Antigens

Major histocompatibility complex and antigen presentation

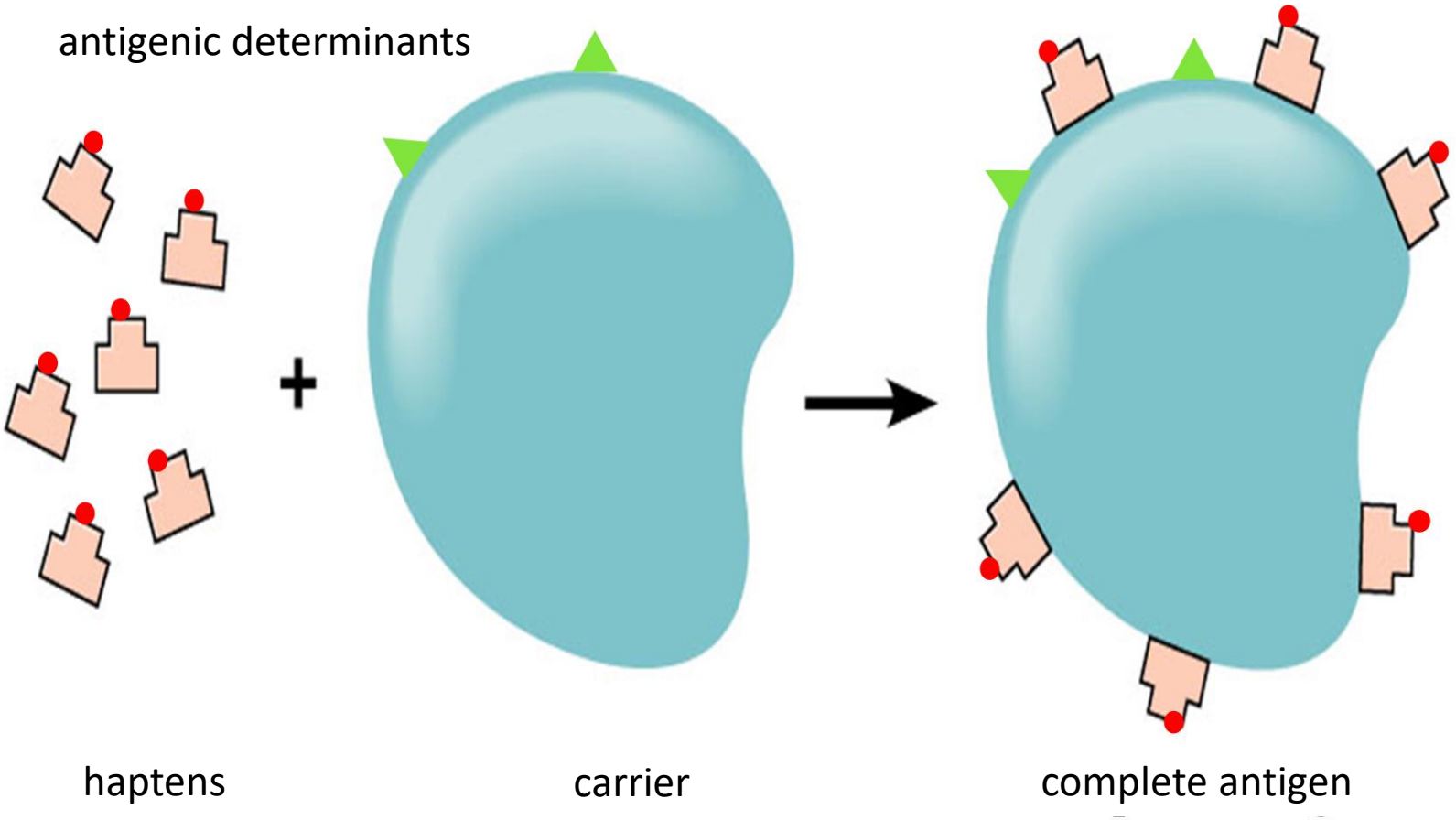
(Milan Číž)

Antigens

Antigens

- complete (immunogen) - immunogenicity
  - specificity
- incomplete (hapten) - specificity
- antigenic determinants (epitopes)

Antigens



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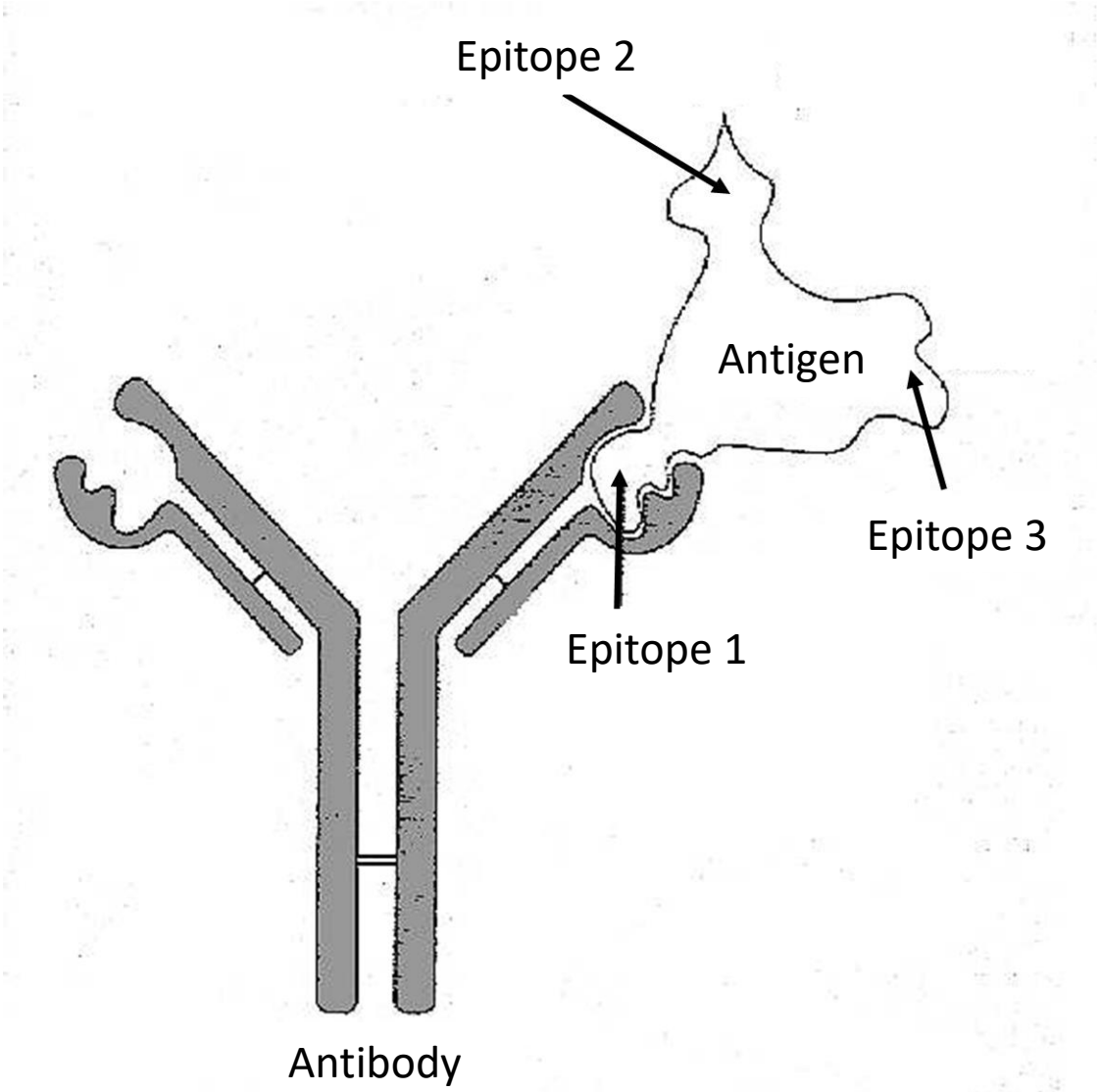
Antigens



Antigen characteristics

Physical

- relative molecular mass
- solubility
- electric charge

Chemical

- structure
- degradability

Biological

- species distance

Chemical composition of immunogens

- polypeptides - hormones, synthetic antigens
- proteins - plasmatic proteins, enzymes, microbial proteins
- polysaccharides – bacterial capsules, synthetic polysacch.
- glycoproteins - immunoglobulins, MHC, blood antigens
- peptidoglycans – bacterial cell walls
- nucleoproteins - chromatin, ribosomes
- lipoproteins - plasmatic and cell membranes
- lipopolysaccharides - endotoxins from G^- bacteria cell walls

Distinguishing of antigens

According to the relation to the given organism

- exogenous
- endogenous
- autoantigens

According to the mutual relation between two organisms

- xenogenic (heterologous)
- allogenic (homologous)
- isogenic ~ syngenic (inbred strains, monozygotic twins)
- autologous

Tumor antigens

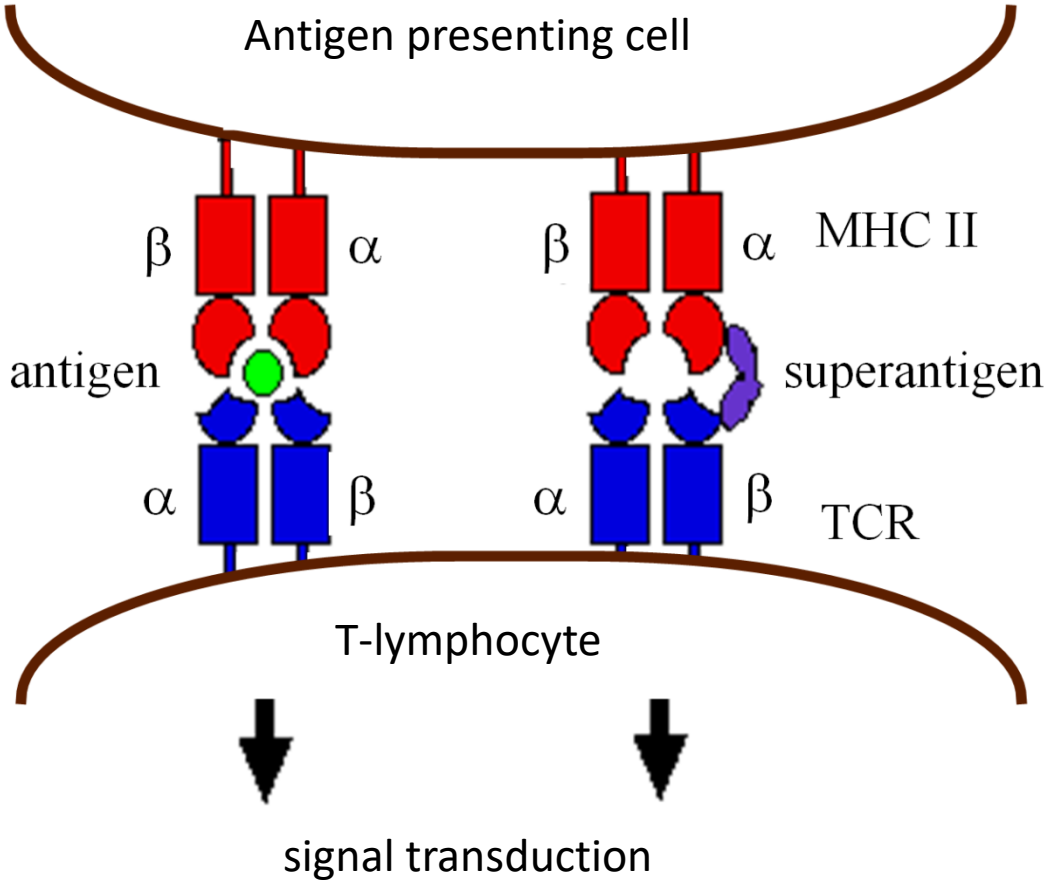
Tumor-specific antigens (TSAs)

- created by tumor specific mutations
- present only on tumor cells

Tumor-associated antigens (TAAs)

- present on tumor cells and normal cells
- more common
- oncofetal antigens
- α-fetoprotein (AFP)
- carcinoembryonal antigen (CEA)

Antigen presentation



Superantigens

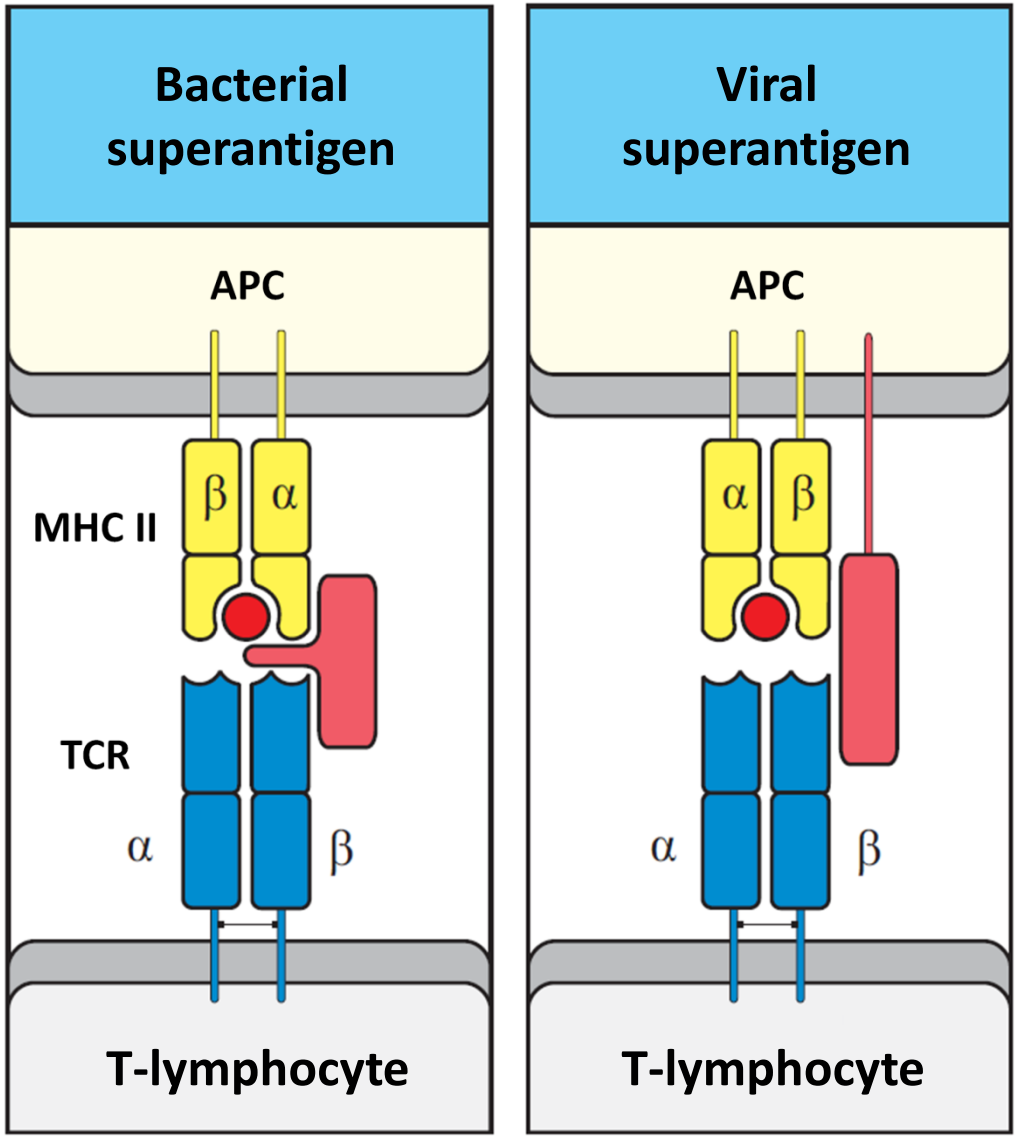


Fig. 6.25 Immunobiology, 9/e.
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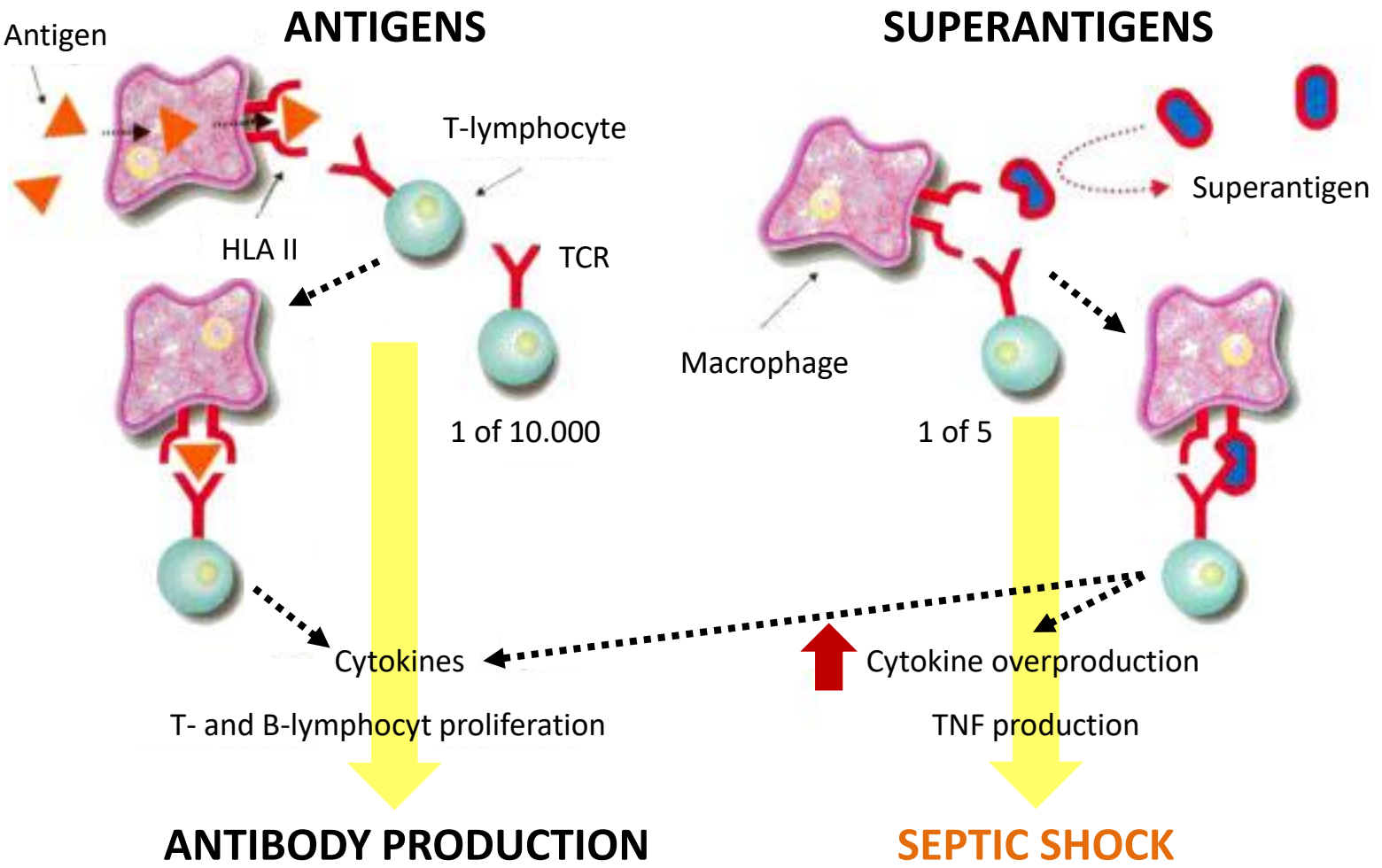
Antigens vs. superantigens

Immune response



MHC antigens

(MHC = Major Histocompatibility Complex)

HLA (Human Leukocyte Antigens)

- classical MHC I – HLA-A, HLA-B, HLA-C
- non-classical MHC I – HLA-E, HLA-F, HLA-G
- MHC II – HLA-DR, HLA-DQ, HLA-DP

H-2 (mice)

B (chickens)

MHC I – all nucleated cells

MHC II – antigen presenting cells

MHC antigeny

Tissue	MHC I	MHC II
Lymphoid tissue		
T-lymphocytes	+++	+
B-lymphocytes	+++	+++
Macrophages	+++	++
Other APC	+++	+++
Thymic epithelial cells	+	+++
Other nucleated cells		
Neutrophils	+++	–
Hepatocytes	+	–
Kidney	+	–
Brain	+	–
Non nucleated cells		
Erythrocytes	–	–

Figure 3-19 Immunobiology, 6/e.
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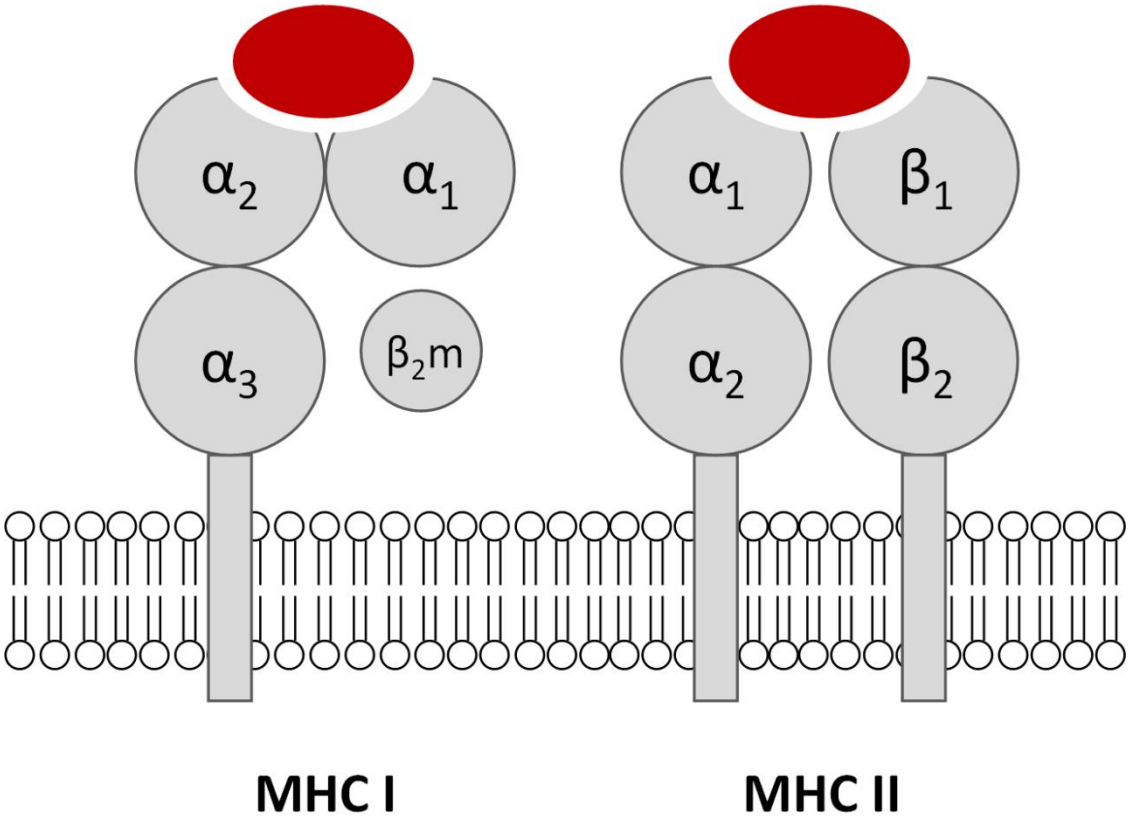
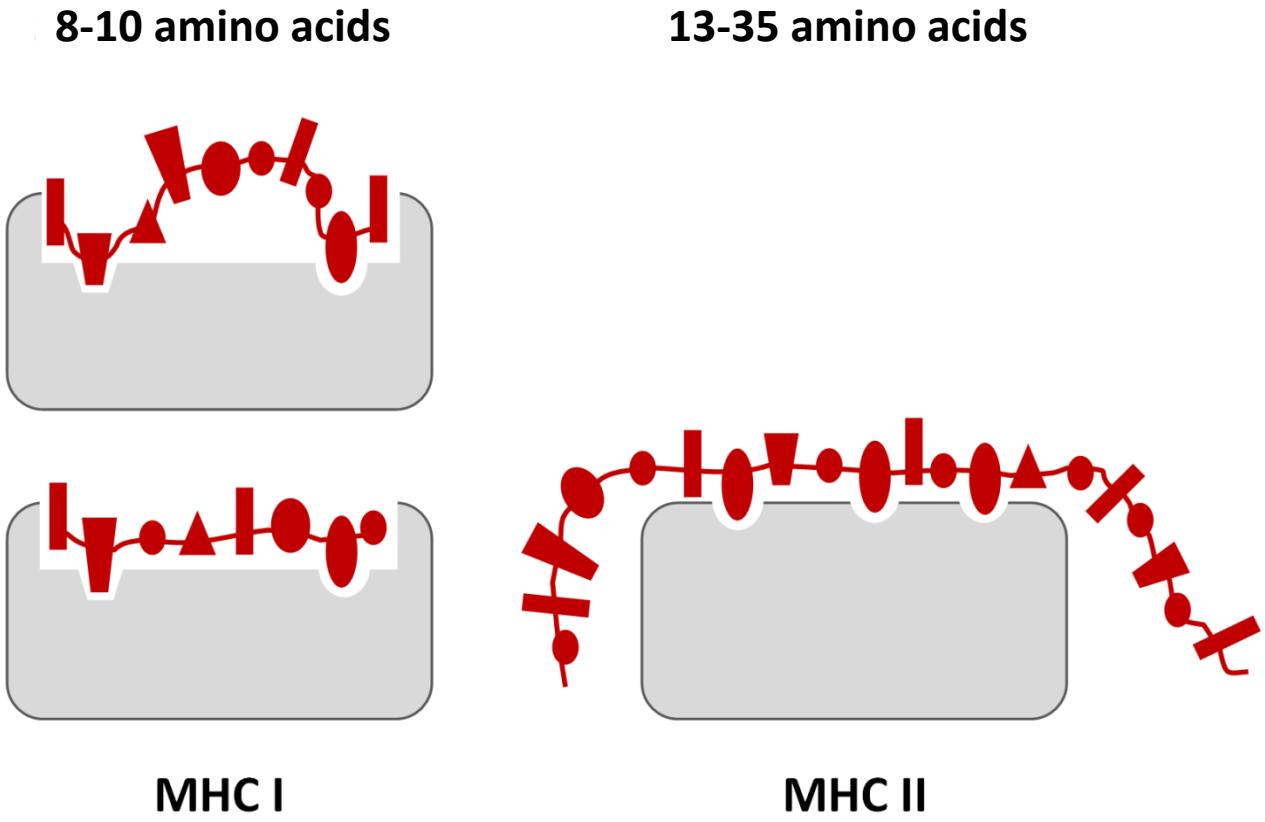
MHC antigens



MHC antigens

MHC I – peptides bound at their ends

MHC II – peptides bound along their entire length



MHC antigens

MHC I – peptides bound at their ends

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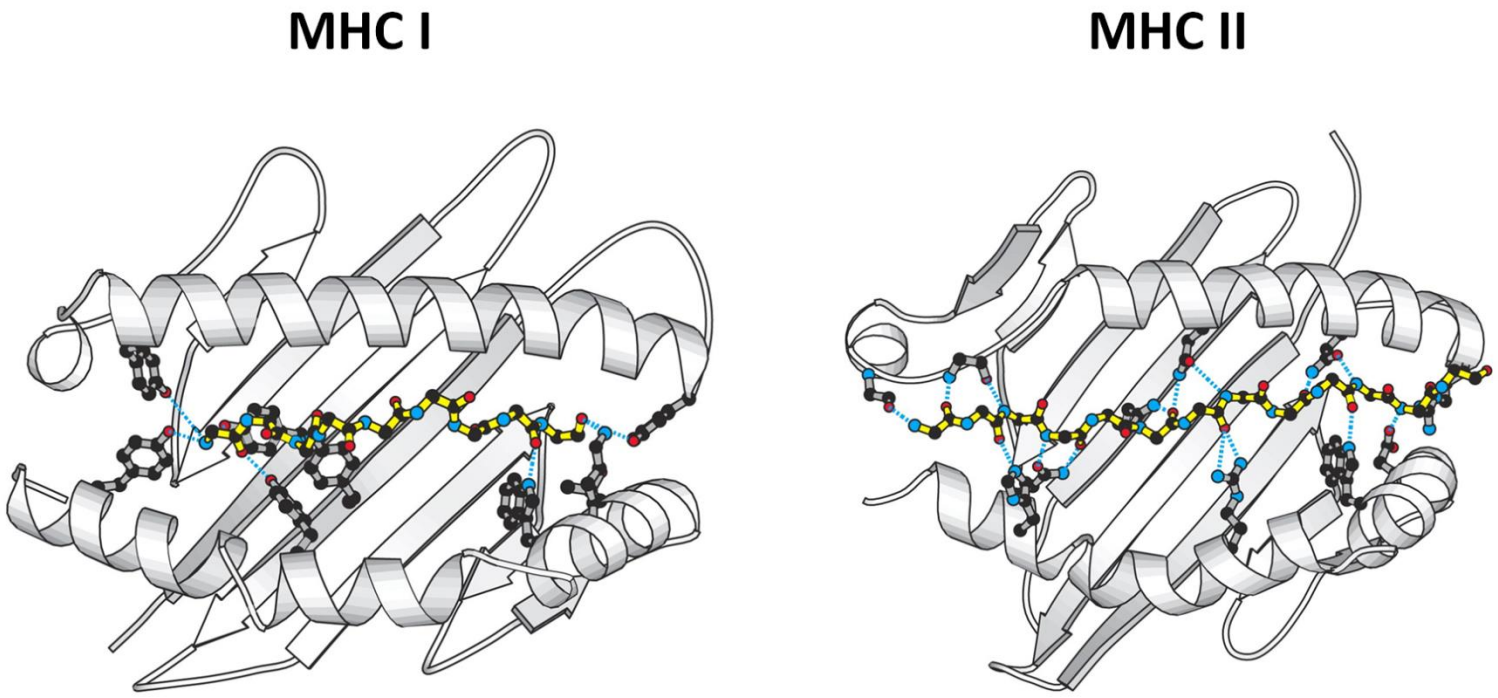


Figure 3-23, 3-25 Immunobiology, 6/e. (© Garland science 2005)

MHC antigens

Principal functions of MHC:

- MHC I – to bind peptide fragments produced in cell
- MHC II – to bind peptide fragments ingested by cell
- to present bound peptide fragments to T-lymphocytes

MHC antigens

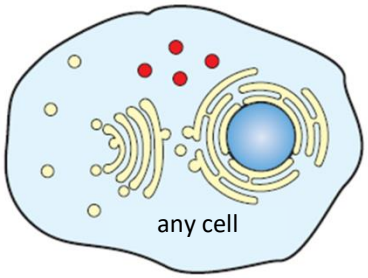
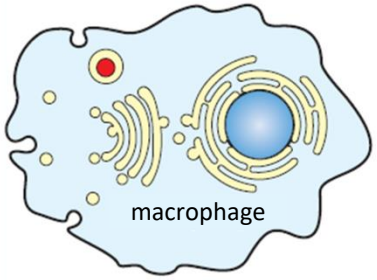
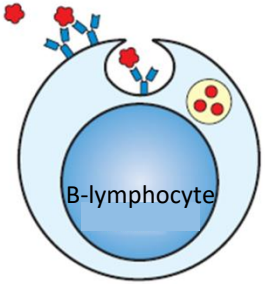
	Cytosolic pathogens	Intravesicular pathogens	Extracellular pathogens
			
Degraded in	Cytosol	Endocytic vesicles	Endocytic vesicles
Bound to	MHC I	MHC II	MHC II
Presented to	CD 8 T-lymphocytes	CD4 T-lymphocytes	CD4 T-lymphocytes
Consequence	Cell death	Activation of microbicidal mechanisms	Activation of B-lymphocytes (Ab production)

Fig. 6.2 Immunobiology, 9/e. (© Garland science 2017)

MHC antigens

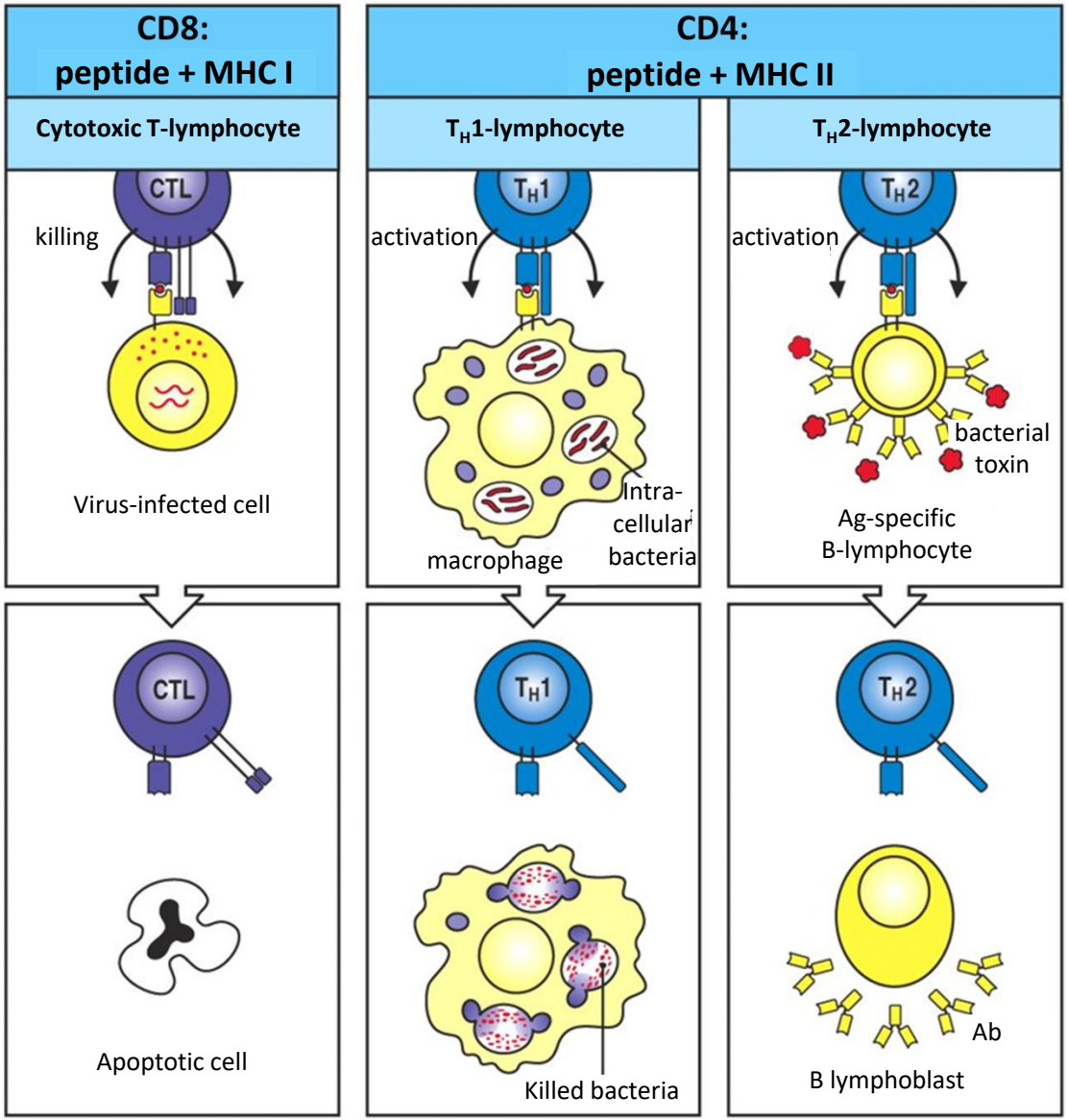


Figure 8-27 Immunobiology, 6/e. (© Garland science 2005)

Intracellular vesicular system

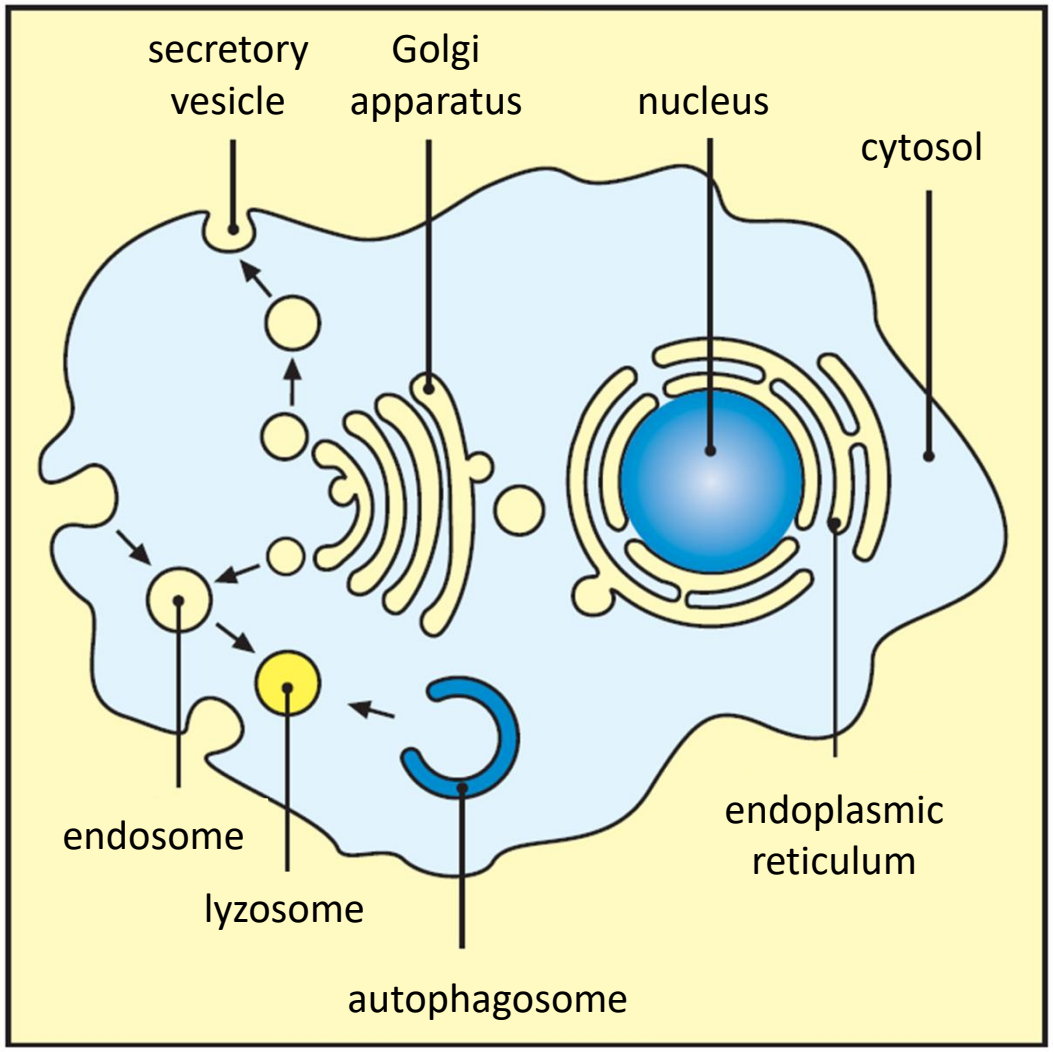
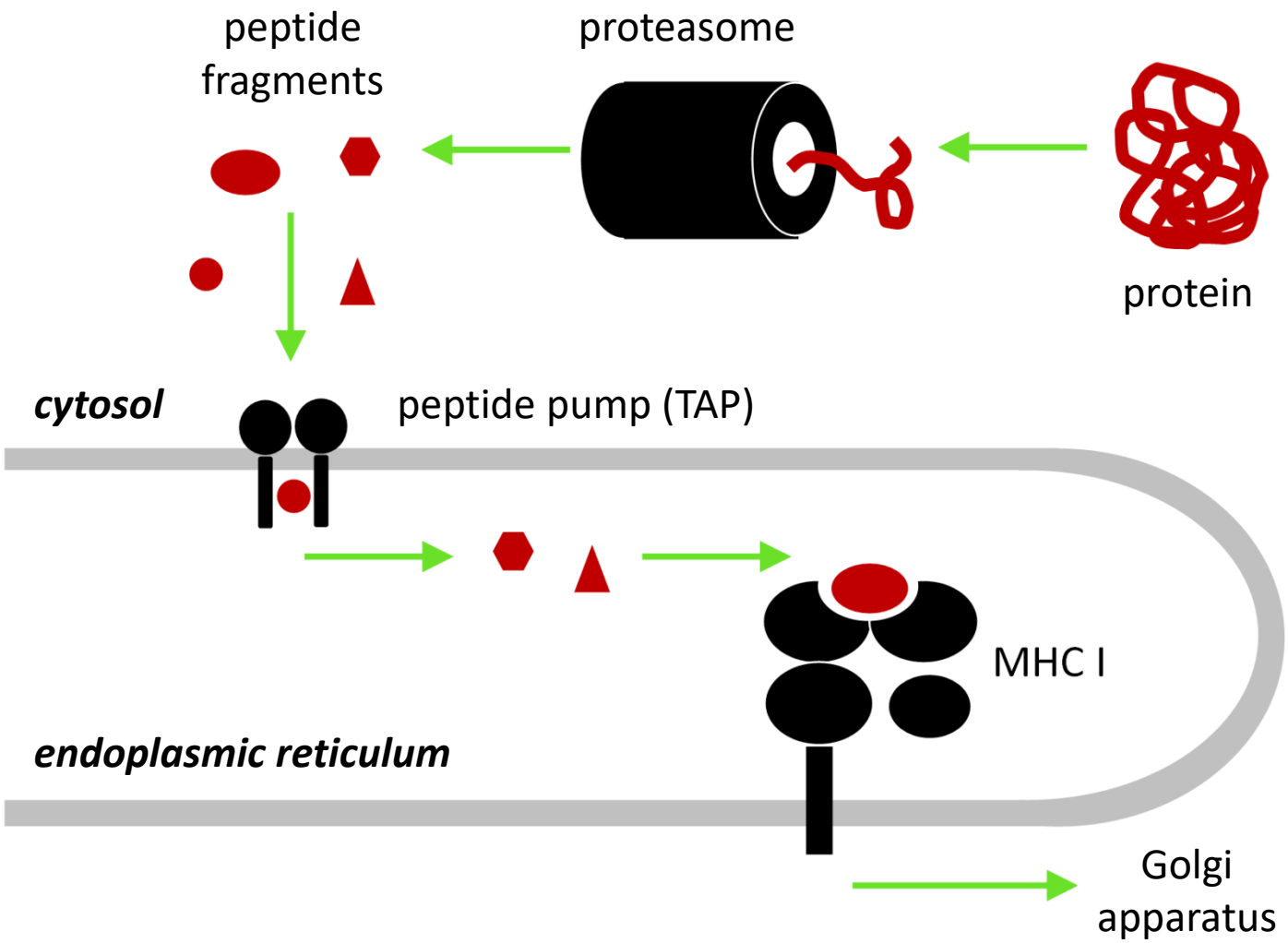
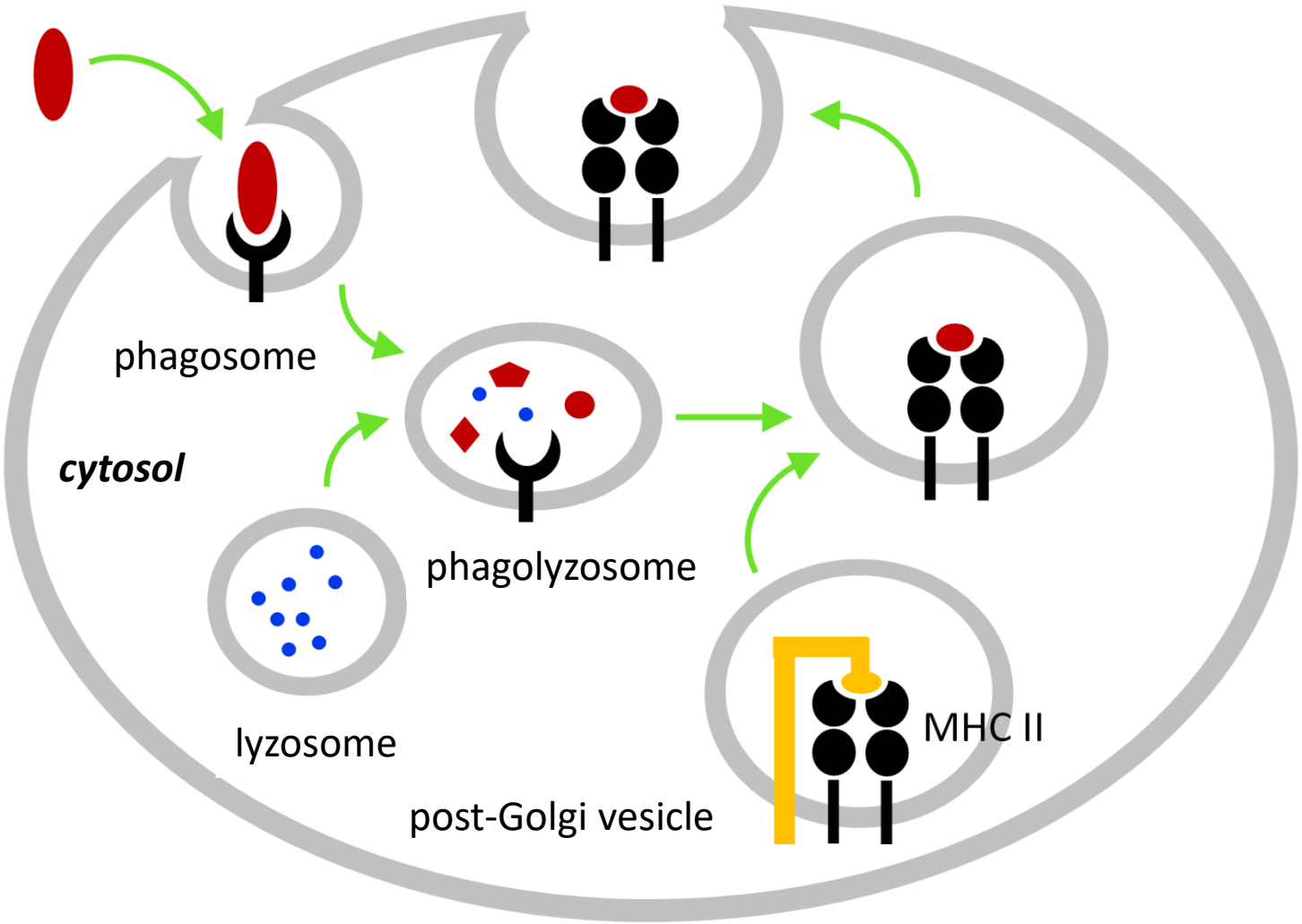


Fig. 6.1 Immunobiology, 9/e. (© Garland science 2017)

Peptide fragment presentation via MHC I



Peptide fragment presentation via MHC II



Invariant chain

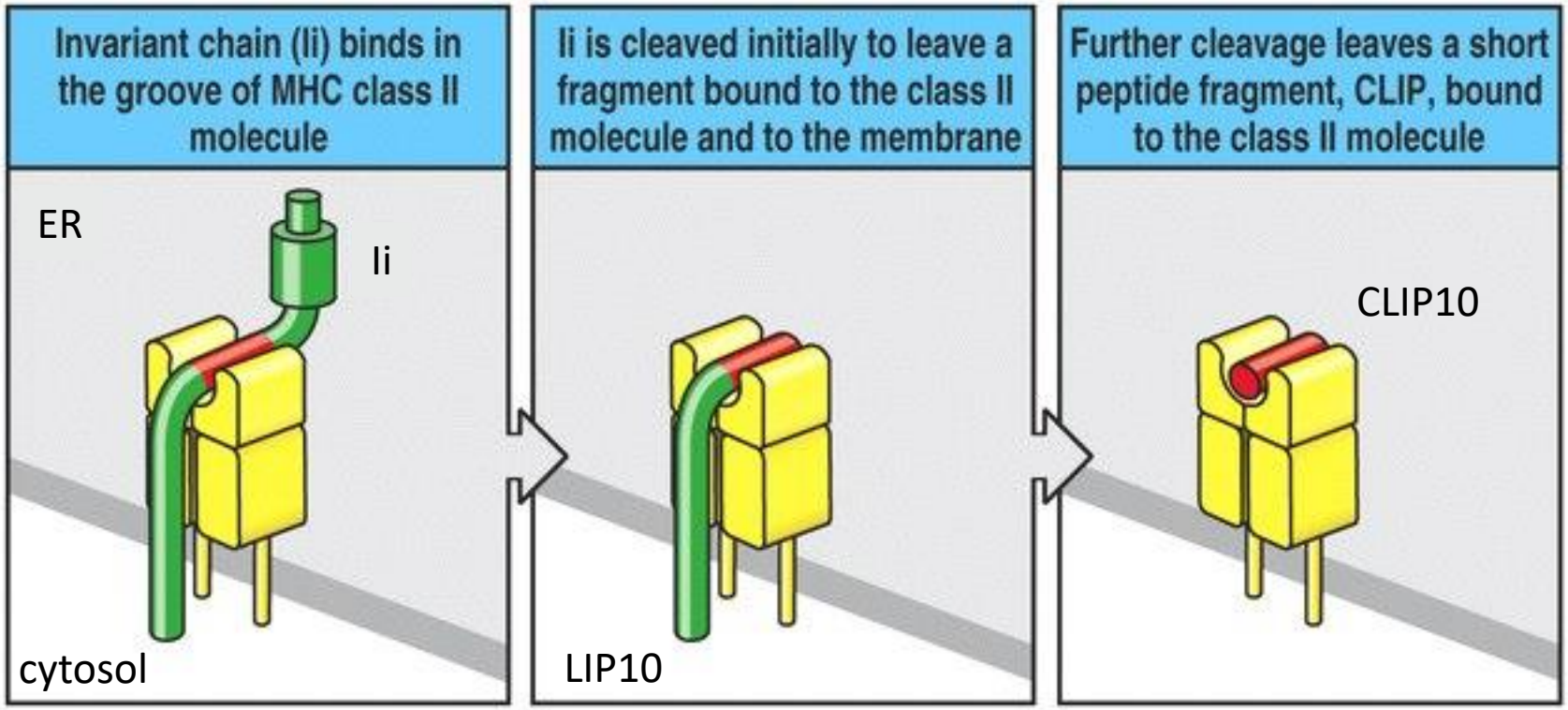


Fig. 6.11 Immunobiology, 9/e. (© Garland science 2017)

Antigen presenting cells (APC)

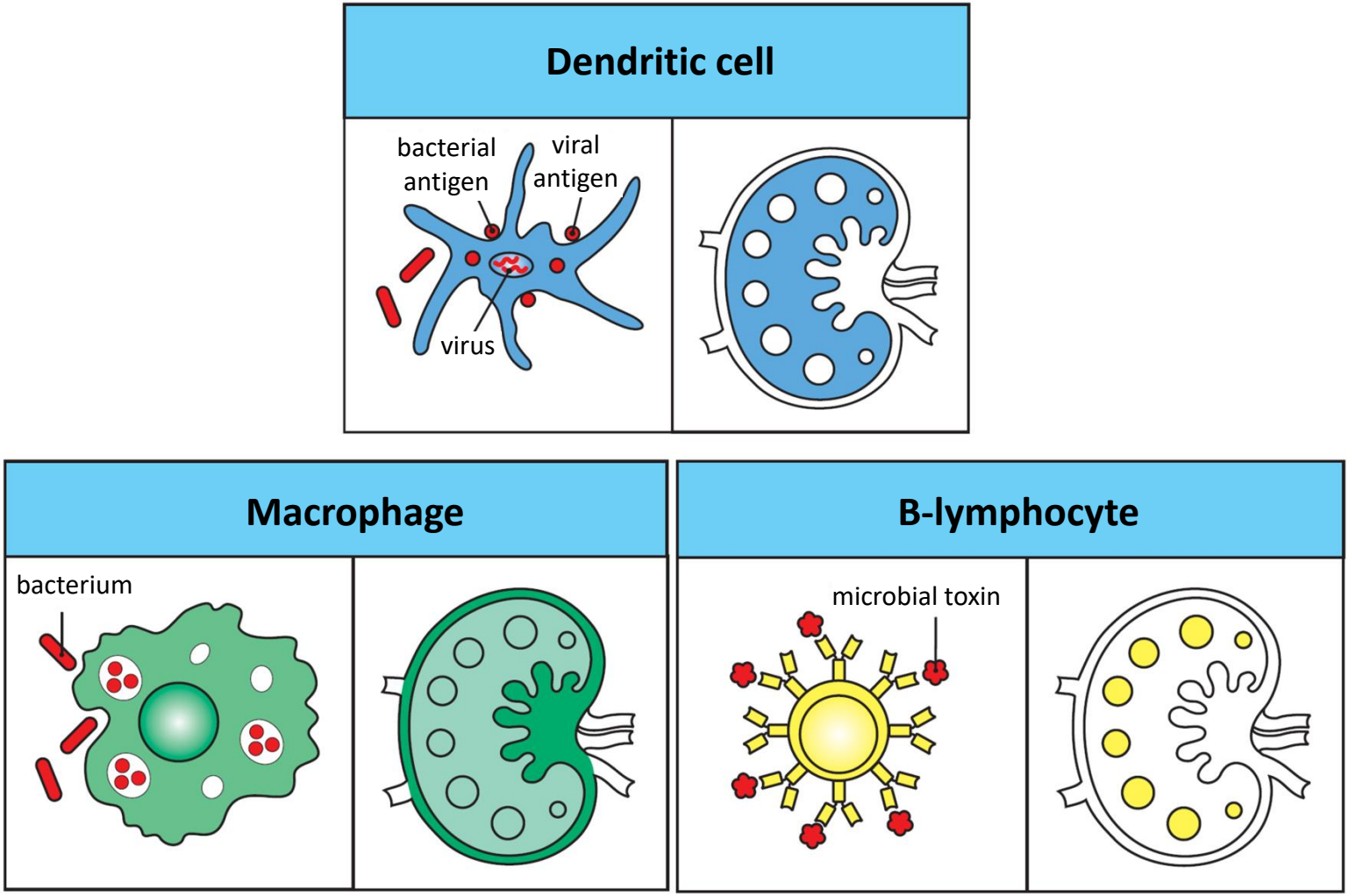


Fig. 9.13 Immunobiology, 9/e. (© Garland science 2017)

T lymphocytes meet antigen

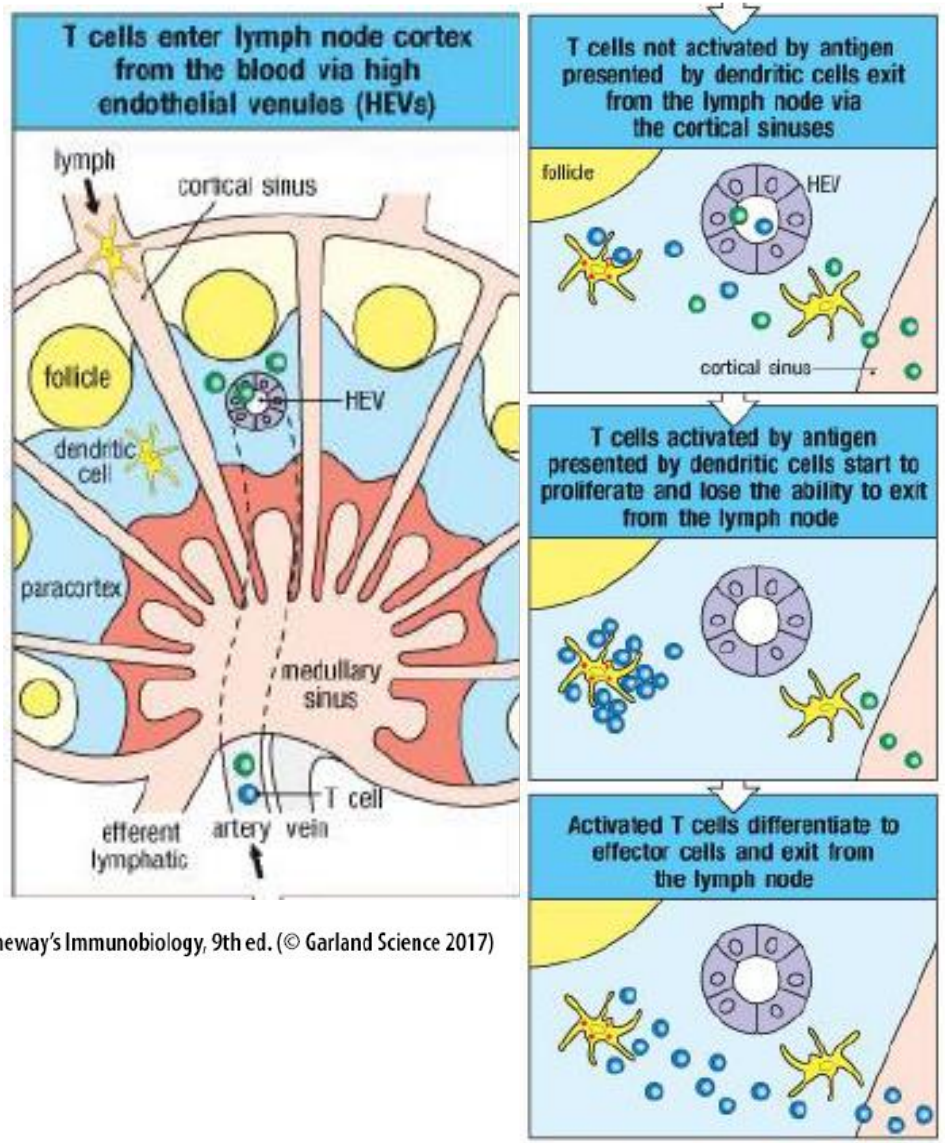


Figure 9.4 Janeway's Immunobiology, 9th ed. (© Garland Science 2017)

Langerhans cells

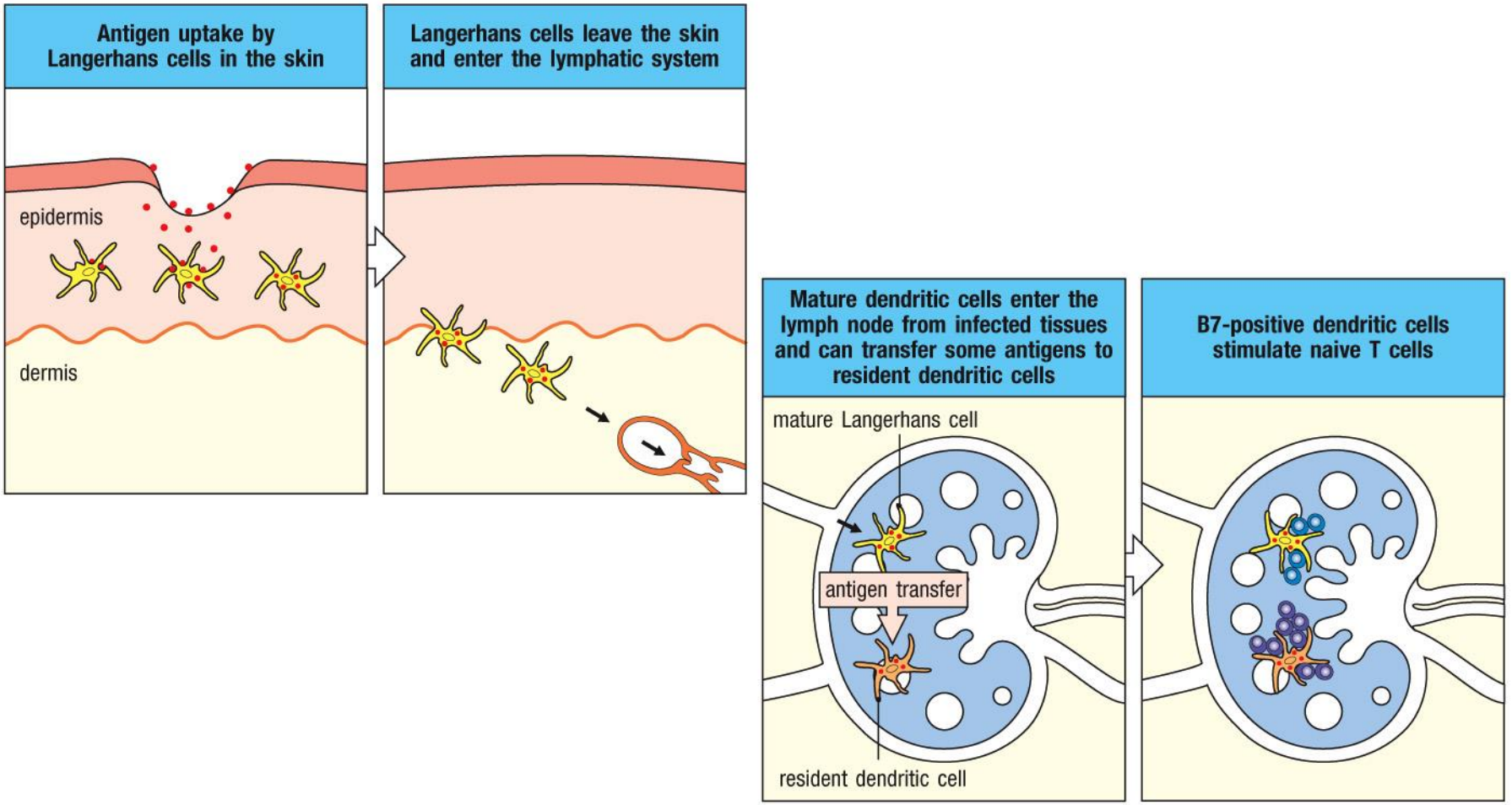


Figure 9.16 Janeway's Immunobiology, 9th ed. (© Garland Science 2017)

Dendritic cells

Fluorescence microscopy | Electron microscopy

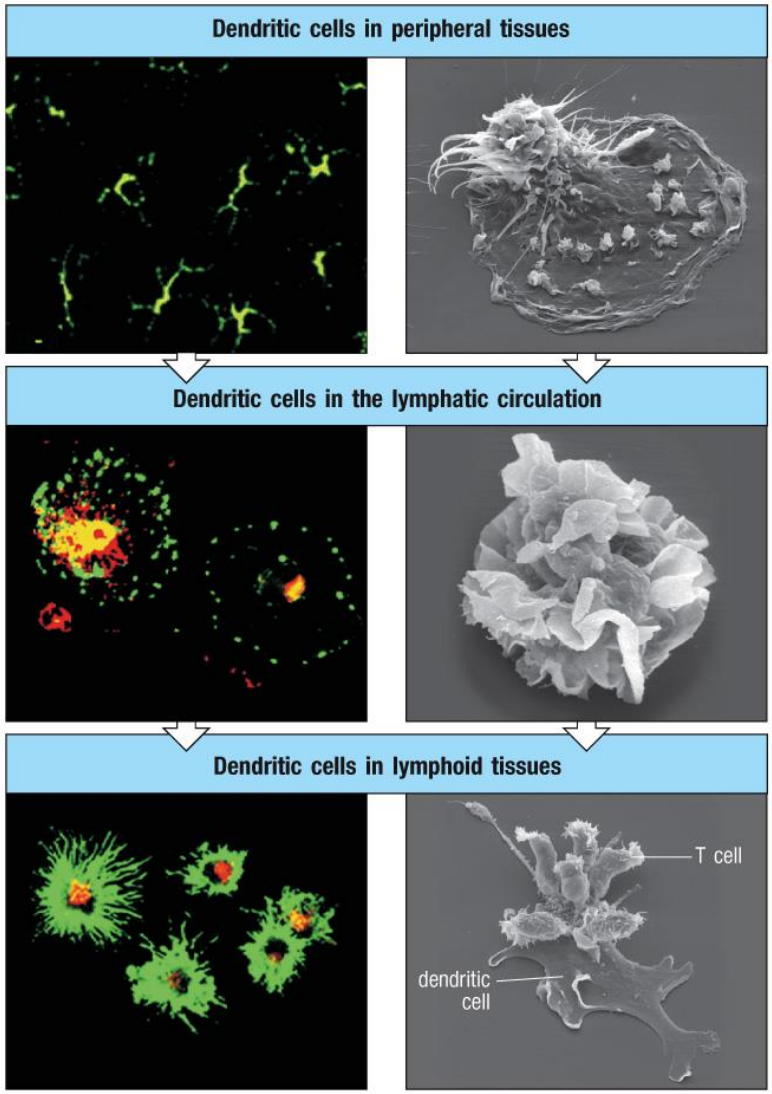


Figure 9.12 Janeway's Immunobiology, 9th ed. (© Garland Science 2017)

- dendritic cells in different stages of activation and migration
- fluorescence microscopy:
  green – MHC II molecules
  red – lyzosomal protein

Antigen presenting cells

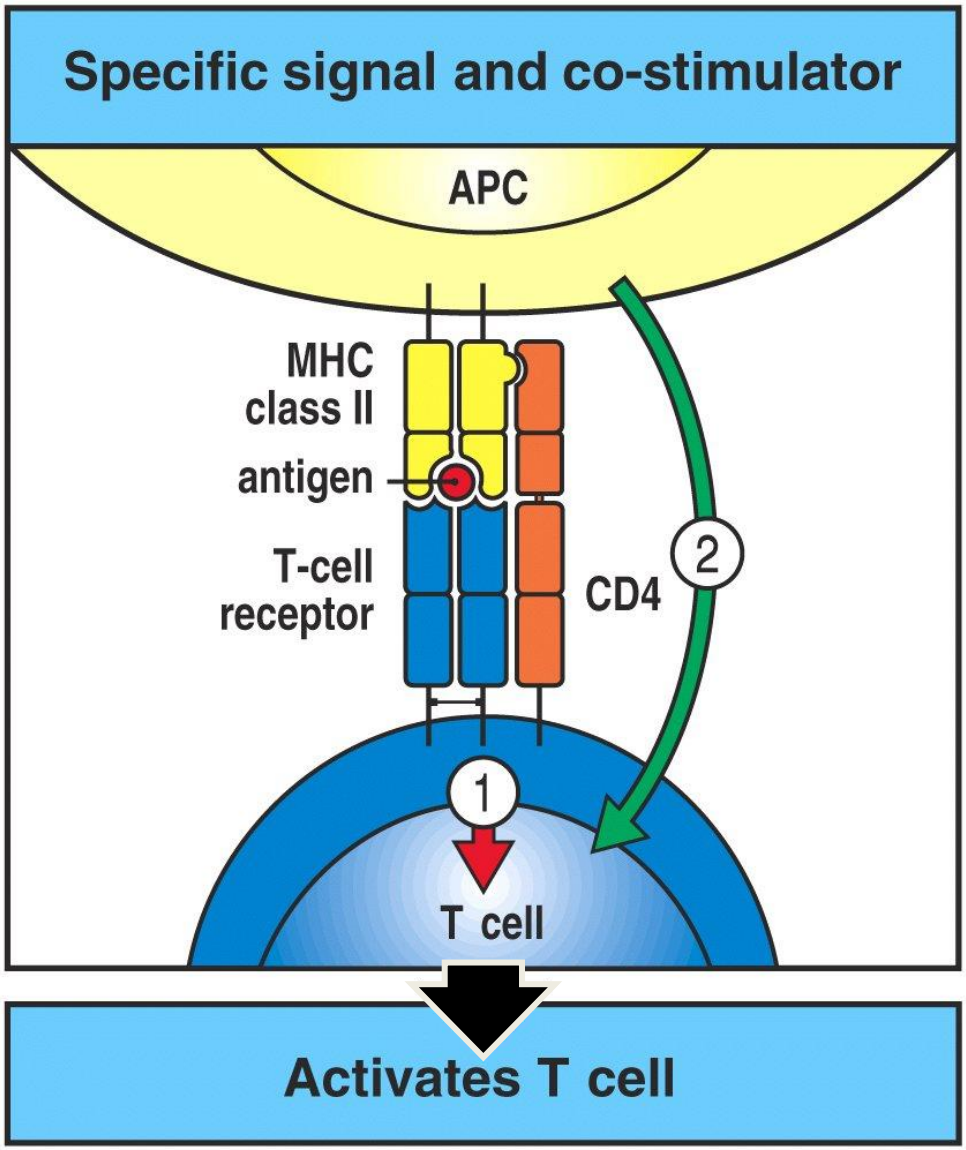


Figure 8-10 Immunobiology, 6/e. (© Garland Science 2005)

Antigen presenting cells

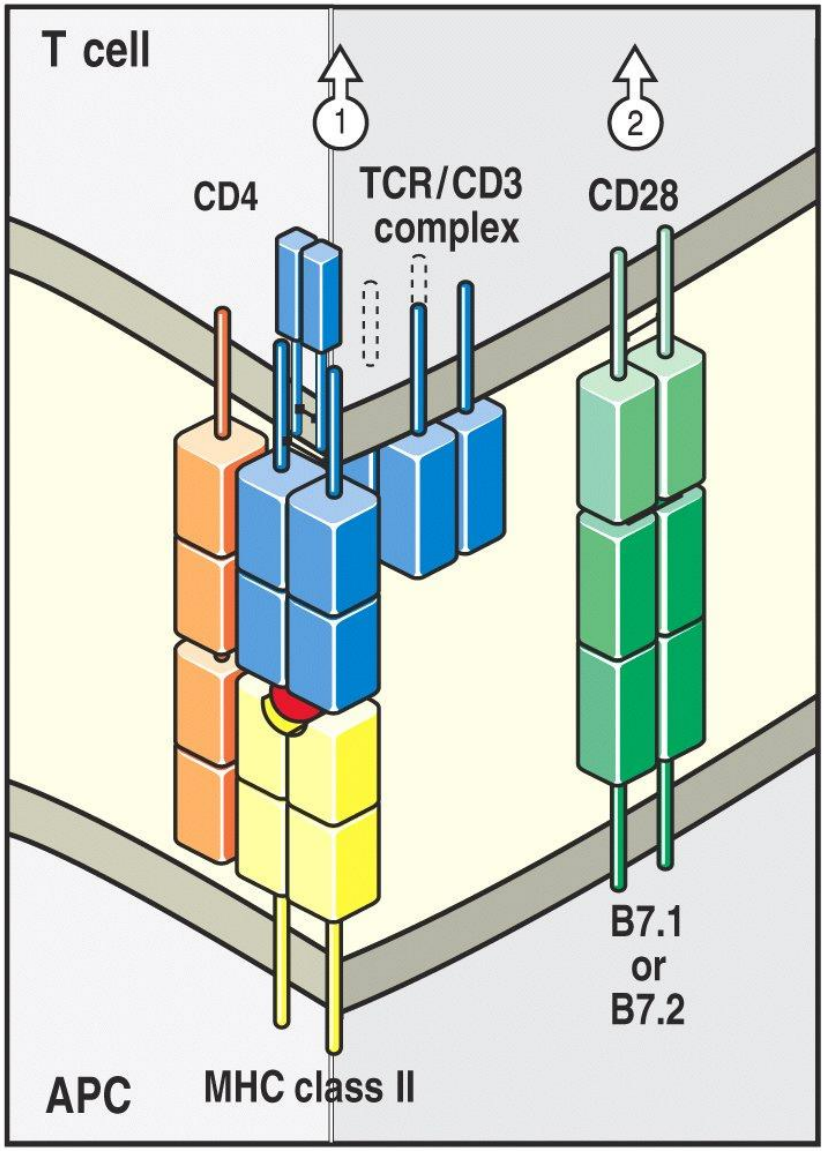


Figure 8-11 Immunobiology, 6/e. (© Garland Science 2005)

Antigen presenting cells

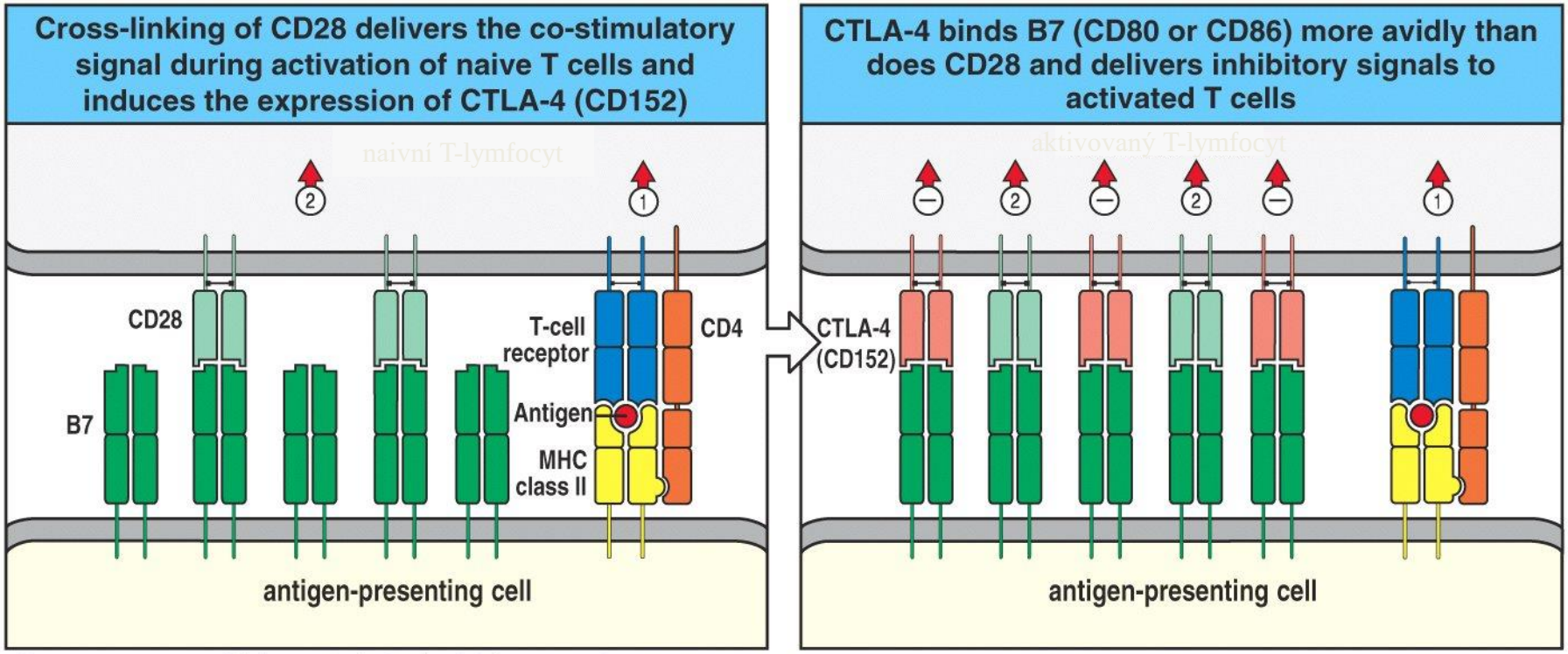


Figure 8-12 Immunobiology, 6/e. (© Garland Science 2005)