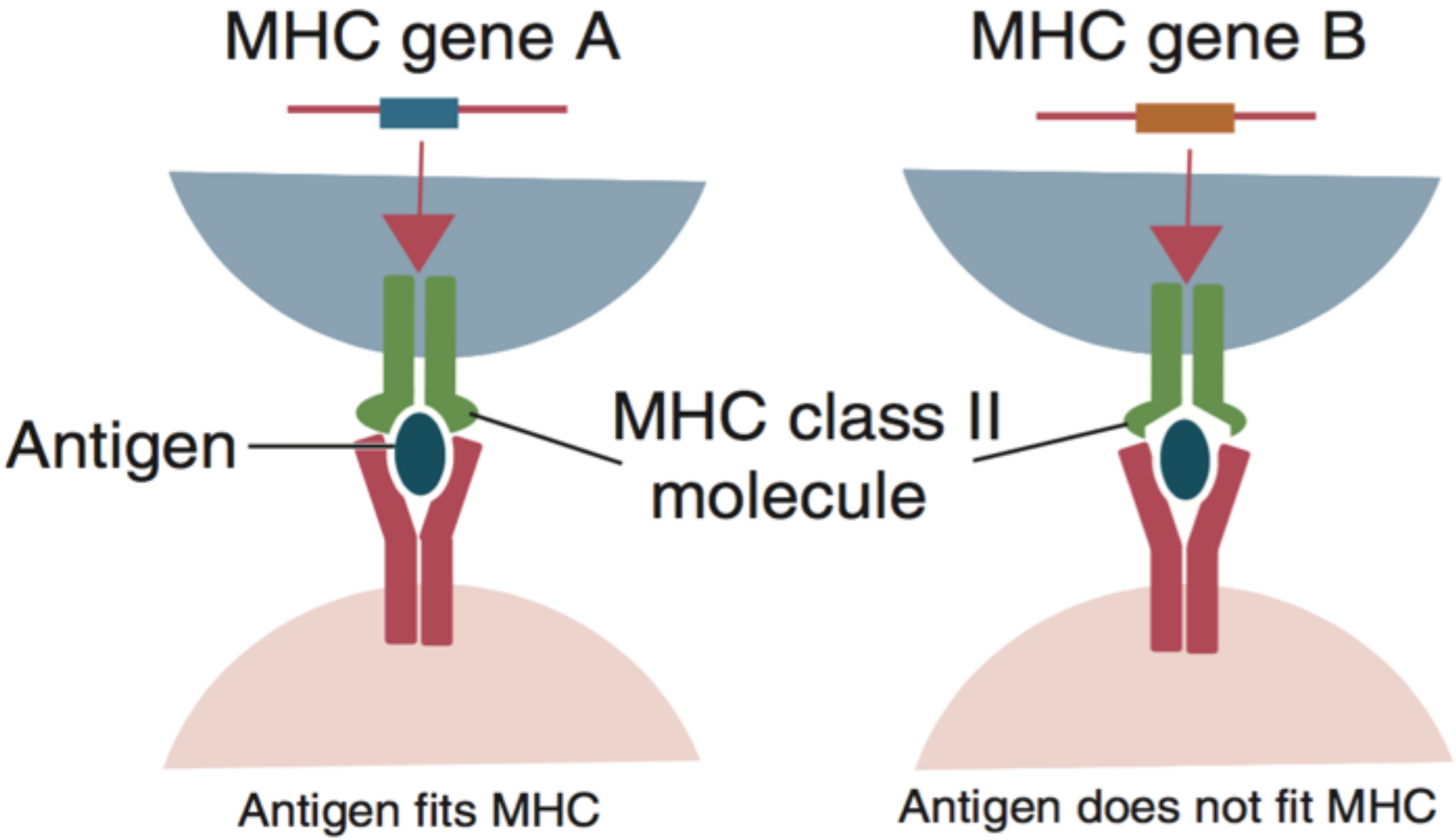
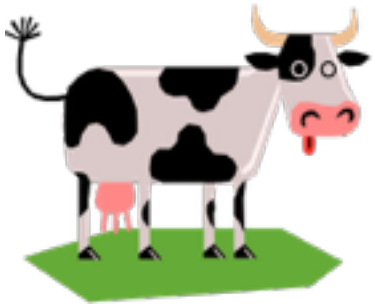


FIGURE 9-15 An example of how major histocompatibility complex (MHC) polymorphism can generate an enormous number of different MHC haplotypes. The numbers above each locus are the number of identified alleles in the human MHC as of January 2007. The number of different combinations can be determined by multiplying all of them together. Thus there are 13×10^9 class II combinations, 12×10^7 class I combinations, and 1.7×10^{18} total possible combinations, more than sufficient to give every human a unique haplotype.


MHC gene A
MHC gene B
Antigen
MHC class II molecule
Antigen fits MHC
Antigen does not fit MHC
Immune response
No immune response

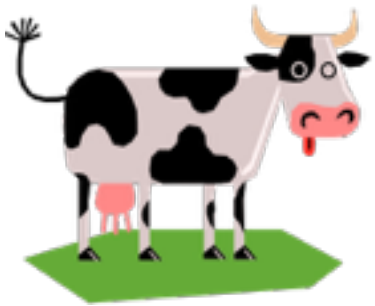
MHC II e susceptibilidade ao vírus da leucemia bovina (leucose bovina)



MHC II DRB3

Ácido glutâmico 70 (polar ácido)
Arginina 71 (polar básico)

RESISTENTE



MHC II DRB3

Valina 75 (apolar)
Asparagina 76 (neutro)
Treonina 77 (neutro)
Tirosina 78 (neutro aromático)

SUSCEPTÍVEL

Tissue	MHC class I	MHC class II
Lymphoid tissues		
T cells	+++	+*
B cells	+++	+++
Macrophages	+++	++
Dendritic cells	+++	+++
Epithelial cells of the thymus	+	+++
Other nucleated cells		
Neutrophils	+++	–
Hepatocytes	+	–
Kidney	+	–
Brain	+	–†
Nonnucleated cells		
Red blood cells	–	–

Figure 4.27 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

conceito importante!

*

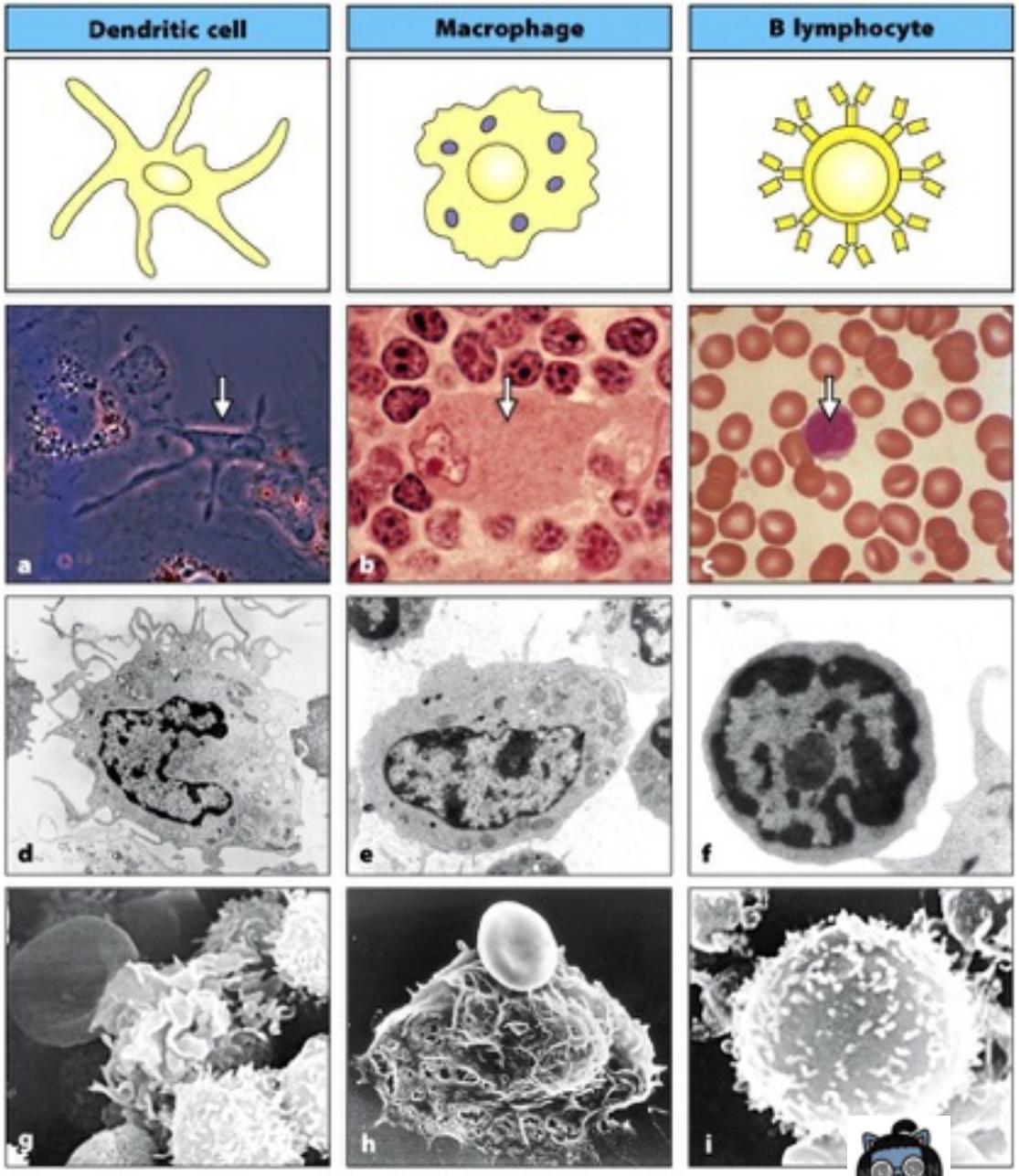


Figure 1.22 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Antigen
Presenting
Cell

Células
aPresentadoras
de Antígeno

expressam
MHC-II
além do
MHC-I

conceito importante!

profissional

semi-profissional

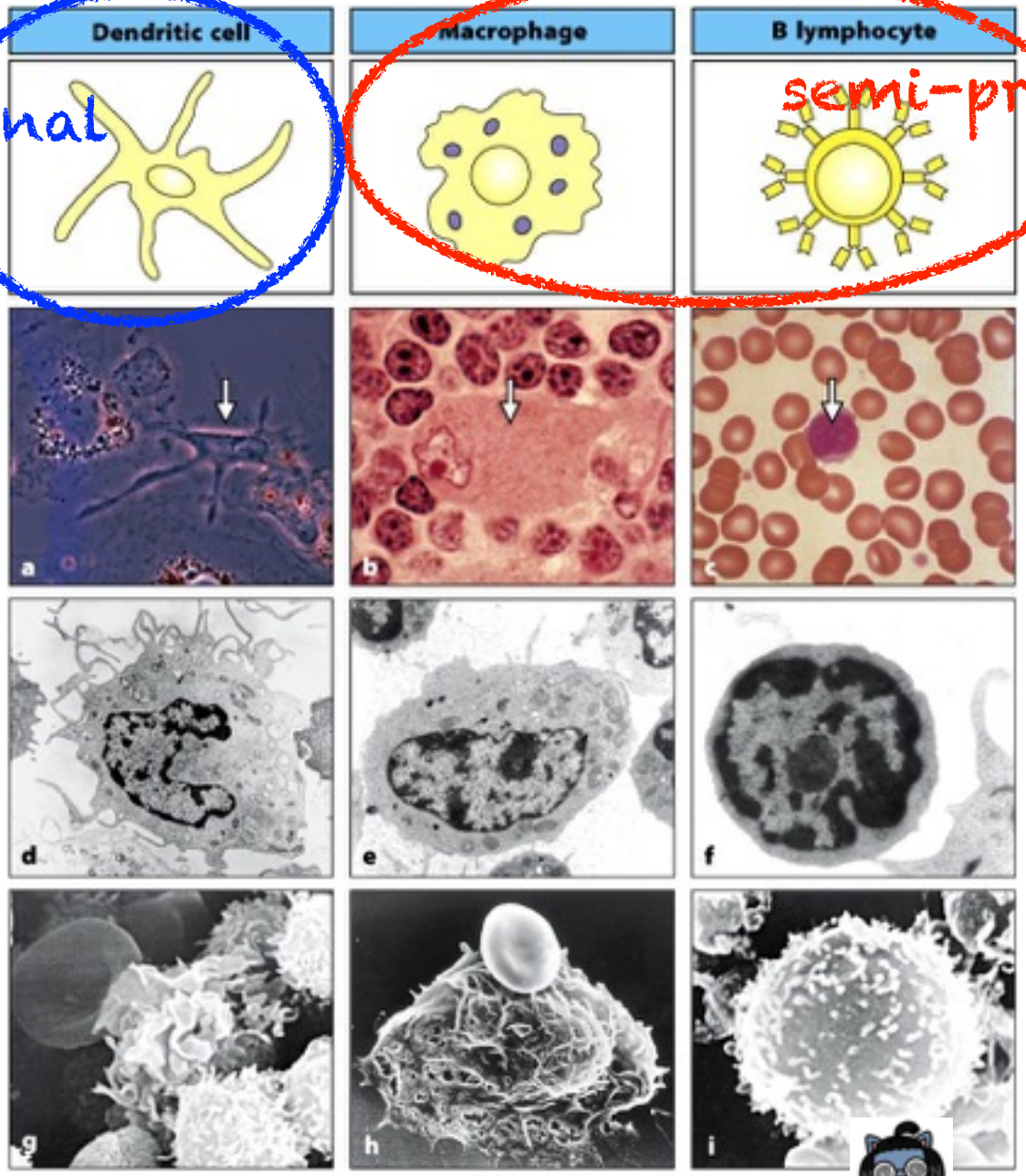


Figure 1.22 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

lisossomos pH alcalino

proteases ineficientes

proteólise incompleta

lisossomos pH ácido

proteases eficientes

proteólise completa

conceito importante!

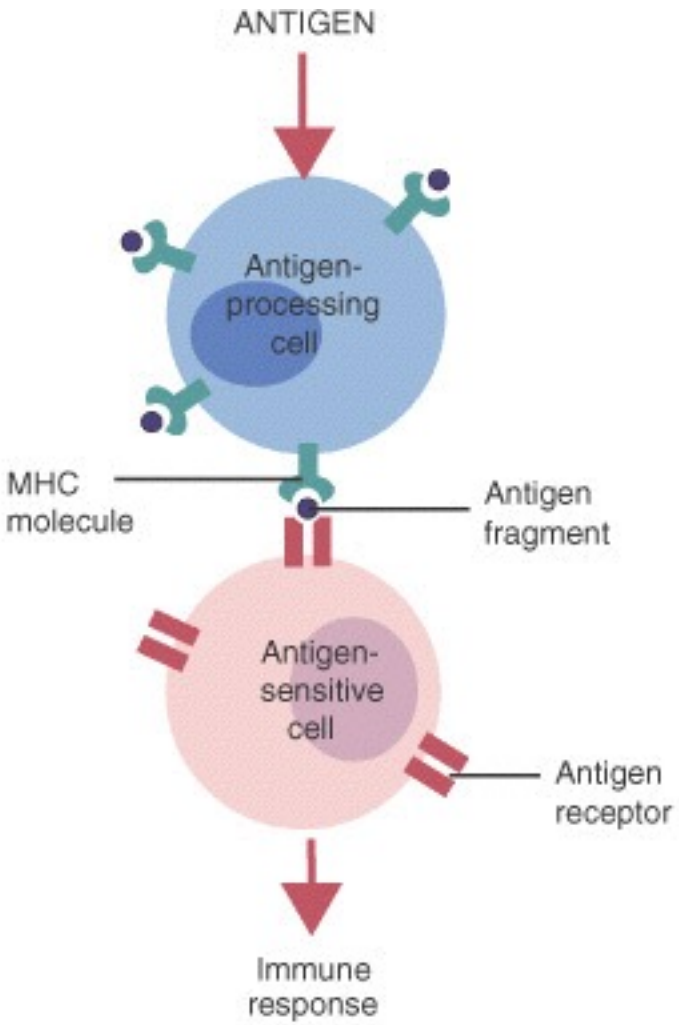
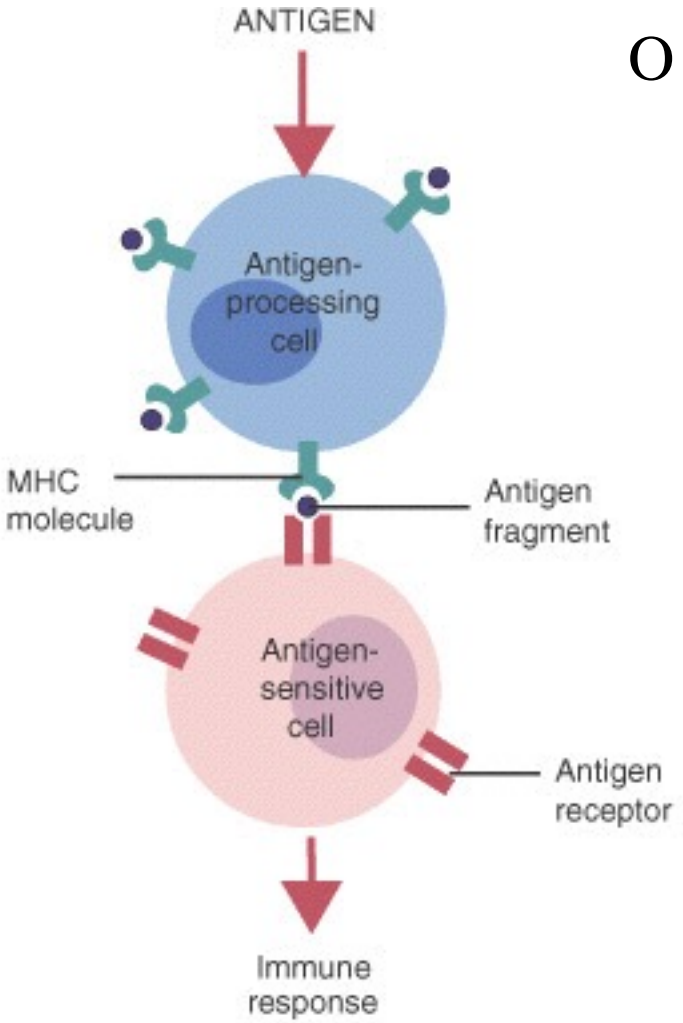


FIGURE 9-1 The key initial step in any immune response is the presentation of antigens by antigen-processing cells to antigen-sensitive cells. This step is performed by major histocompatibility complex *(MHC)* molecules located on the surface of antigen-processing cells.

processadora
x
apresentadora
x
APC (DC x B e Mø)

O que acontece com o linfócito T após reconhecer o antígeno?



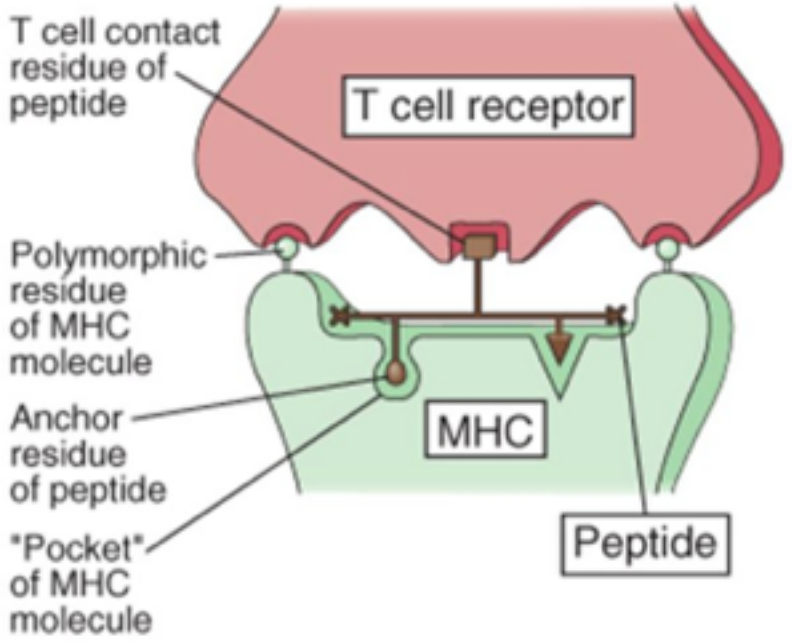
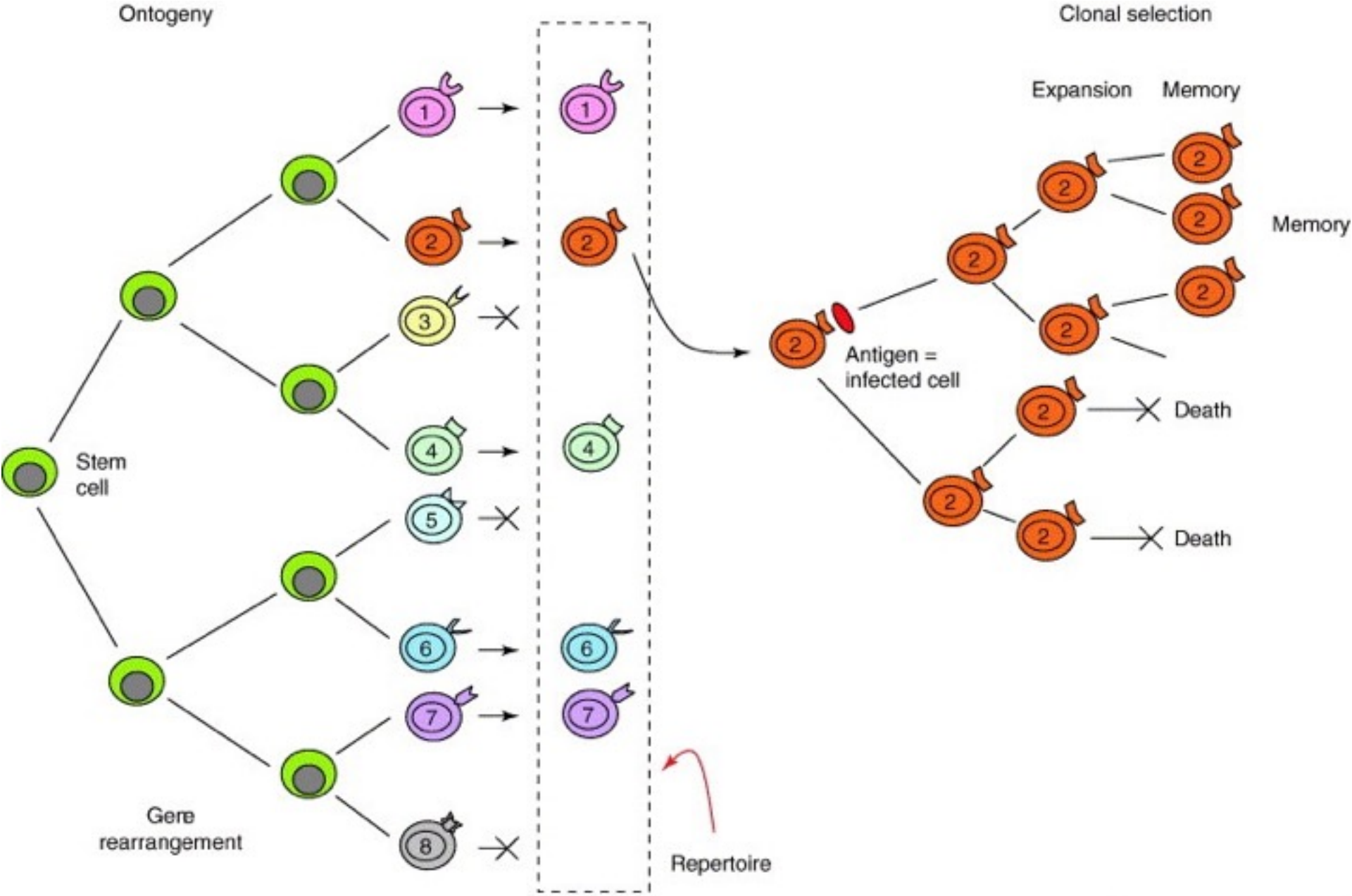
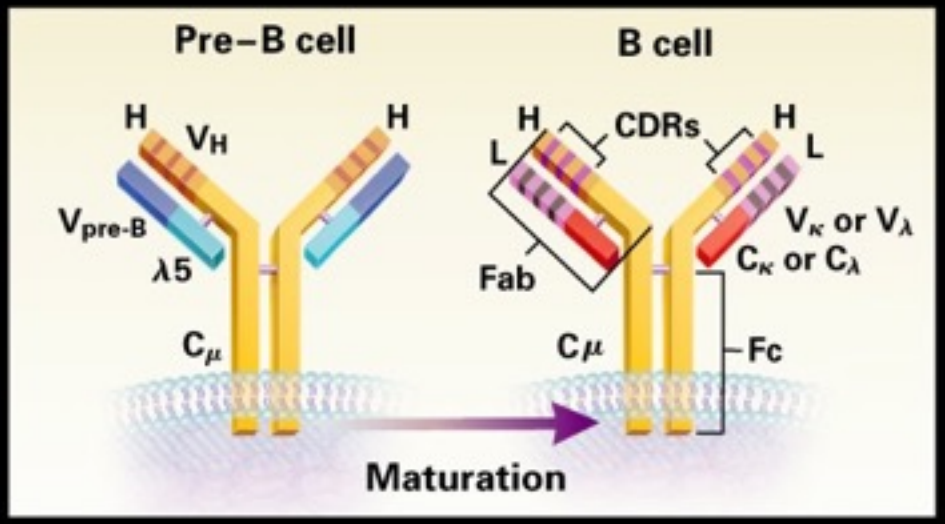


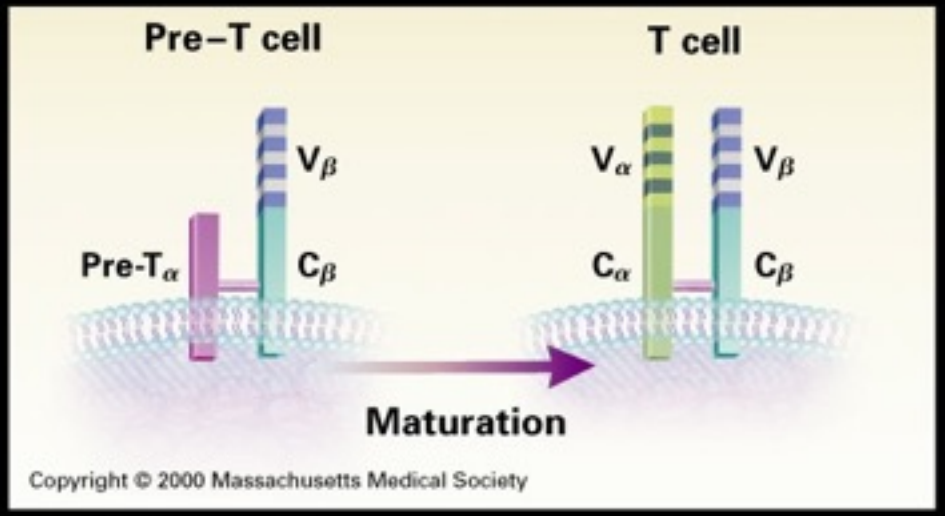
FIGURE 9-1 The key initial step in any immune response is the presentation of antigens by antigen-processing cells to antigen-sensitive cells. This step is performed by major histocompatibility complex *(MHC)* molecules located on the surface of antigen-processing cells.


STAR WARS
EPISODE II
ATTACK OF THE
CLONE AMPLIFIERS


Ontogeny
Clonal selection
Expansion
Memory
Memory
Stem cell
Gene rearrangement
Antigen = infected cell
Death
Death
Repertoire
1
2
3
4
5
6
7
8

Structure of Immature and Mature B-Cell and T-Cell Antigen Receptors





Delves PJ, Roitt IM.
The Immune System (Part1).
N Engl J Med 2000;343:37-49.

The New England Journal of Medicine

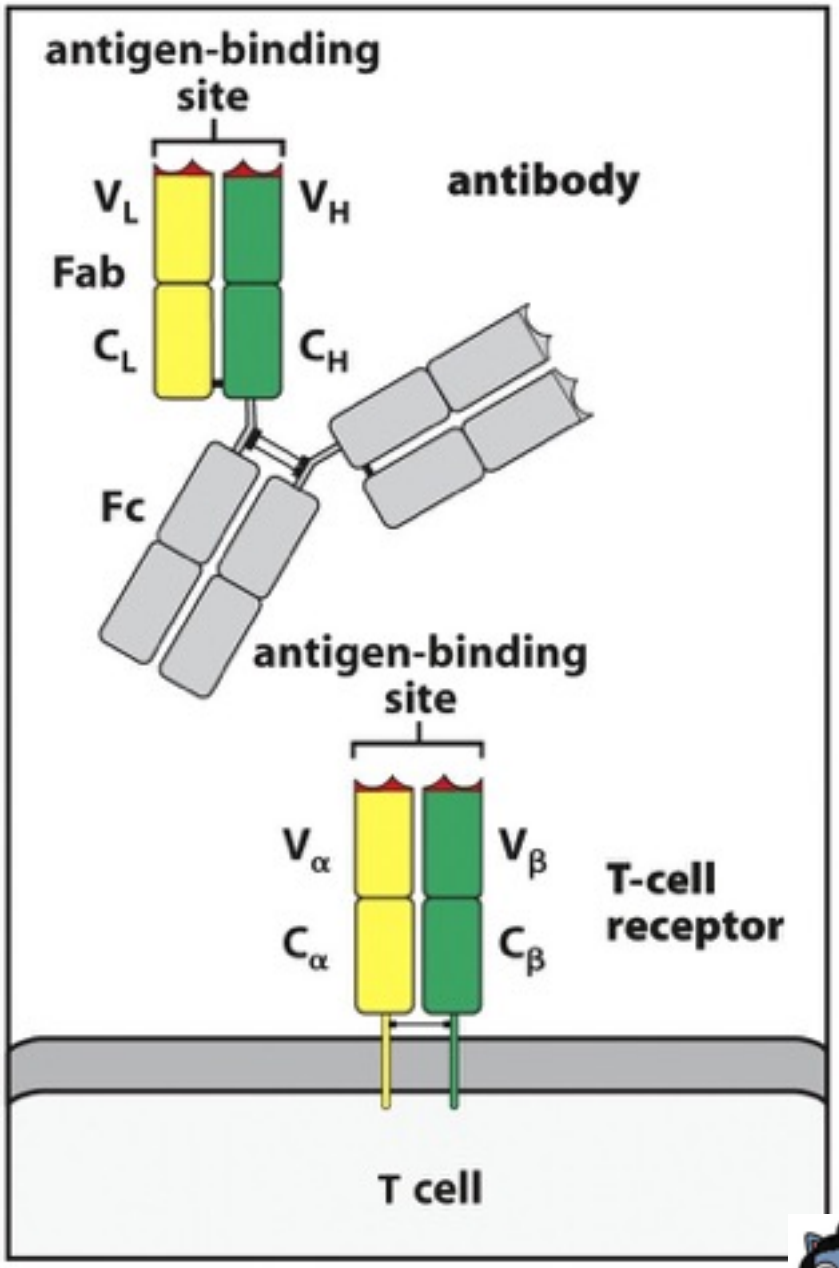


Figure 4.11 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

B
Cell
Receptor

T
Cell
Receptor

conceito importante!

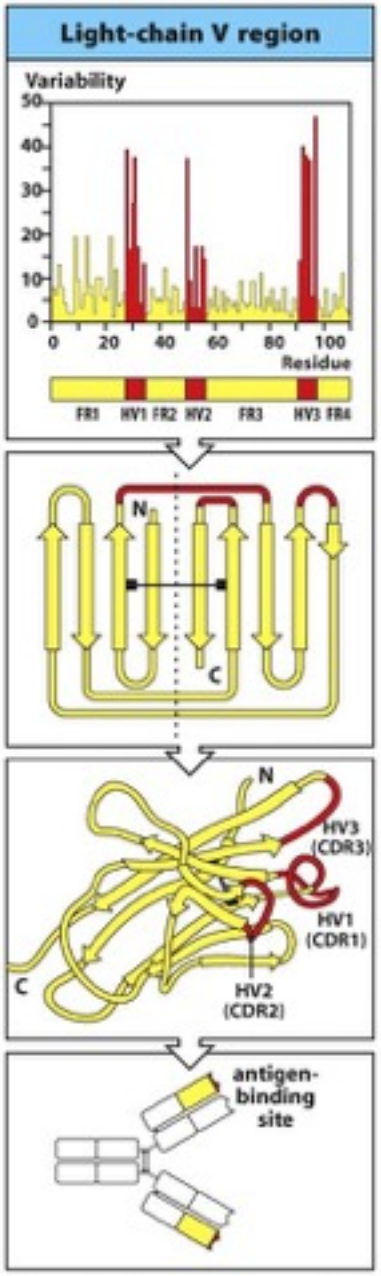


Figure 4.7 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

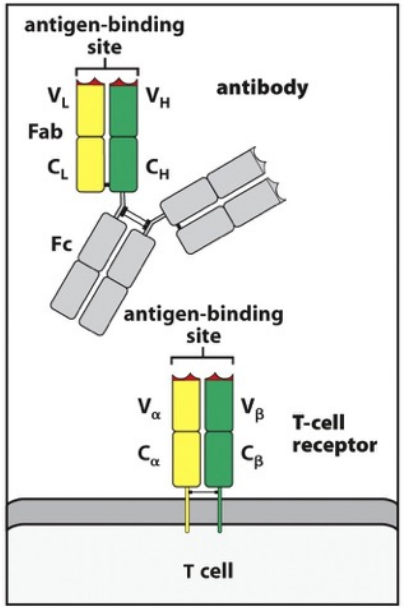
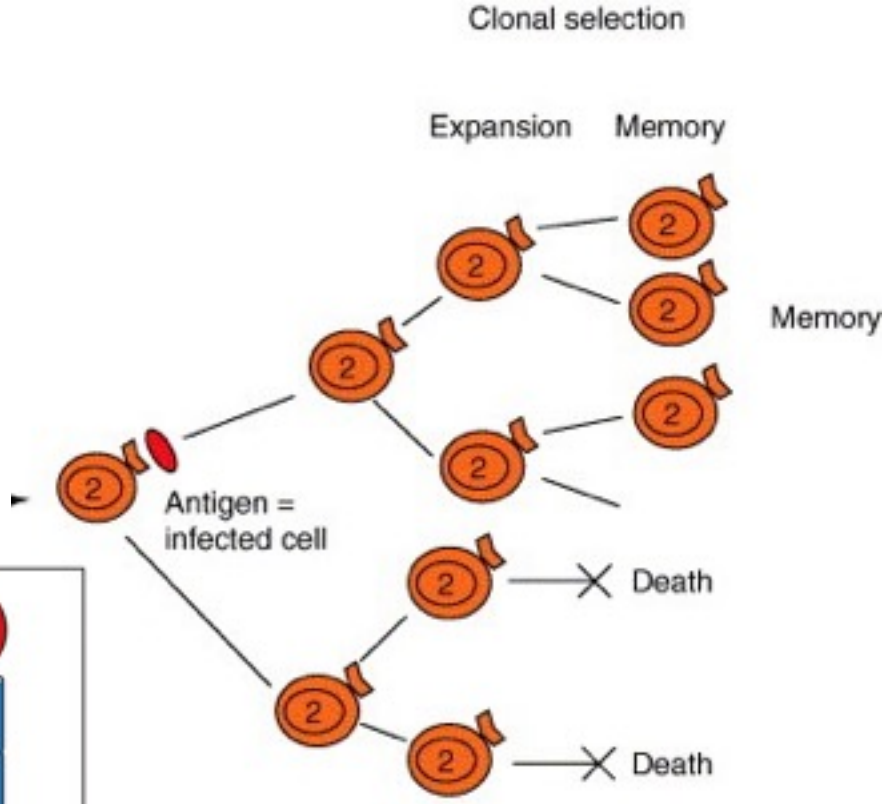


Figure 4.11 Janeway's Immunobiology, 8ed. (© Garland Science 2012)



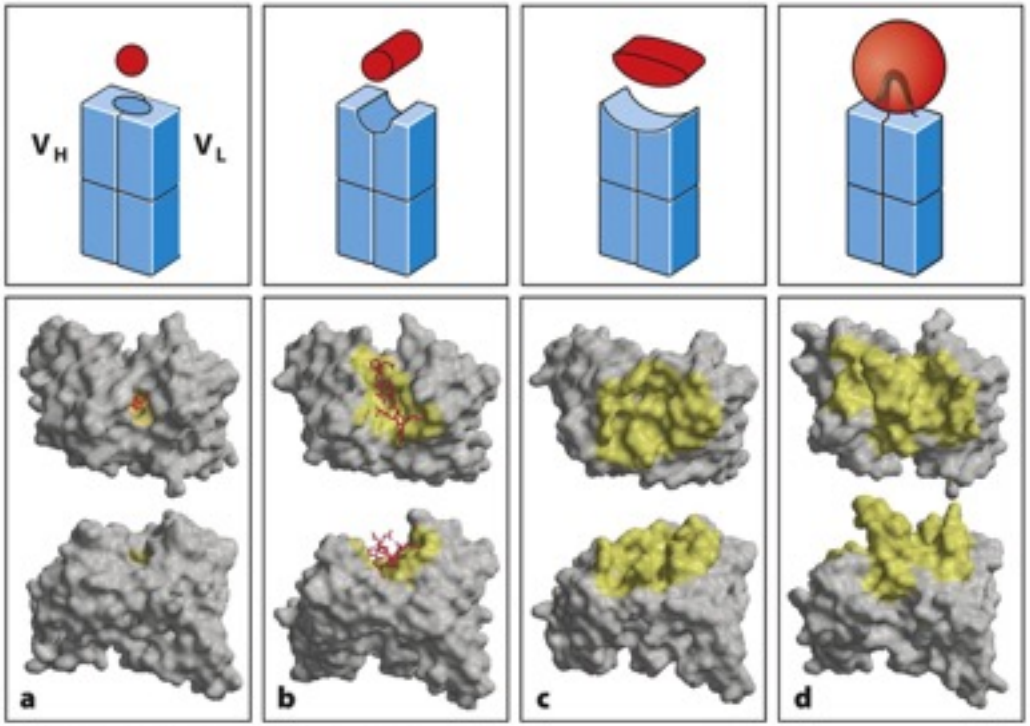
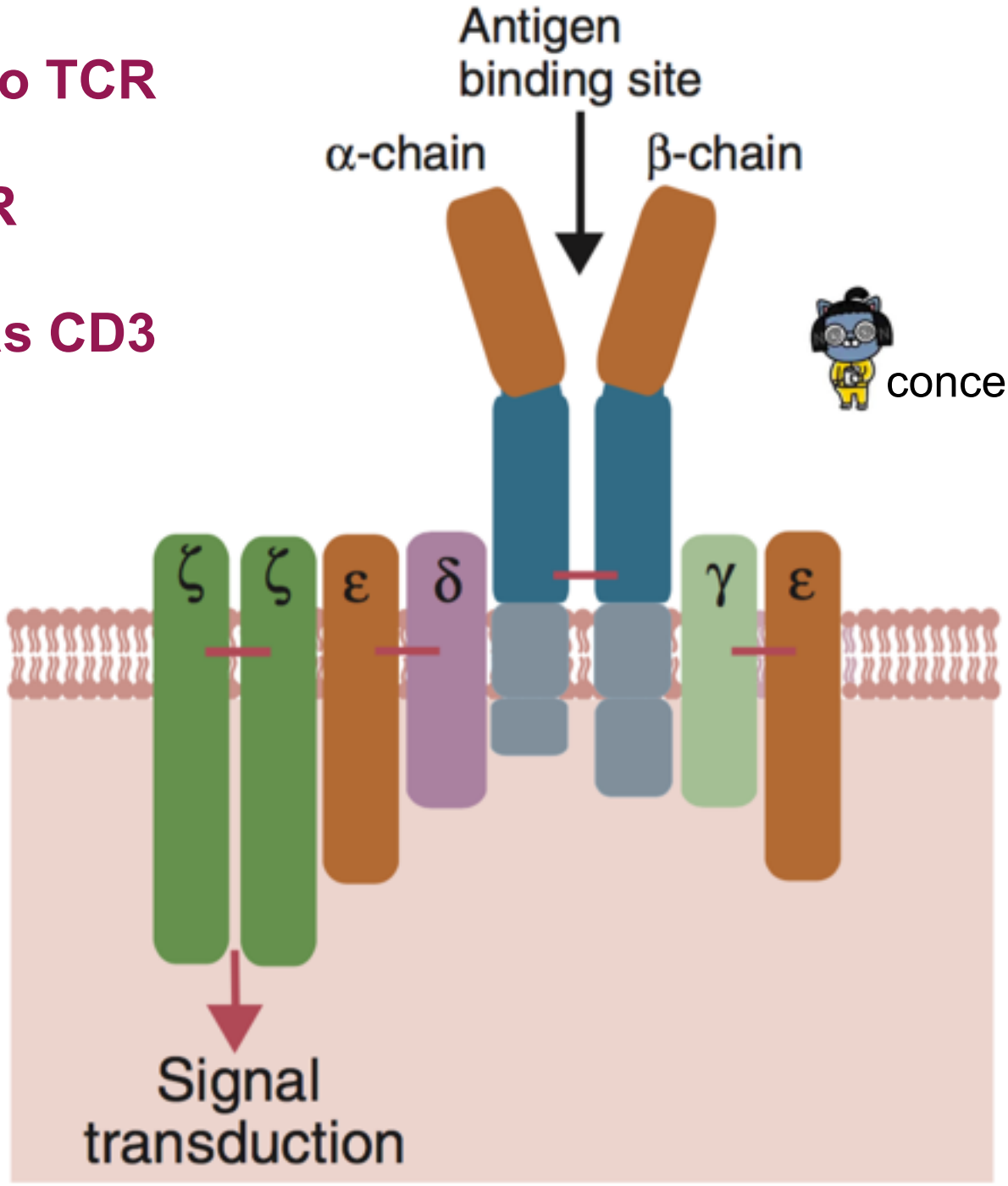


Figure 4.8 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

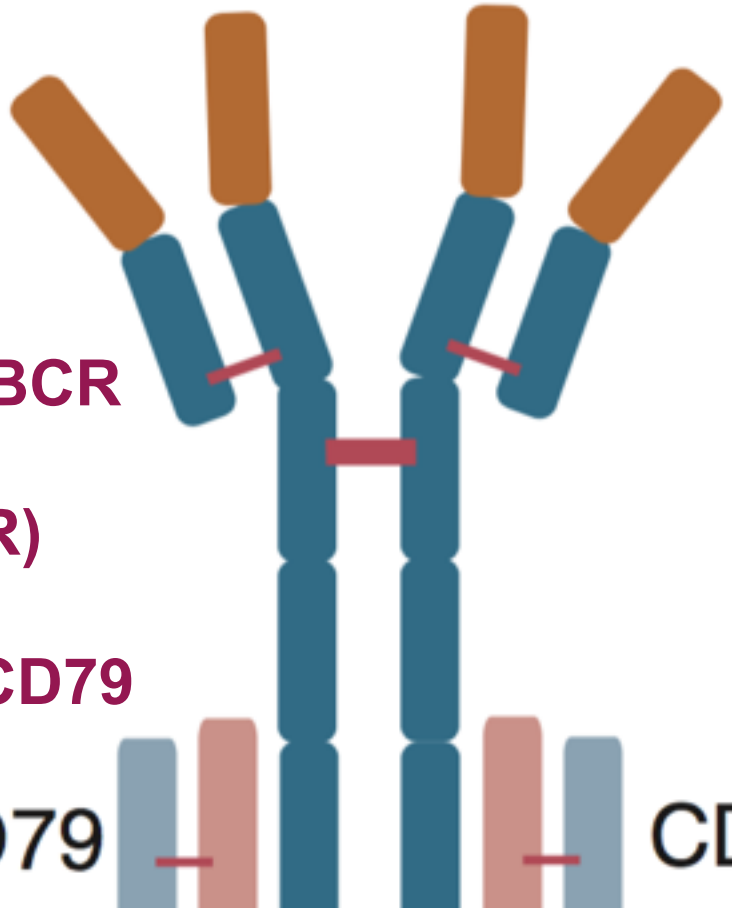
TRENDS in Ecology & Evolution

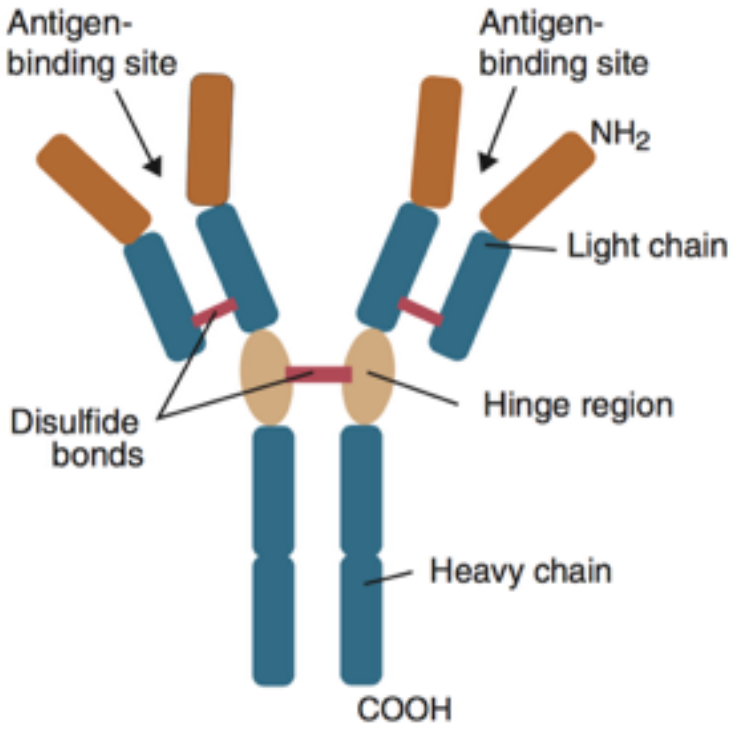
Complexo TCR
=
TCR
+
moléculas CD3

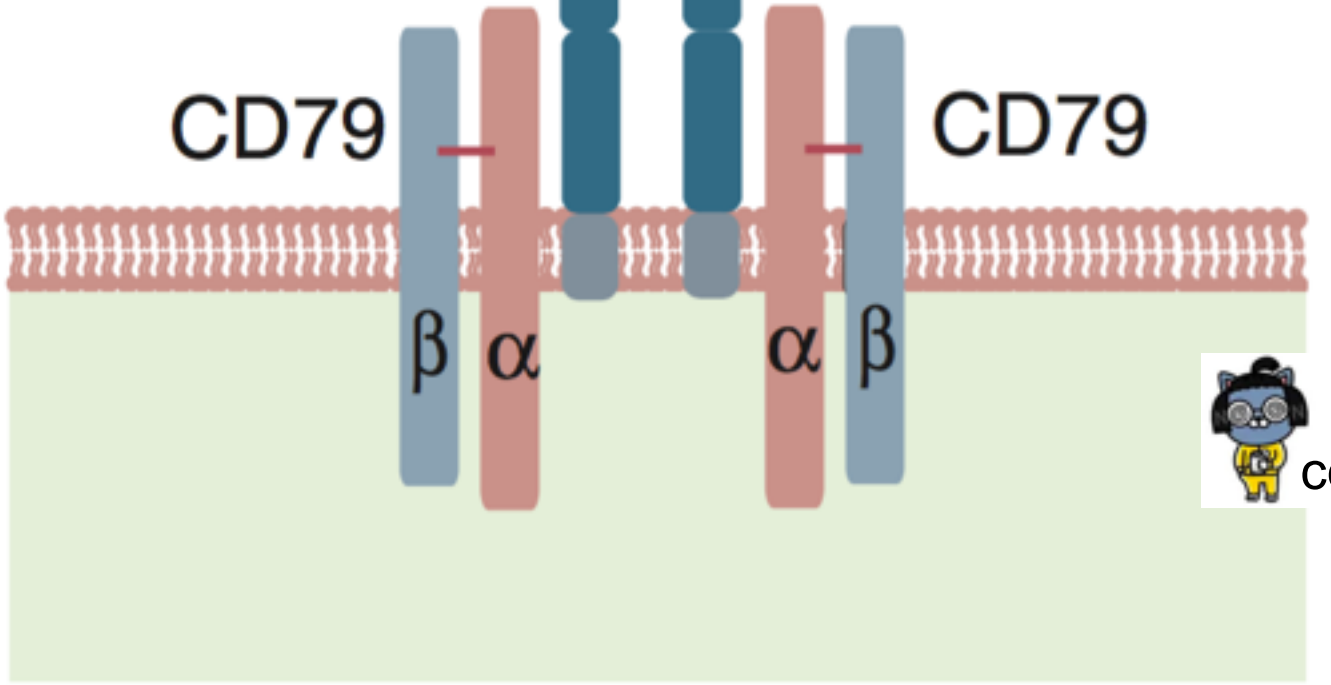


conceito importante!

Complexo BCR
=
IgM (BCR)
+
moléculas CD79

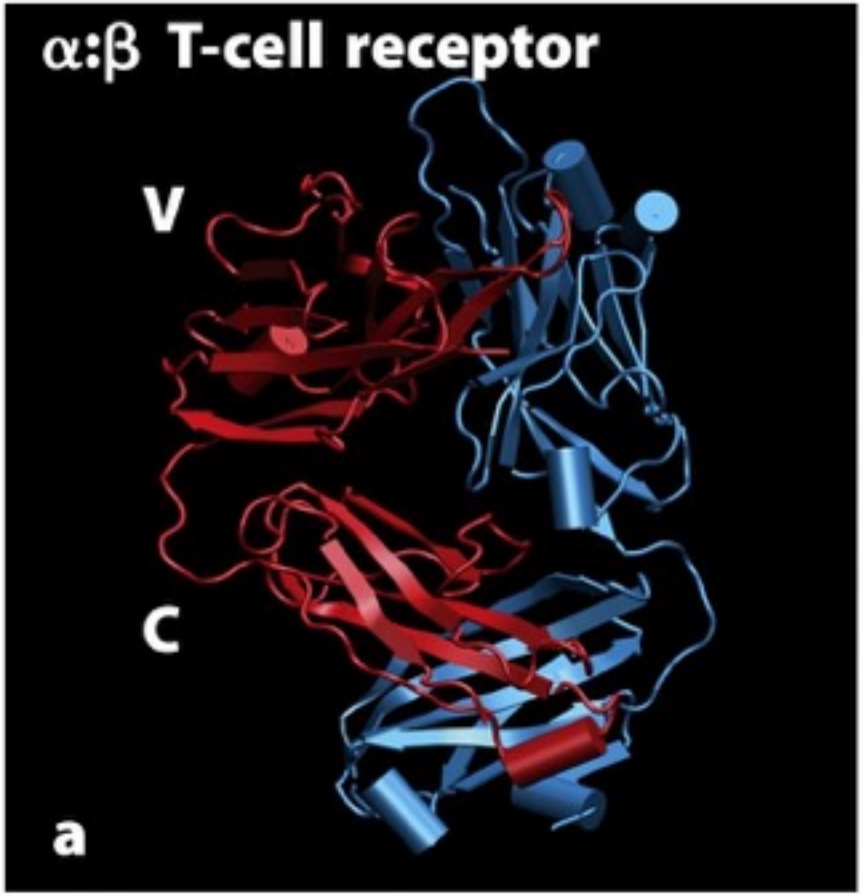






conceito importante!

Existem 2 tipos de TCRs



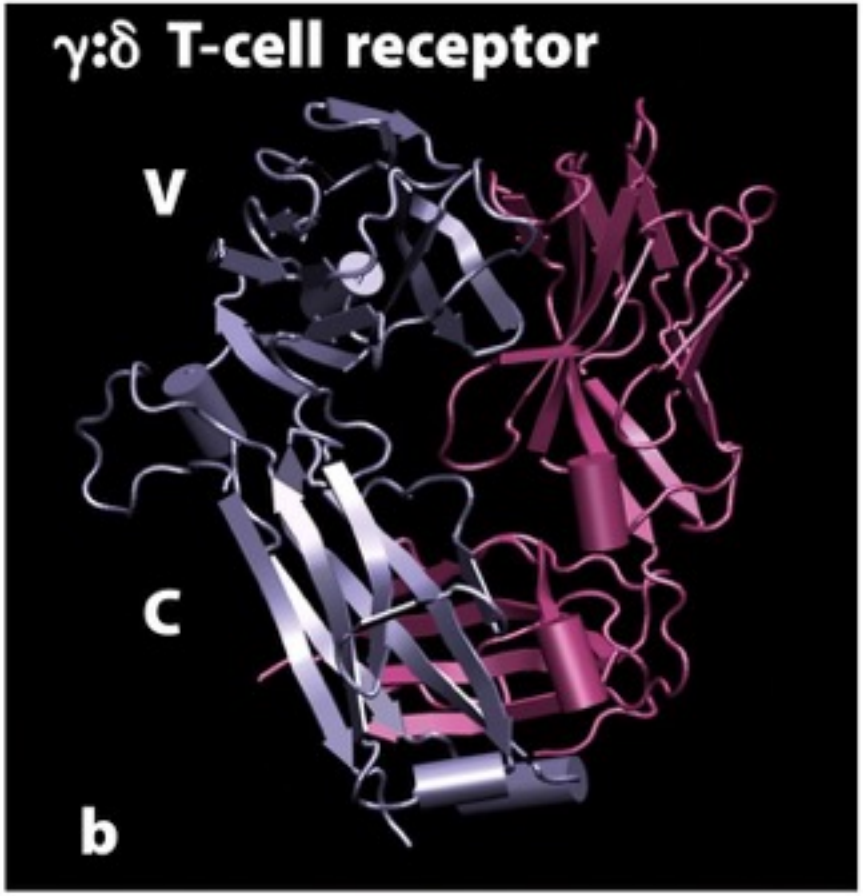
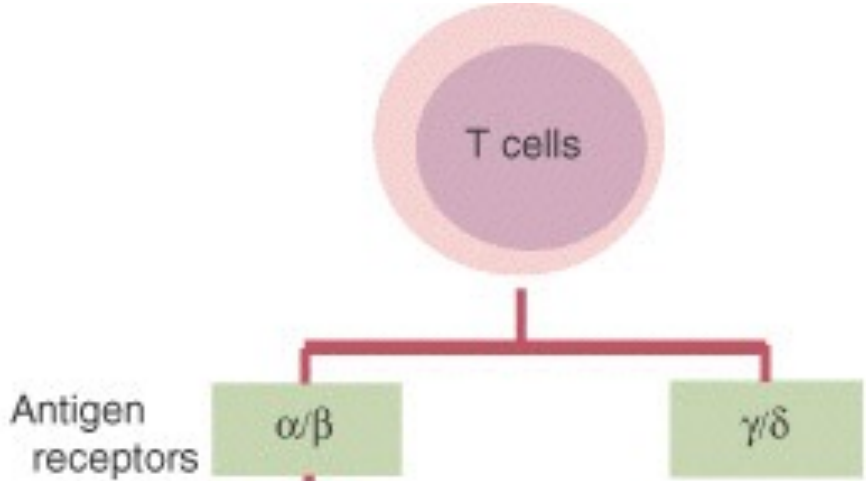


Figure 4.28 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

conceito importante!



conceito importante!

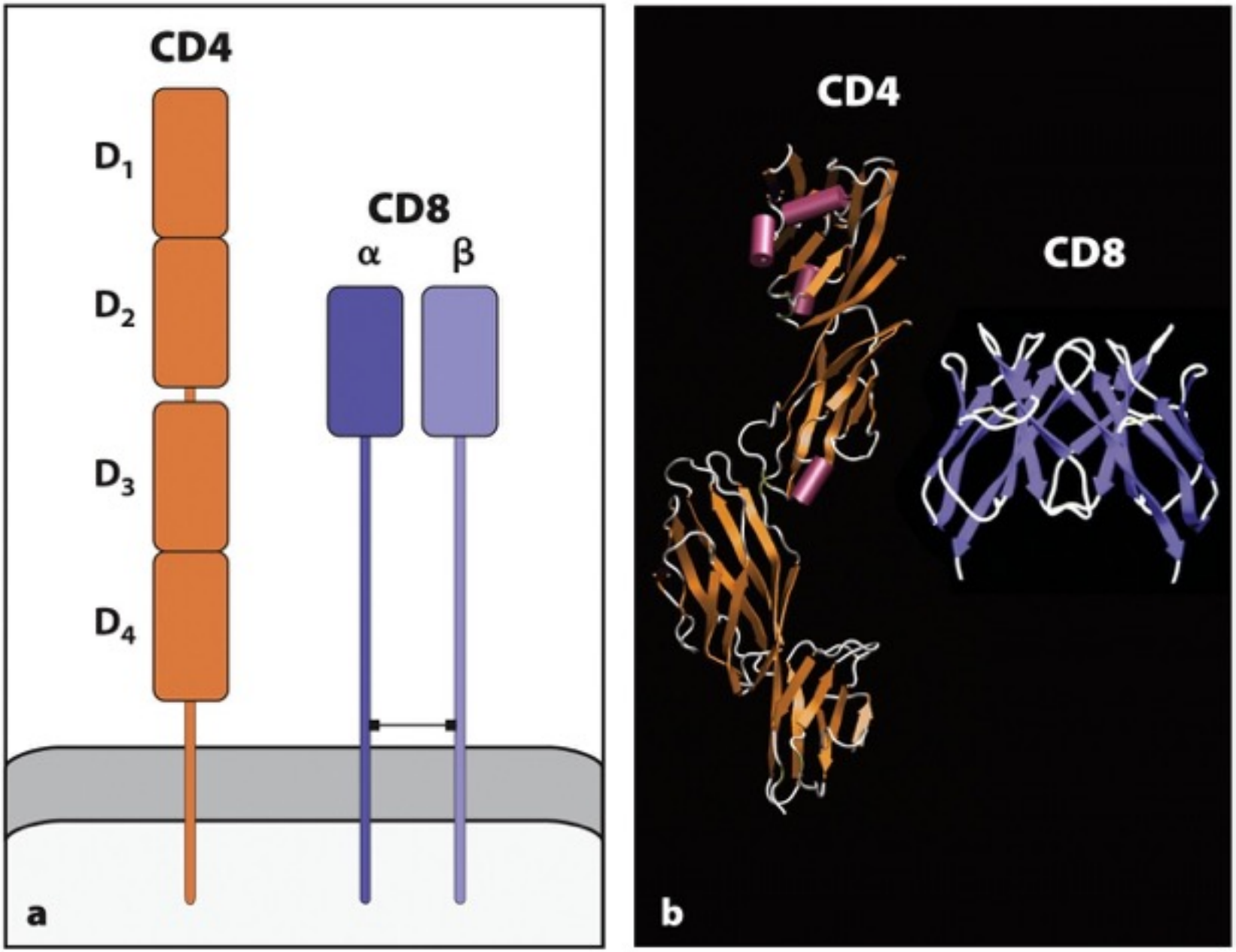


Figure 4.24 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

As moléculas CD4 e CD8 são expressas na superfície dos linfócitos T e servem para ancorar o MHC durante a interação entre o linfócito T e a célula portadora do MHC

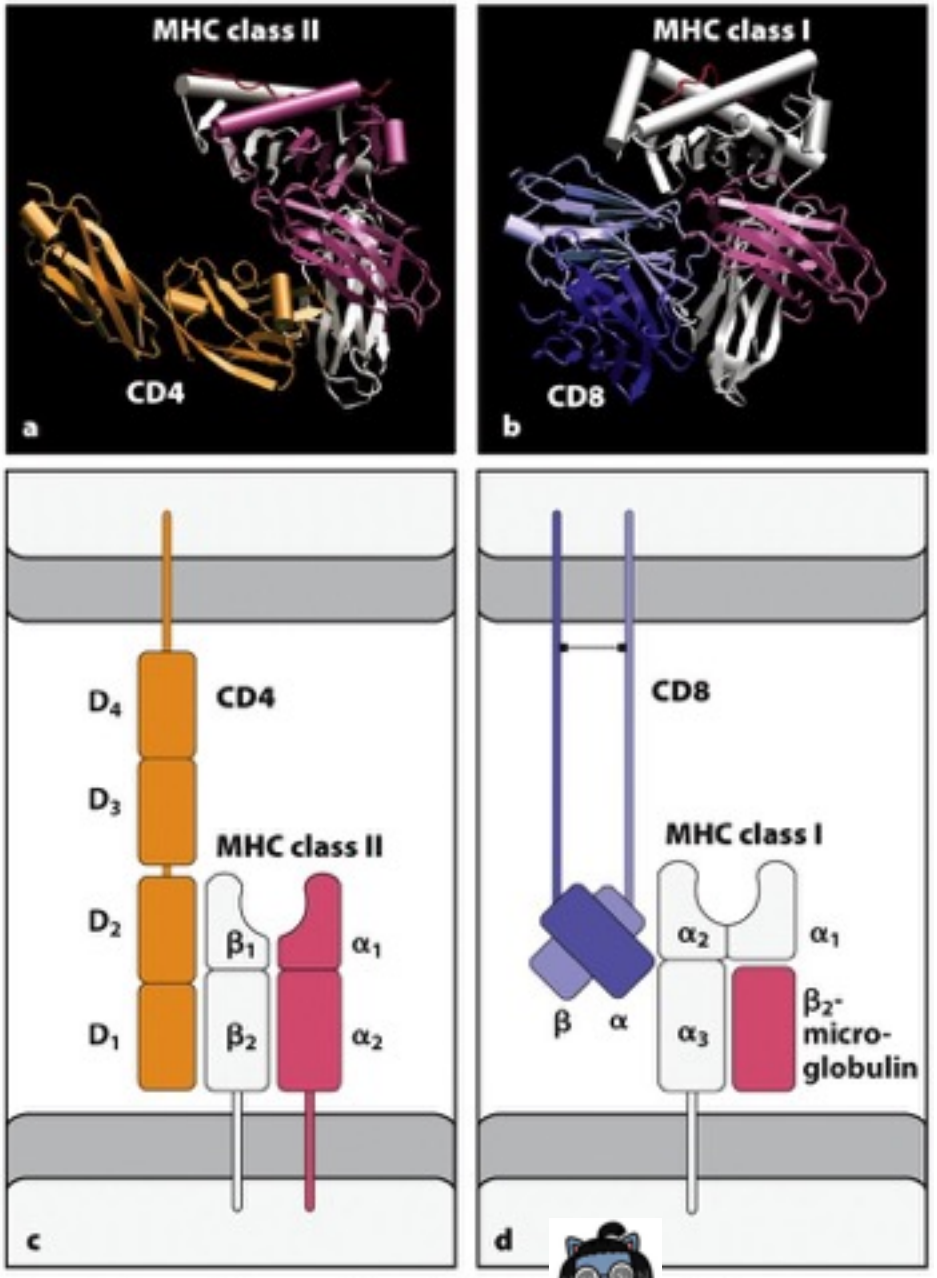
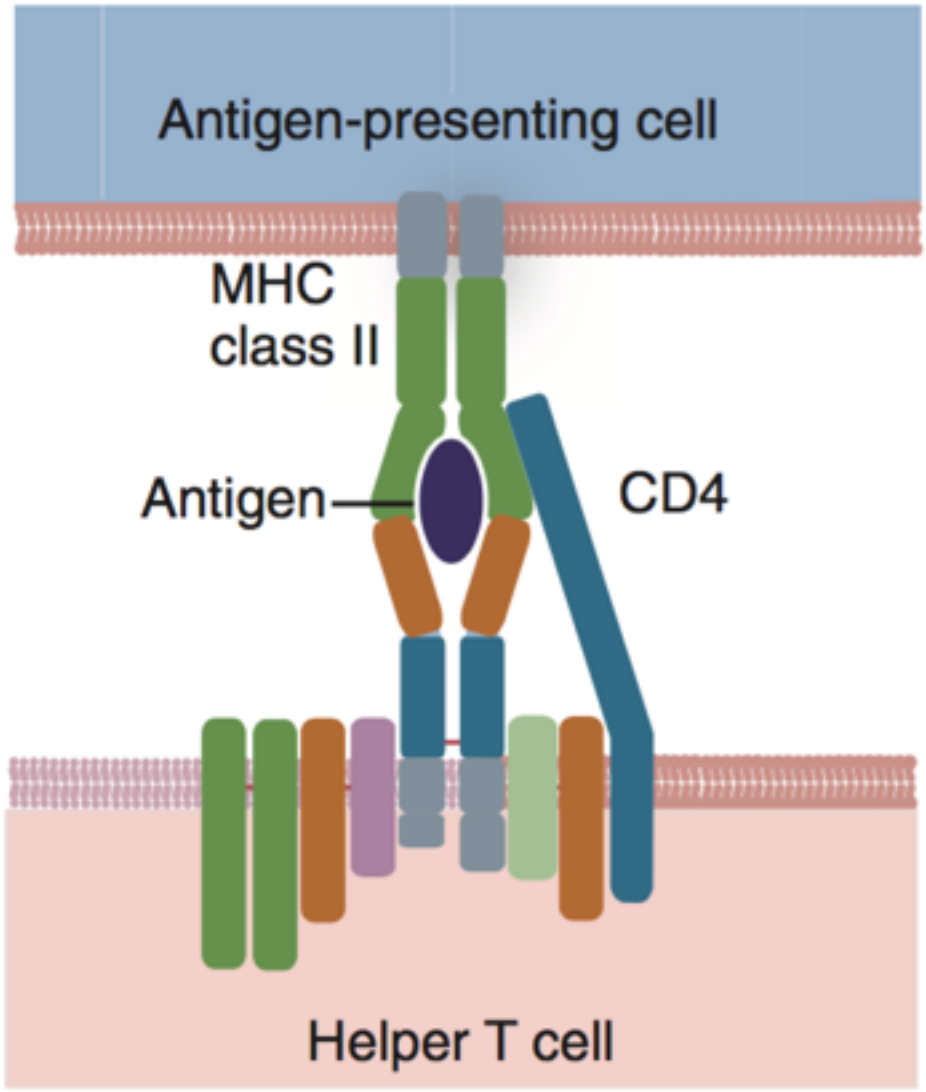
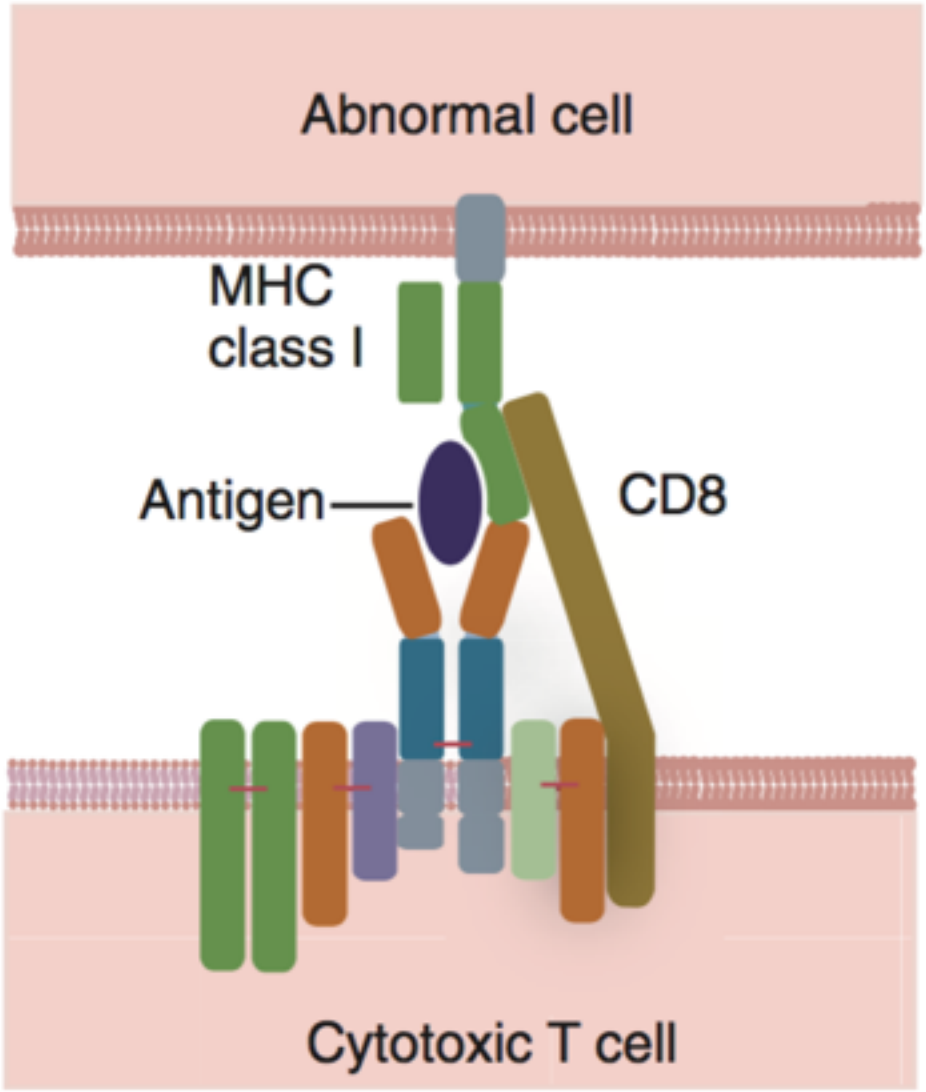


Figure 4.25 Janeway's Immunobiology, 8ed. (© Garl e 2012)

conceito importante!

A presença do CD4/CD8 determina qual linfócito T vai interagir com o MHC de classe II ou I





conceito importante!

conceito importante!

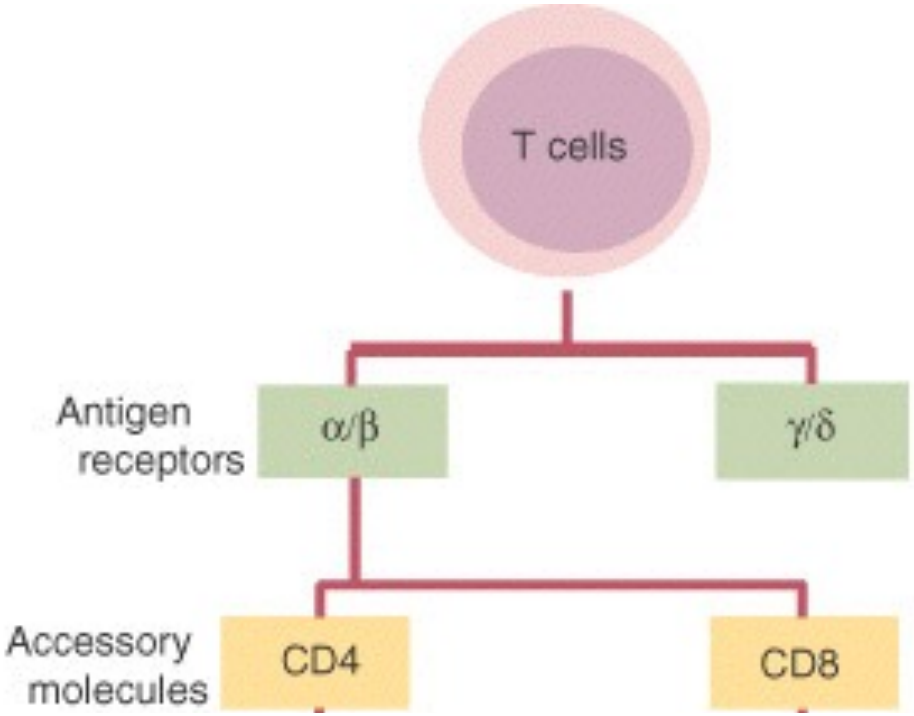


FIGURE 12-2 T cells can be divided into many different subpopulations based on the antigen receptors they employ, on the accessory molecules that support their activity, and ultimately on their functions.

$1{,}8 \times 10^{16}$ regiões variáveis diferentes para BCR (humanos)

5×10^{15} regiões variáveis diferentes para TCRalfa/beta (humanos)

se 1 gene = 1 proteína,
não existe espaço no genoma mamífero para conter todos os genes necessários

Como resolver este problema?

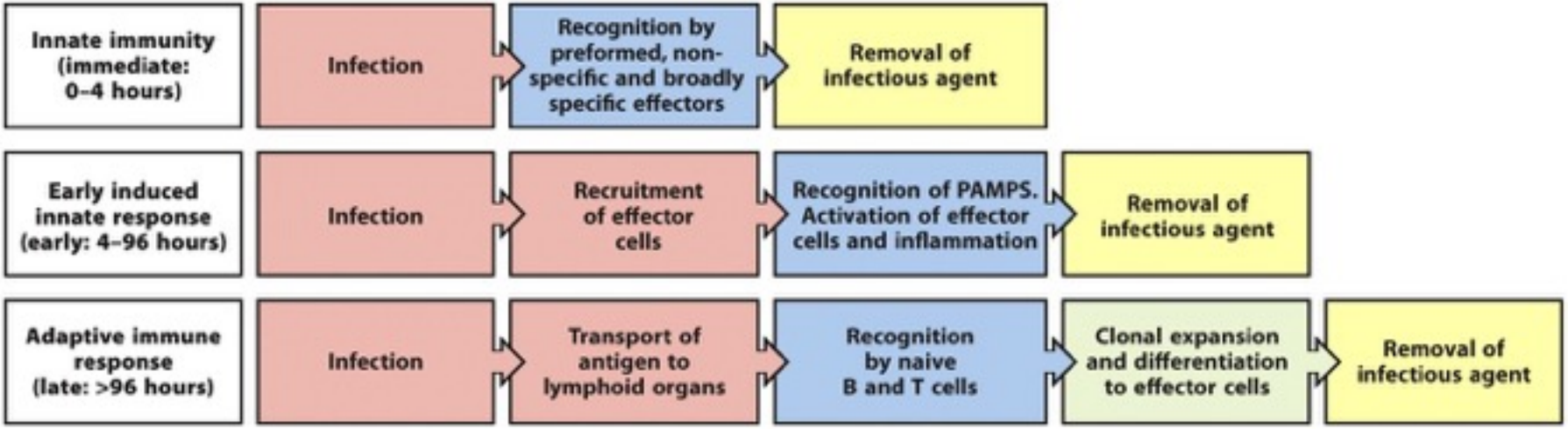


Figure 2.1 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

conceito importante!

As moléculas do Complexo de Histocompatibilidade Principal (MHC) identificam as “famílias"

O MHC é polimórfico e poligênico

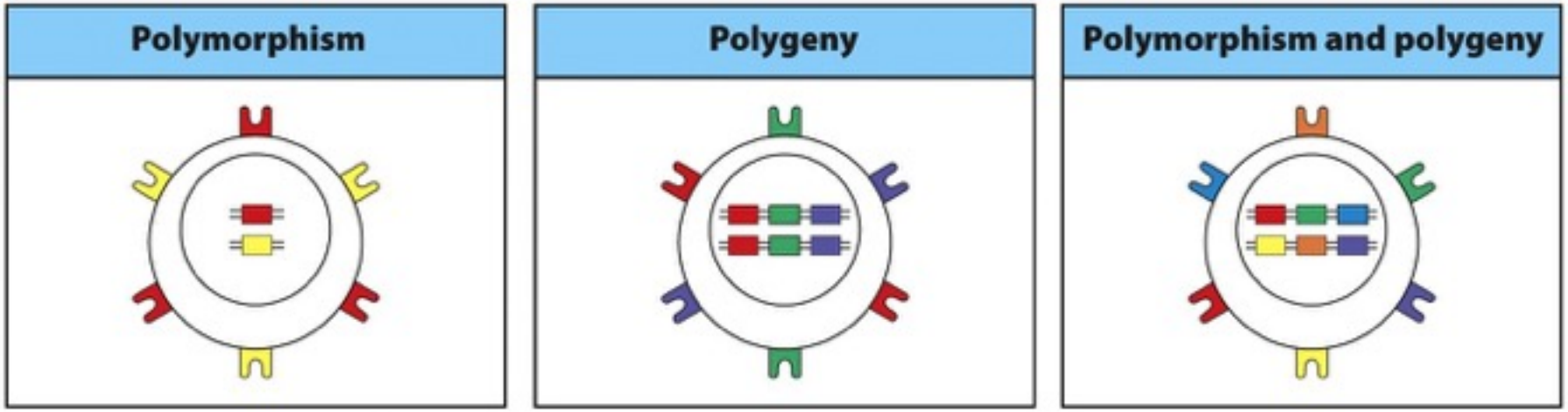


Figure 6.17 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

MHC classe I

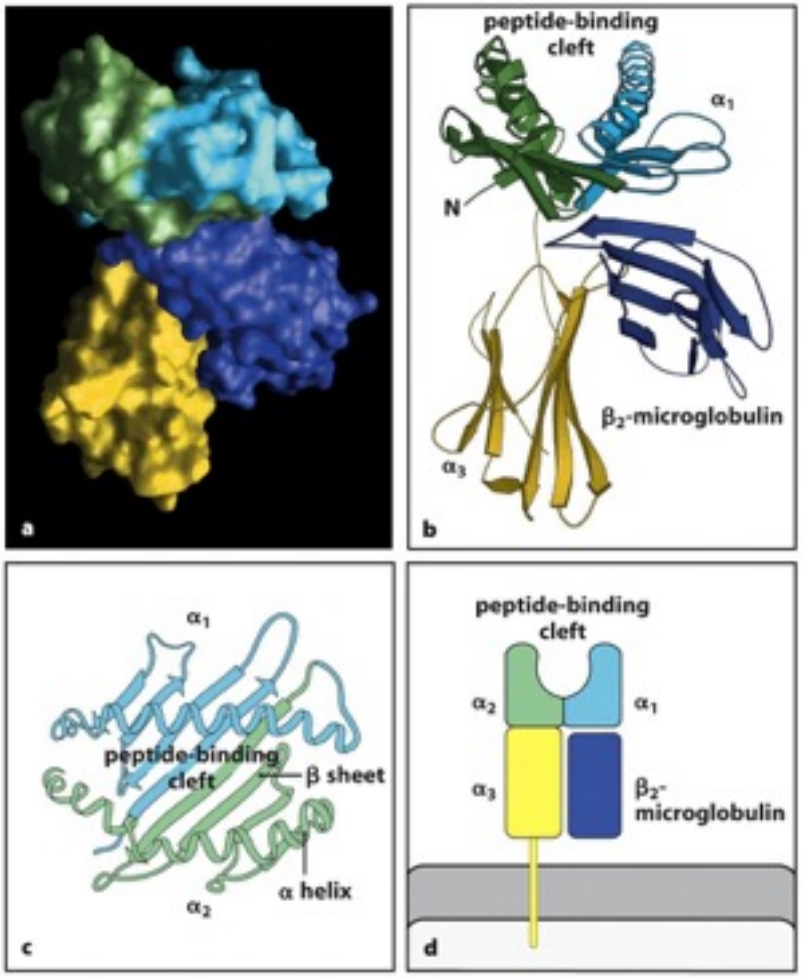
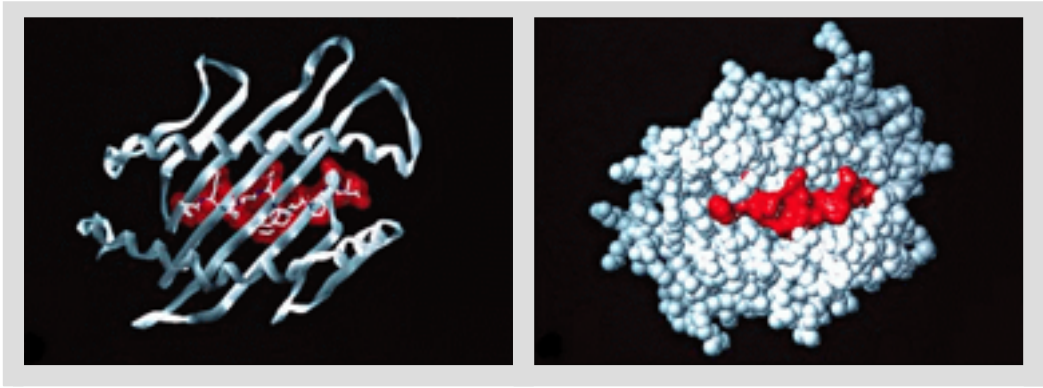
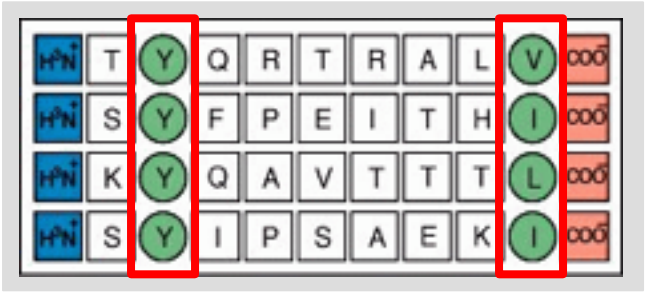
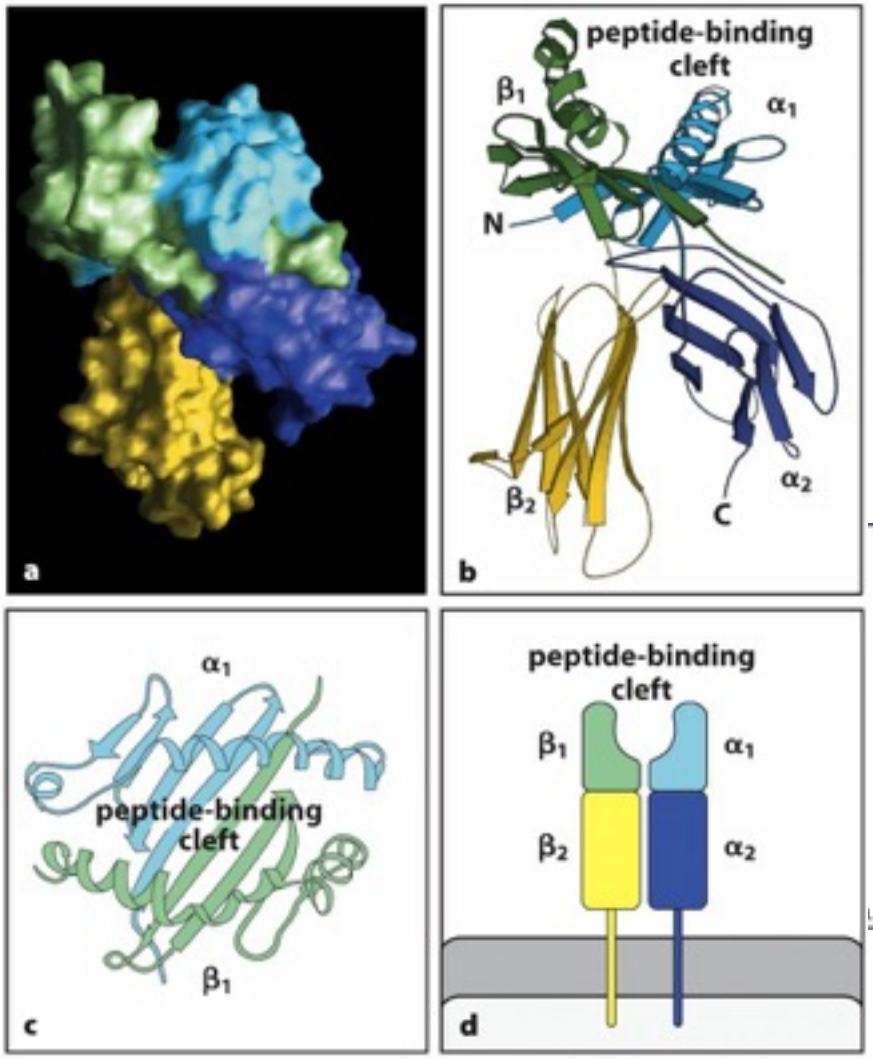


Figure 4.15 Janeway's Immunobiology, 8ed. (© Garland Science 2012)





MHC classe II



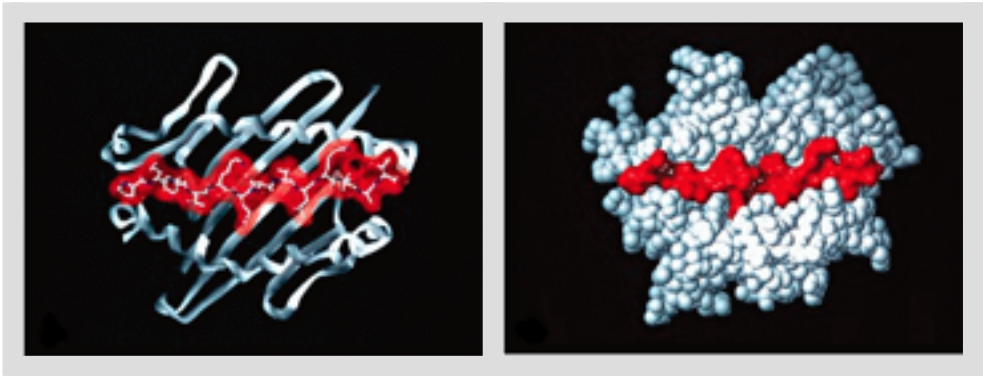
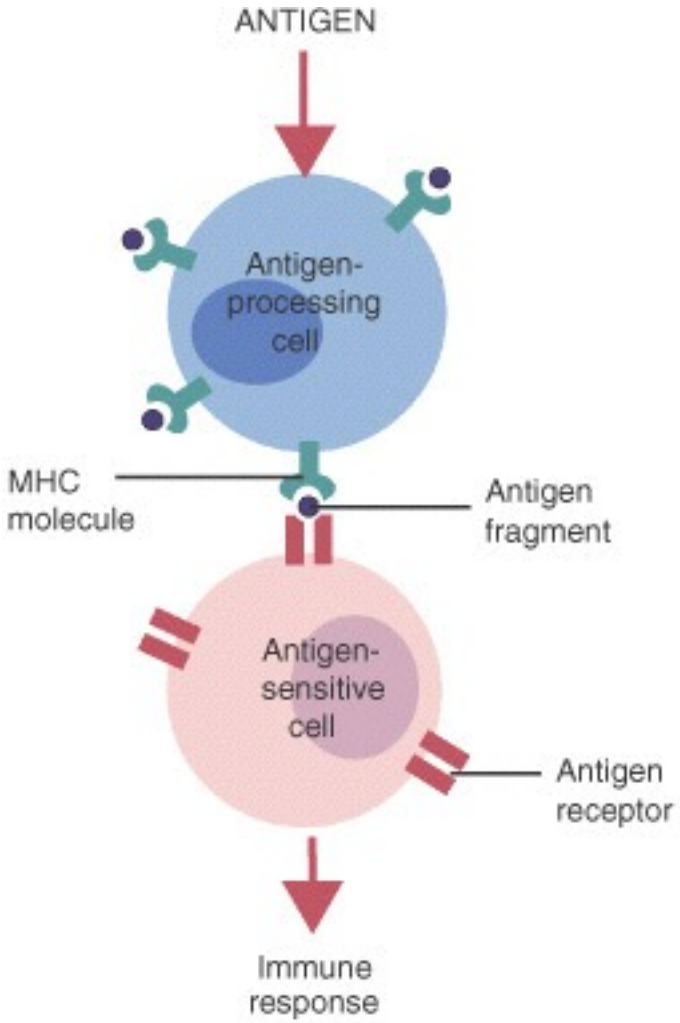


Figure 4.16 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

conceito importante!



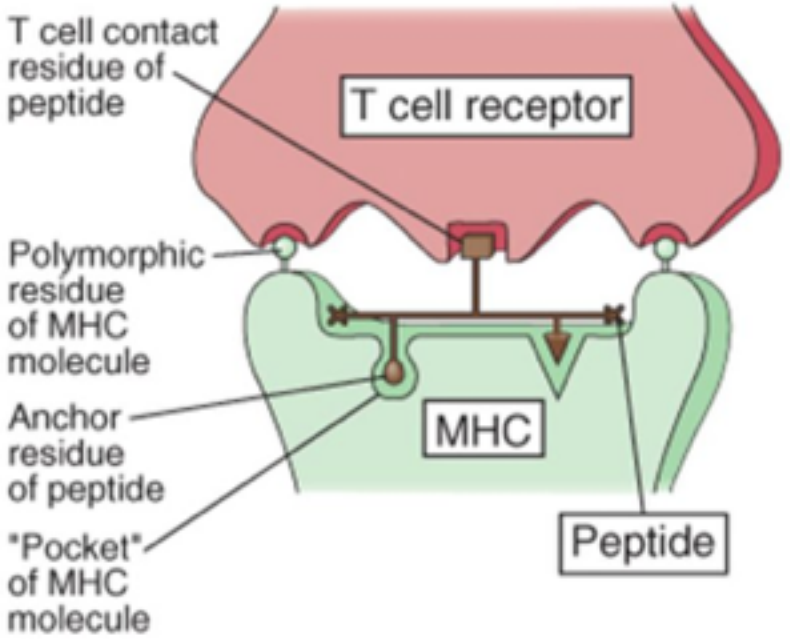


FIGURE 9-1 The key initial step in any immune response is the presentation of antigens by antigen-processing cells to antigen-sensitive cells. This step is performed by major histocompatibility complex *(MHC)* molecules located on the surface of antigen-processing cells.

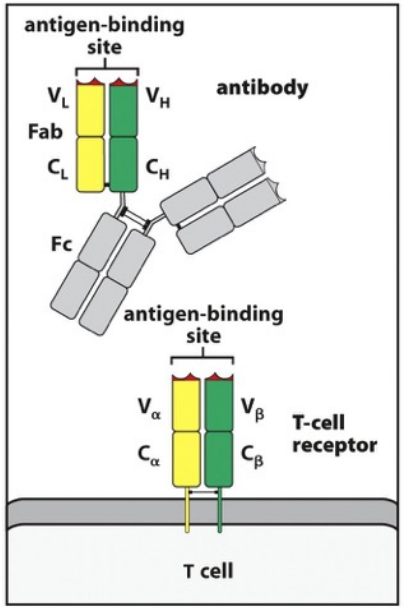
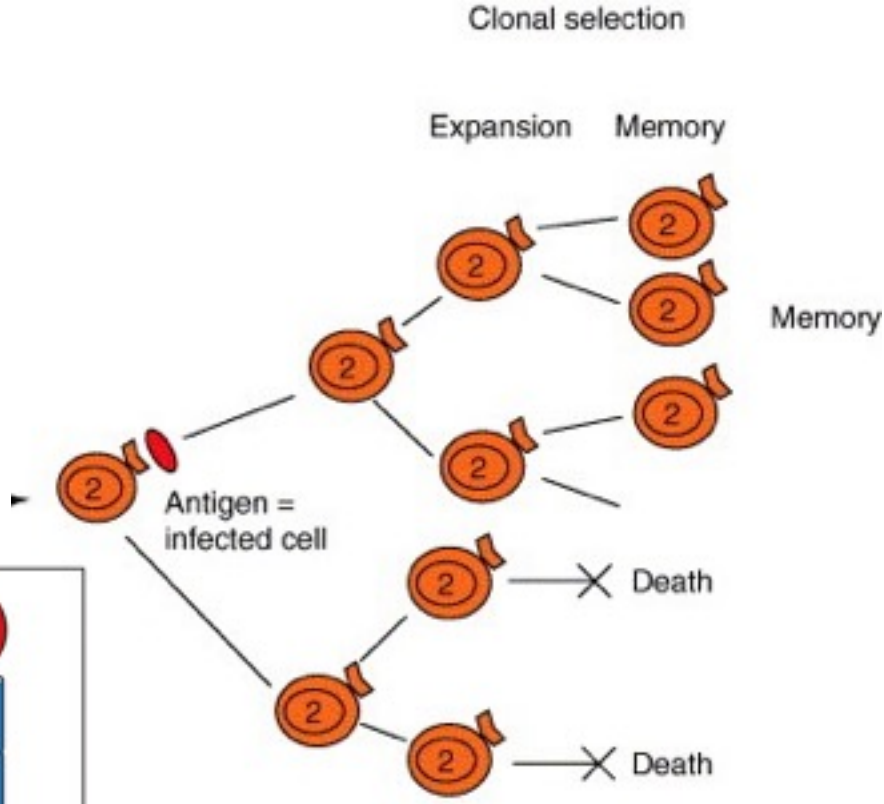


Figure 4.11 Janeway's Immunobiology, 8ed. (© Garland Science 2012)



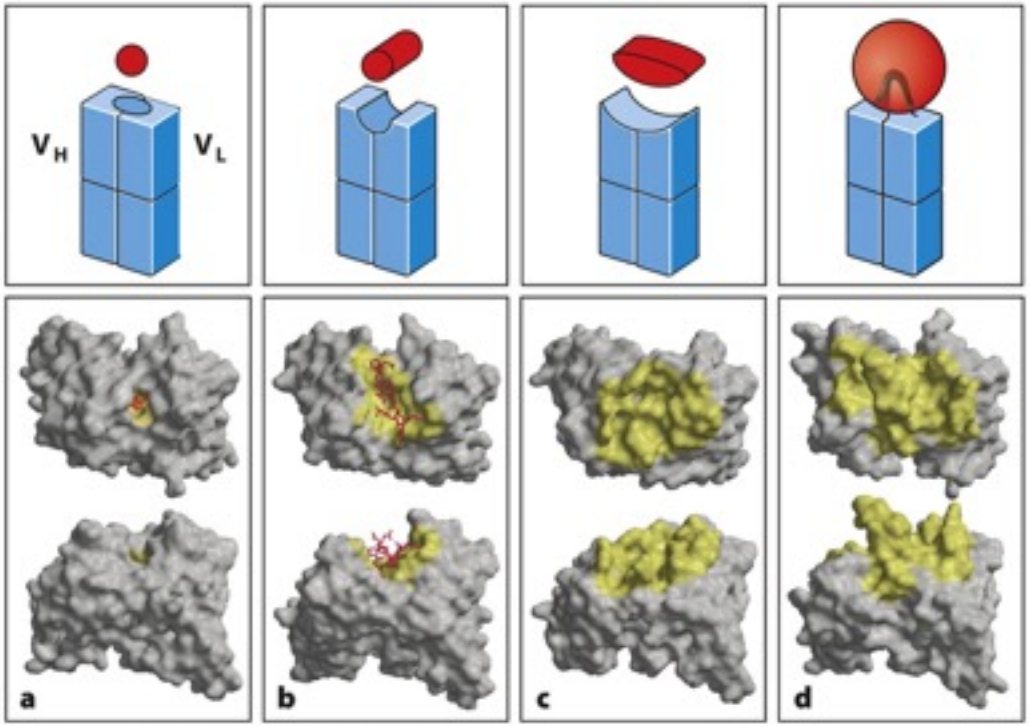


Figure 4.8 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

TRENDS in Ecology & Evolution

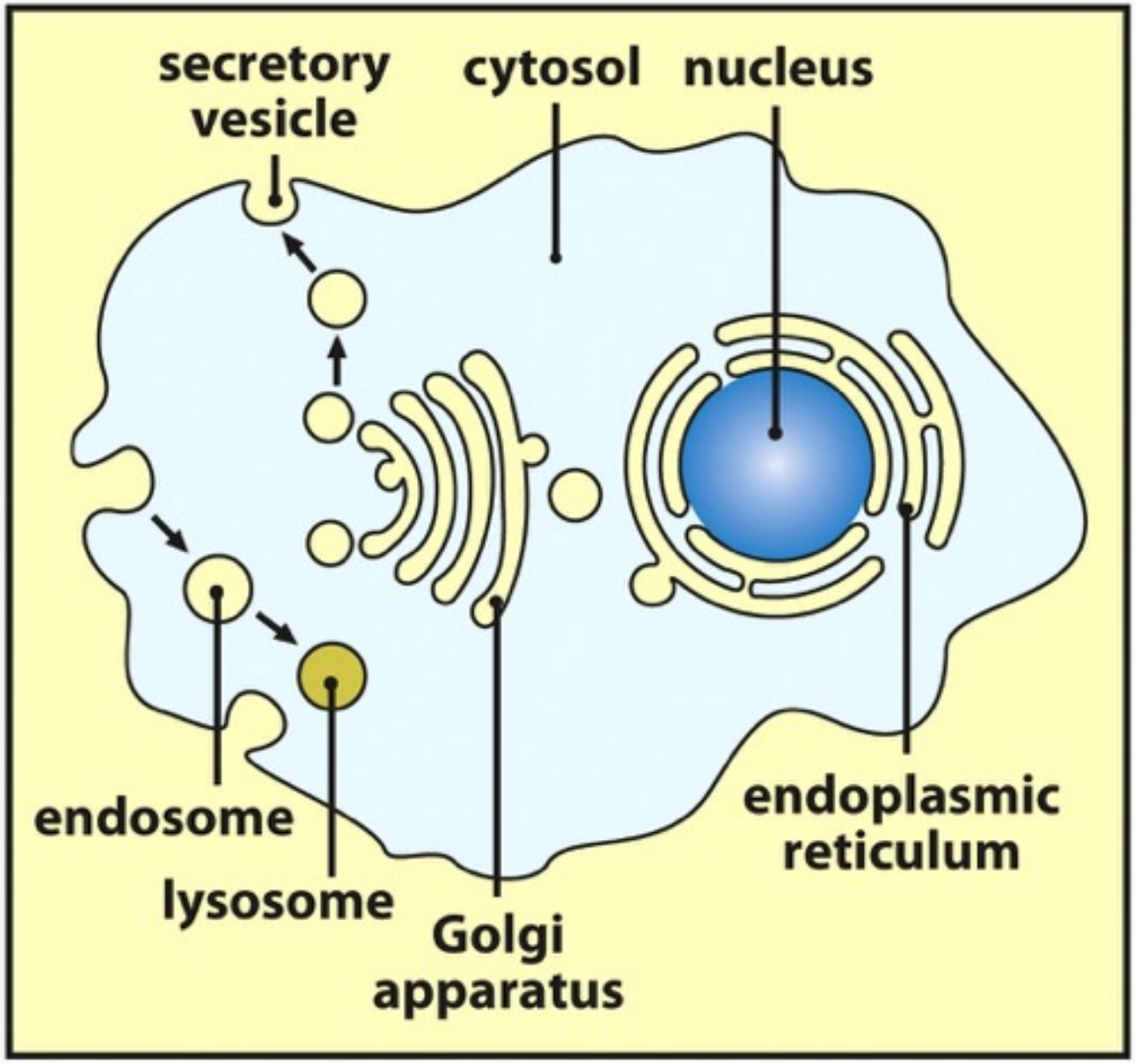


Figure 6.1 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Apresentação de Antígeno via MHC classe I

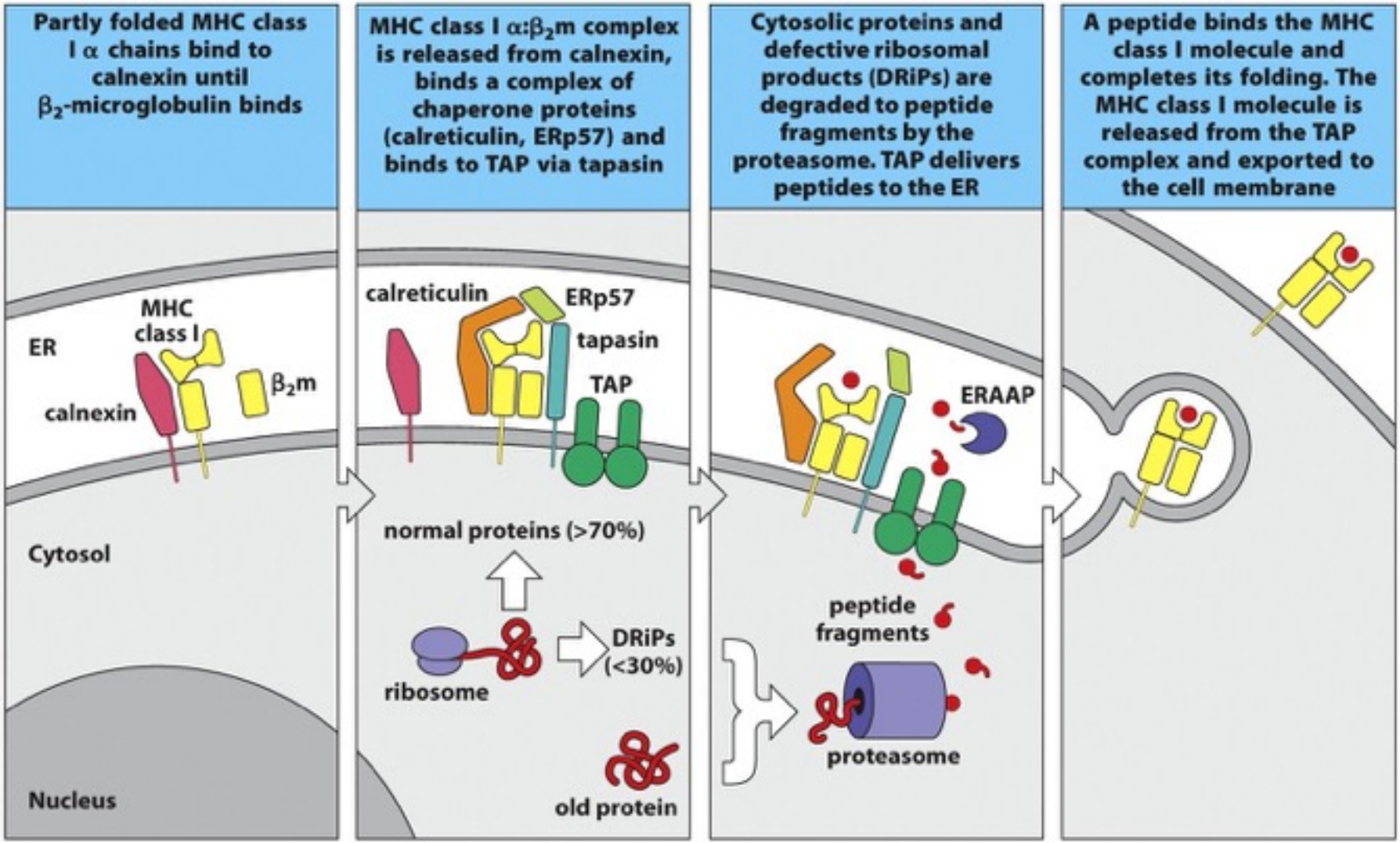


Figure 6.5 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Apresentação de Antígeno via MHC classe II…

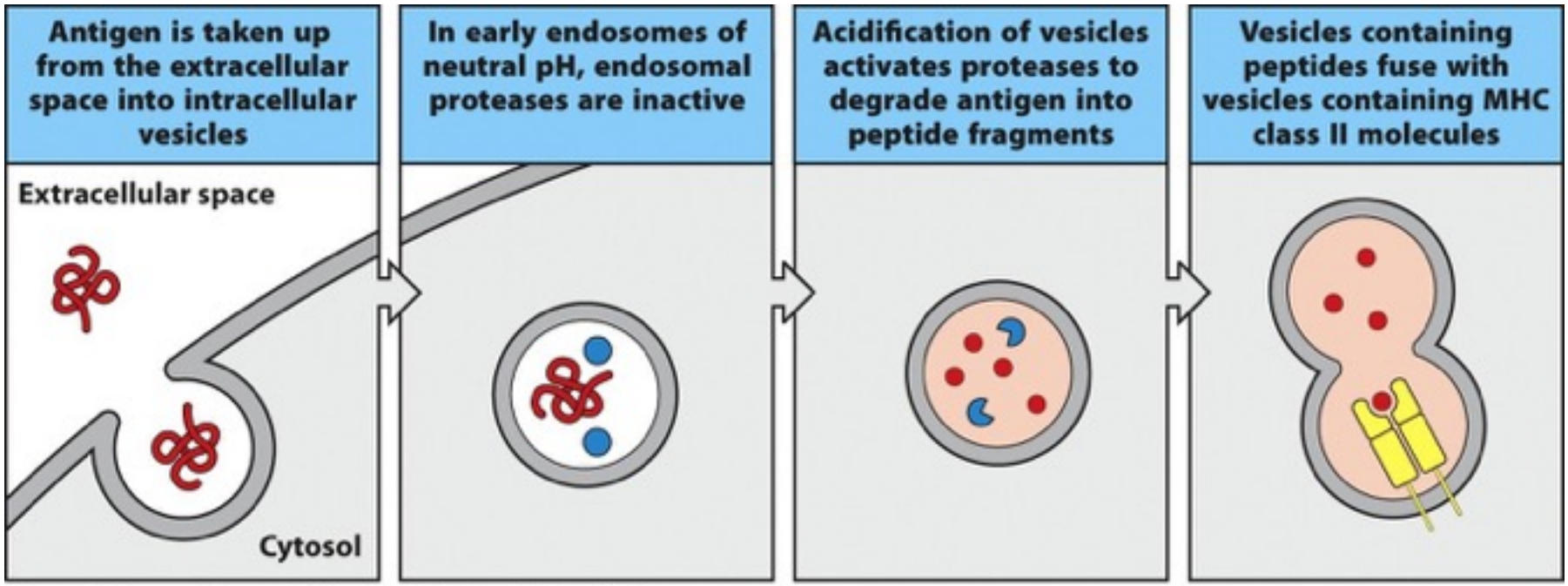


Figure 6.9 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

… apresentação de Antígeno via MHC classe II

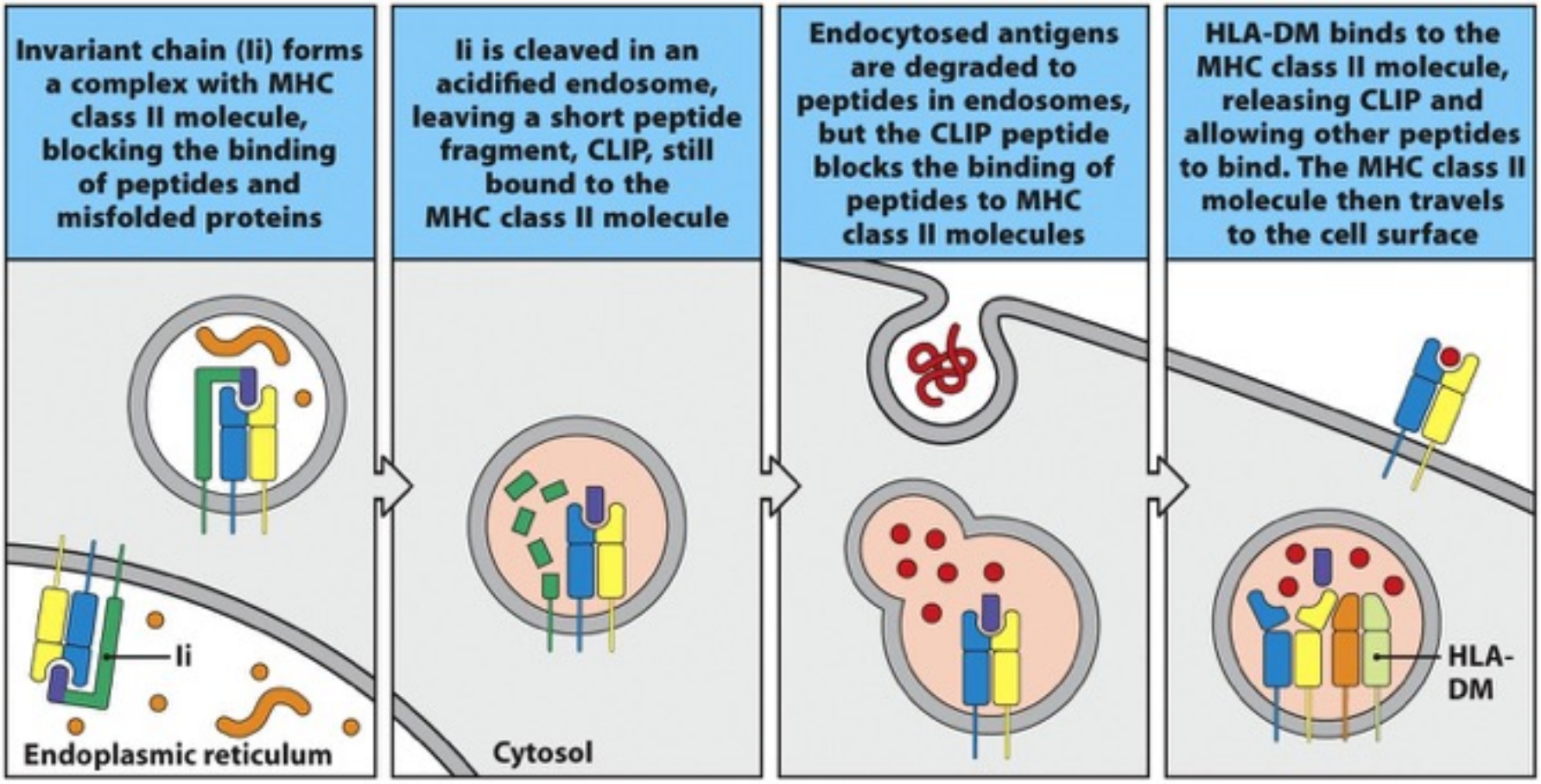


Figure 6.12 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Apresentação Cruzada

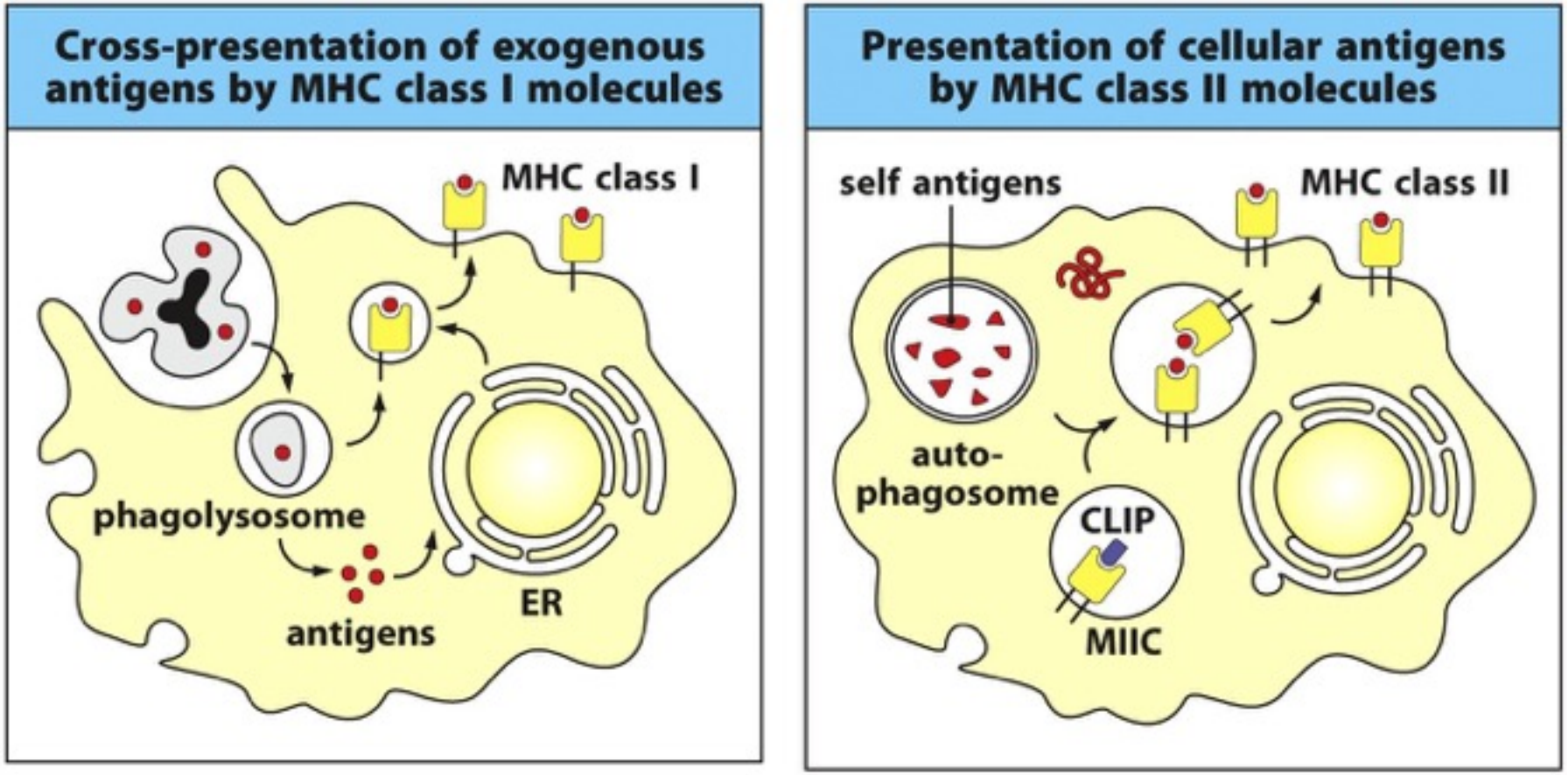


Figure 6.13 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

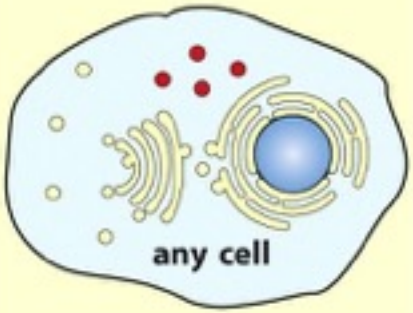
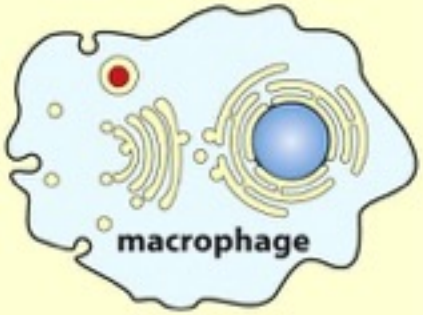
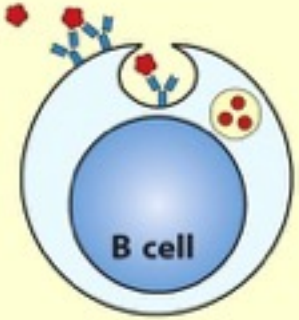
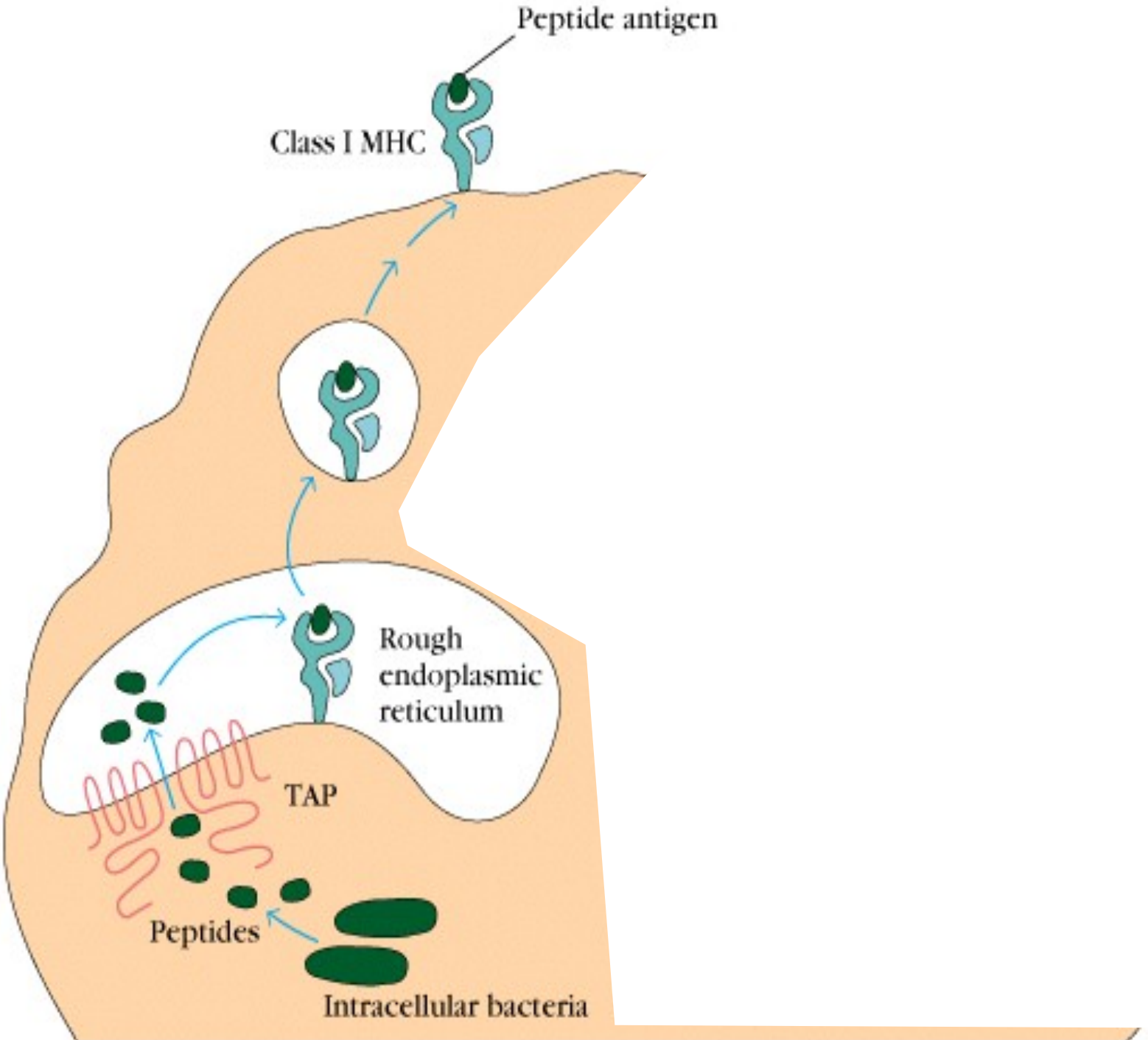
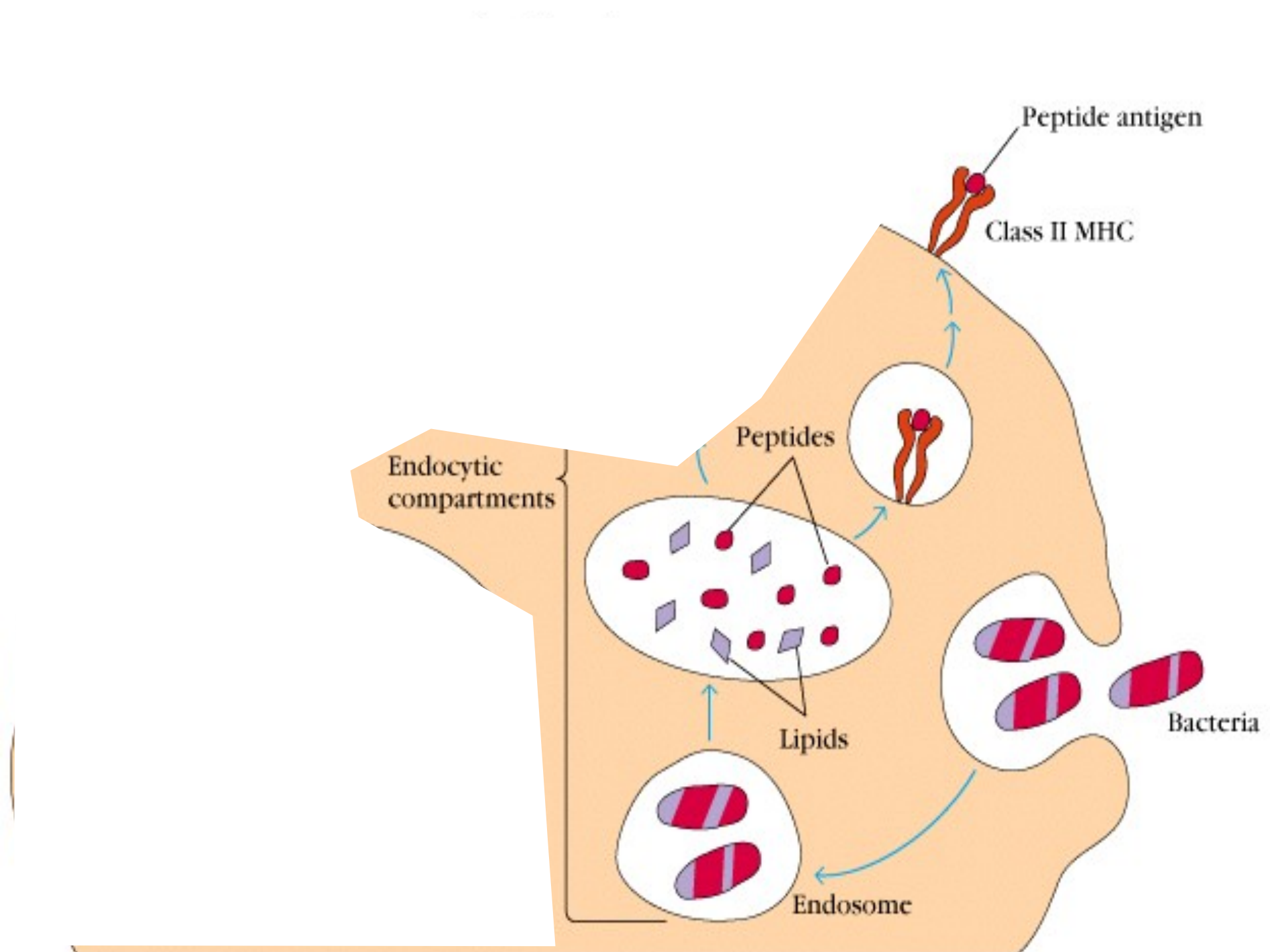
	Cytosolic pathogens	Intravesicular pathogens	Extracellular pathogens and toxins
			
Degraded in	Cytosol	Endocytic vesicles	Endocytic vesicles
Peptides bind to	MHC class I	MHC class II	MHC class II
Presented to	Effector CD8 T cells	Effector CD4 T cells	Effector CD4 T cells
Effect on presenting cell	Cell death	Activation to kill intravesicular bacteria and parasites	Activation of B cells to secrete Ig to eliminate extracellular bacteria/toxins

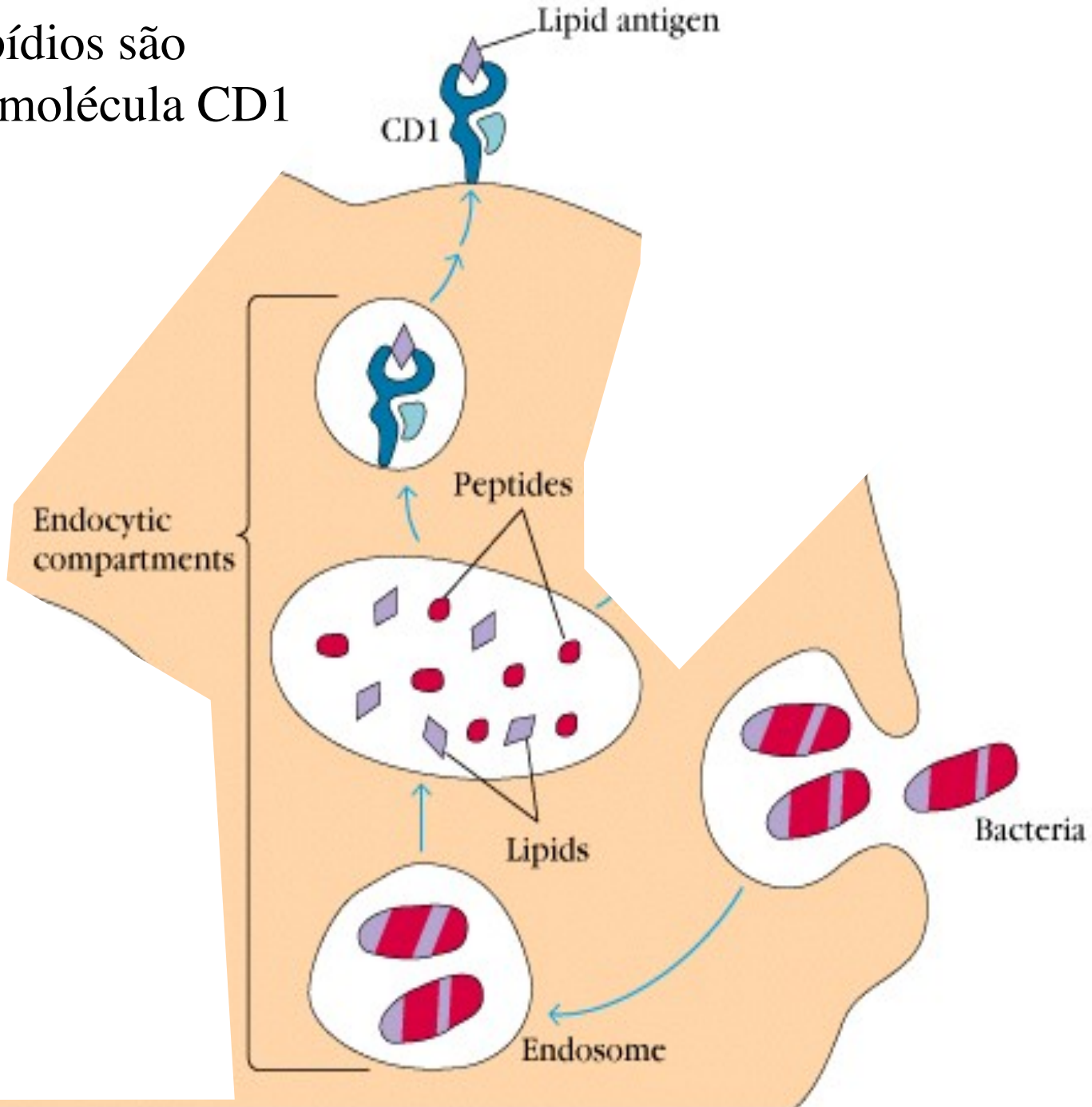
Figure 6.2 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

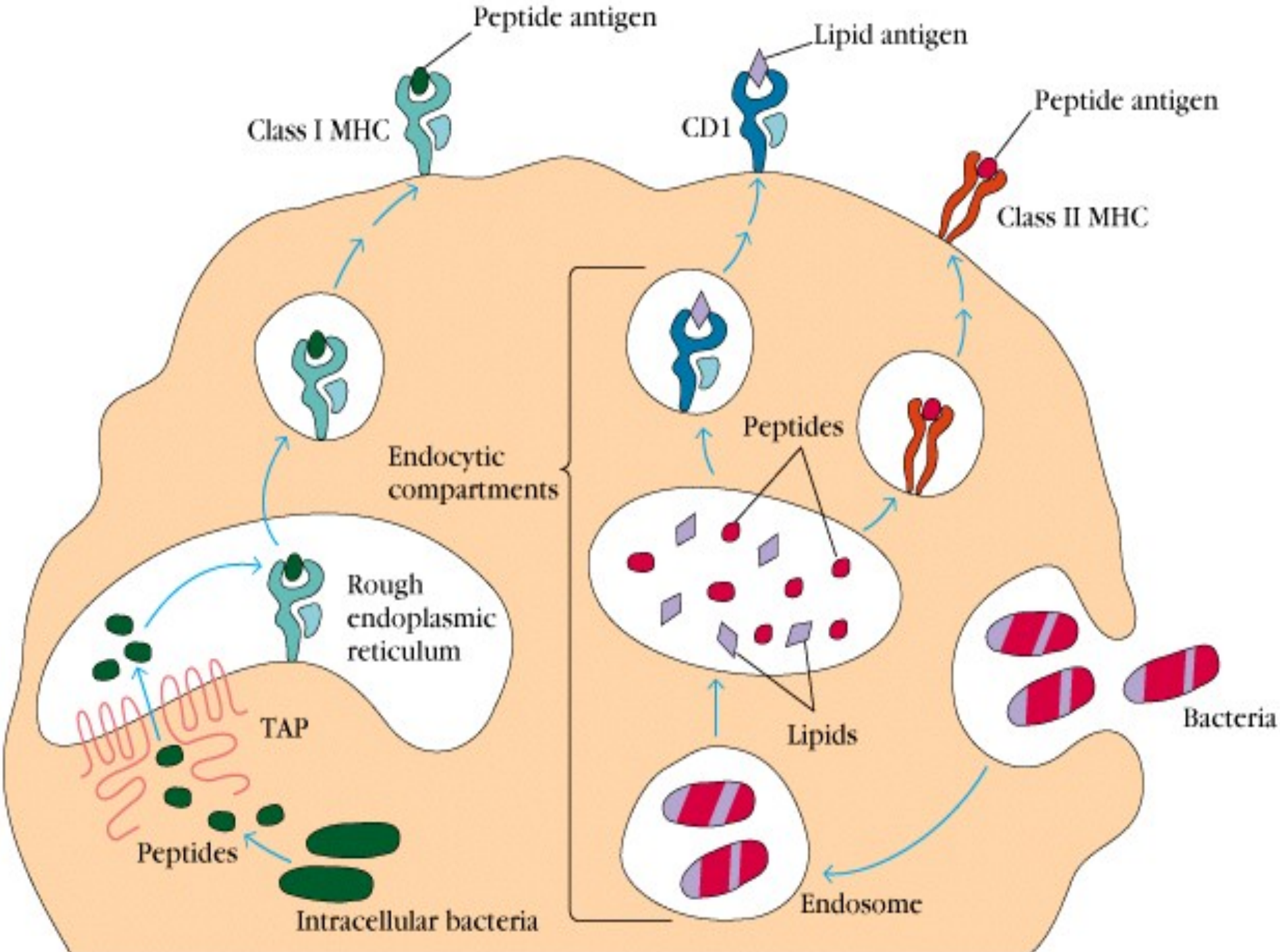
conceito importante!


Peptide antigen
Class I MHC
Rough endoplasmic reticulum
TAP
Peptides
Intracellular bacteria


Peptide antigen
Class II MHC
Peptides
Endocytic compartments
Lipids
Bacteria
Endosome

Antígenos lipídios são apresentados pela molécula CD1




Peptide antigen
Lipid antigen
Peptide antigen
Class I MHC
CD1
Class II MHC
Endocytic compartments
Peptides
Rough endoplasmic reticulum
TAP
Lipids
Bacteria
Peptides
Intracellular bacteria
Endosome

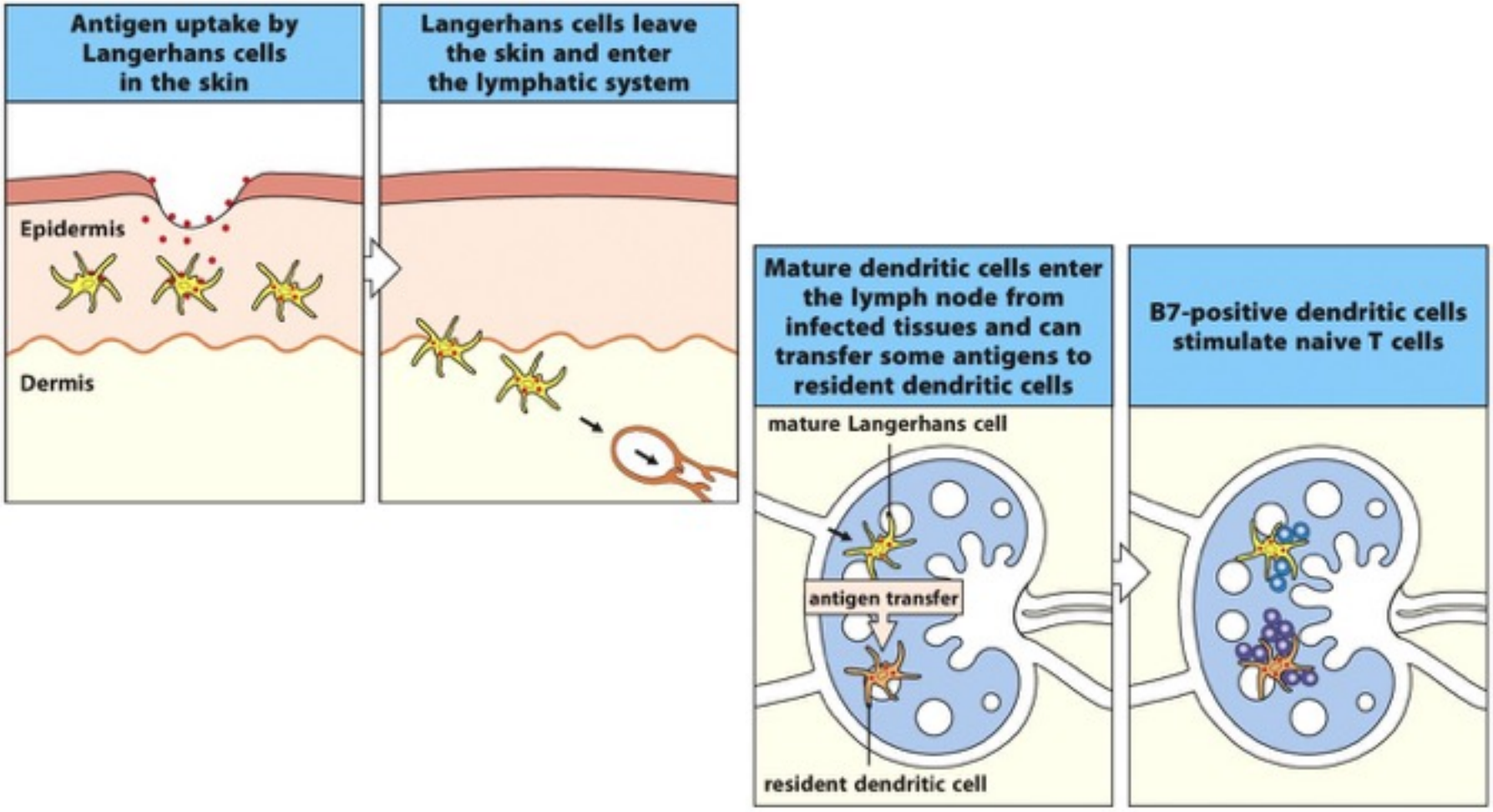


Figure 9.13 Janeway's Immunobiology, 8ed. (© Garland Science 2012)