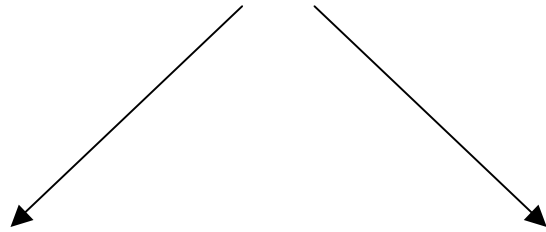


Two branches of immune system



Innate

Adaptive

Characteristics of innate immunity

- Act the same way in all individuals
- Requires no previous exposure to pathogen
- Seen in many types of animals
- Available early in infection
- Necessary for induction of adaptive immunity

Characteristics of adaptive immunity

- Specific to a given pathogen
- Occurs within lifetime of the individual
- Only in vertebrates
- Takes time to mount specific response later in infection (4-5 days)

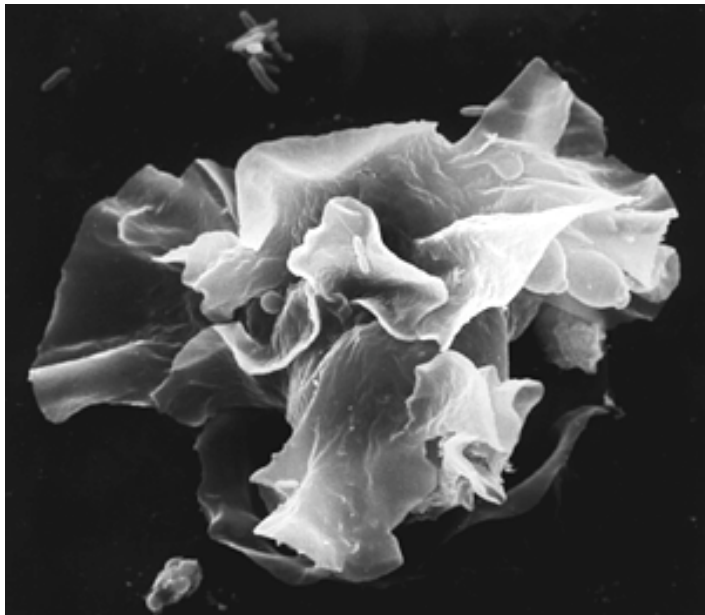
Innate defenses

- Barriers
- Phagocytosis and inflammation
- Complement
- Natural killer cells

Barriers

- Mechanical/Physical
- Chemical
- Microbiological

Phagocytosis



Neutrophil



Macrophage

Inflammation

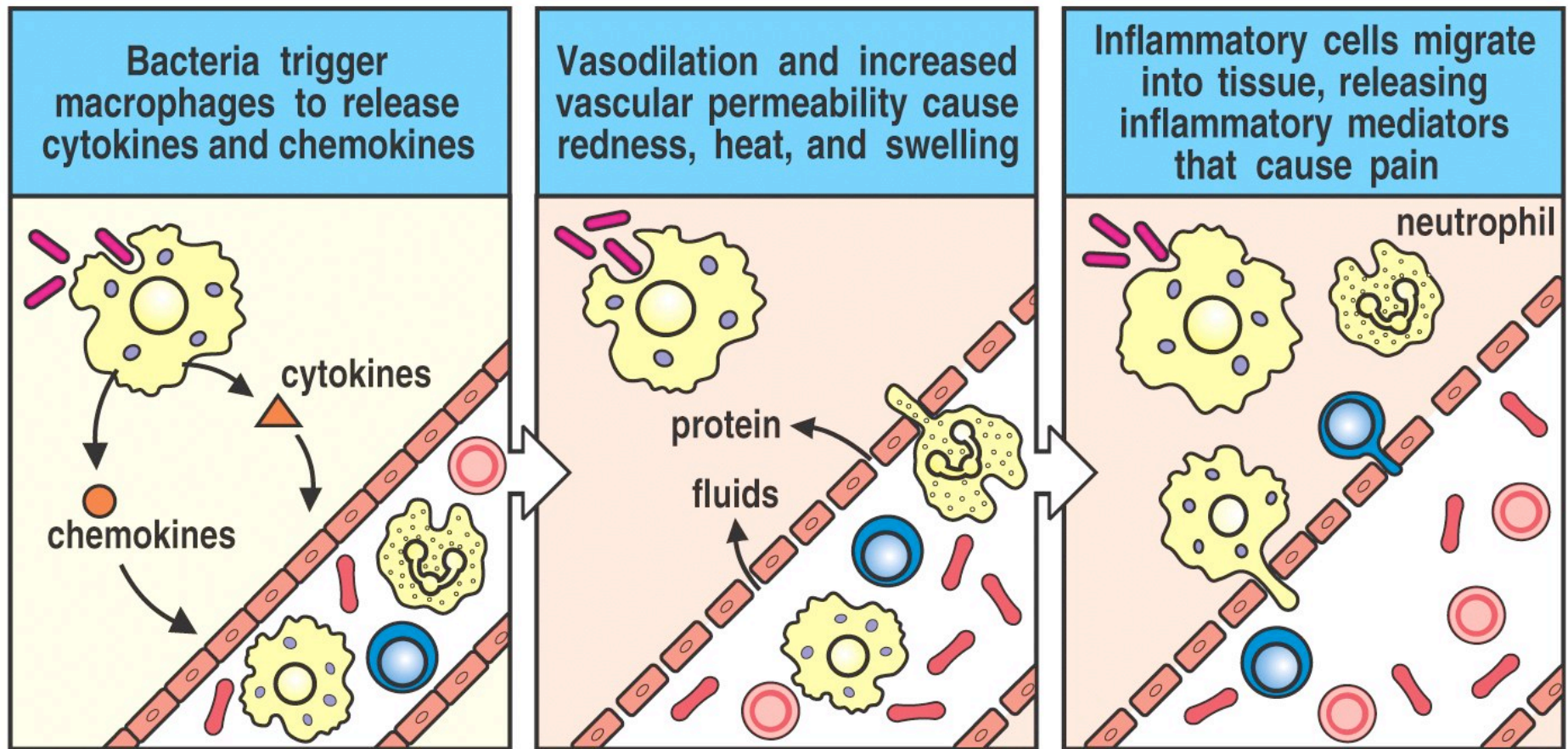


Figure 1-12 Immunobiology, 6/e. (© Garland Science 2005)

Complement activation

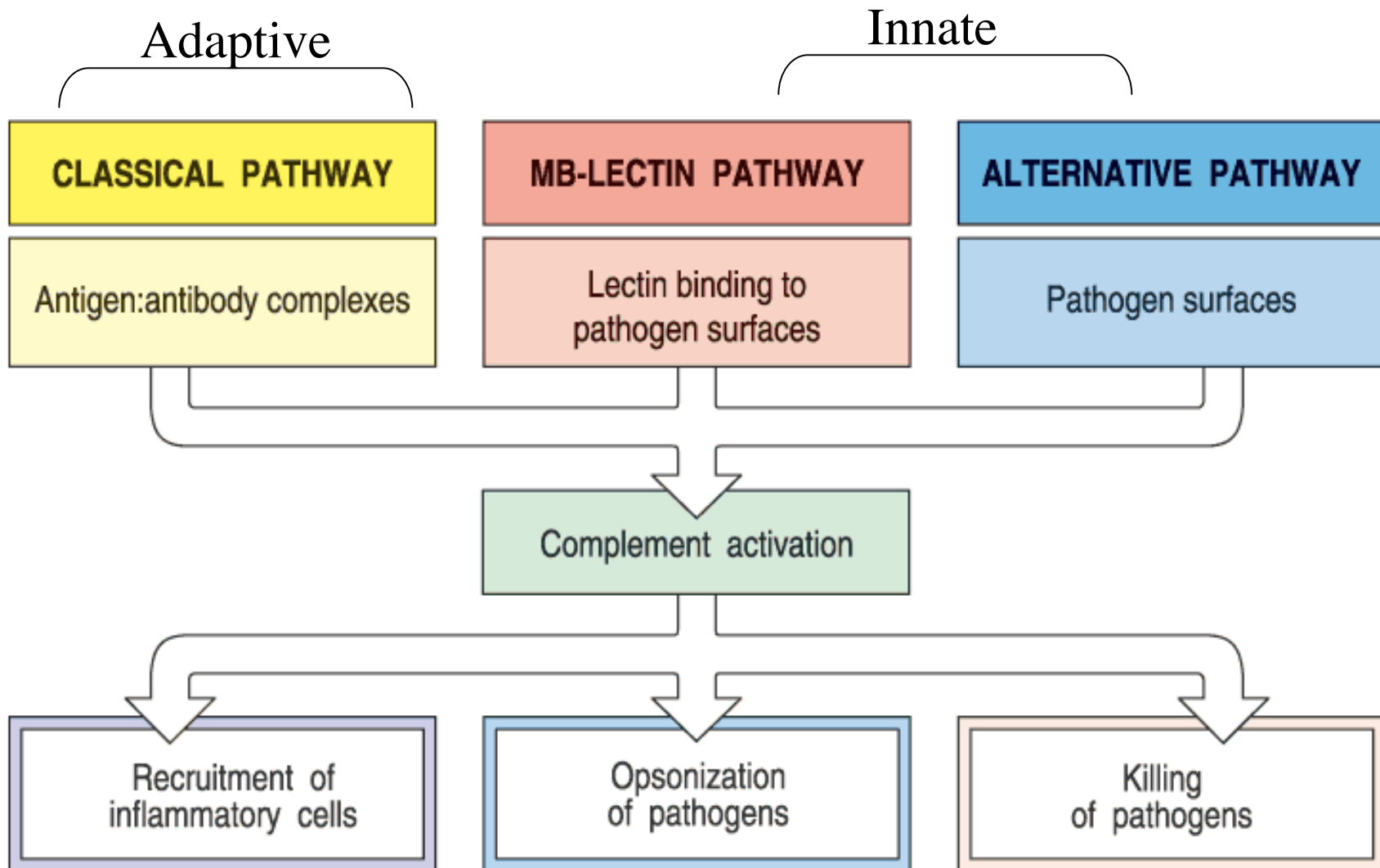


Fig 2.7 © 2001 Garland Science

Fig. 2.18

Adaptive responses

- Antibody production (B cells)
- Cell mediated response (T cells)
 - Cytotoxic T cells= kill infected cells
 - Helper T cells= increase activity of other cells of the immune system (Macrophages, B cells)
- Potentiate the function of accessory cells:
 - NK cells
 - Macrophages/neutrophils
 - Eosinophils
 - Basophils
 - Mast cells

Adaptive responses are specific to antigen

- **Antigen=**
 - Recognized as foreign= “non-self”
 - Generally protein
 - Can be carbohydrate or nucleic acid
 - Only portion of a protein recognized by receptor= **epitope**
 - Recognized by Ig of B cells or TCR of T cells

Immunoglobulin= Antibody

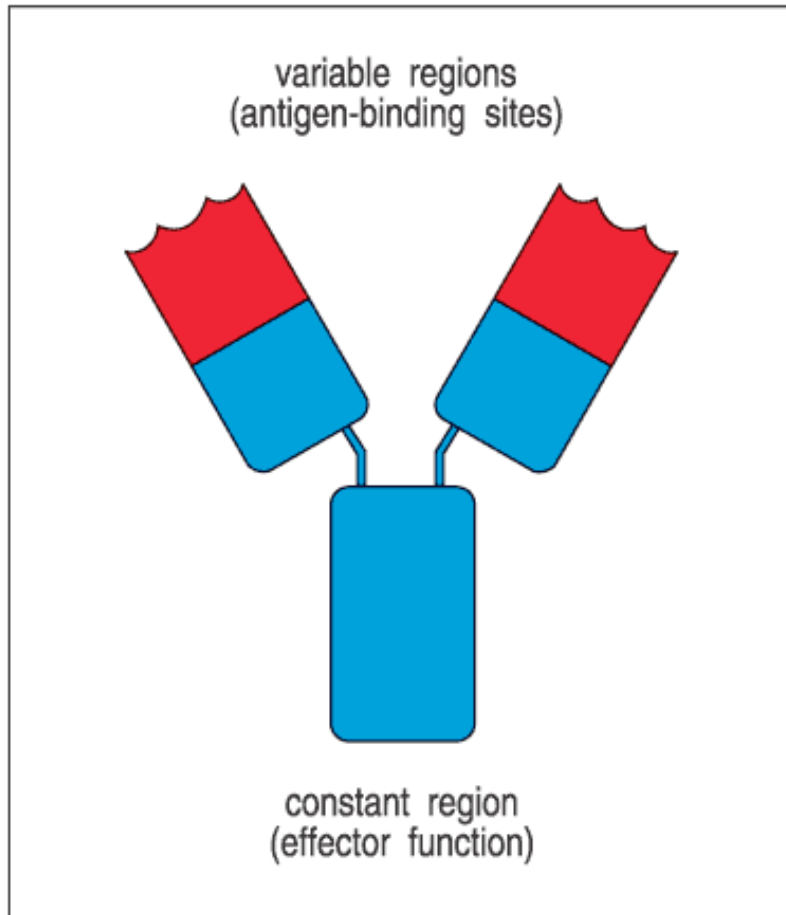


Fig 1.16 © 2001 Garland Science

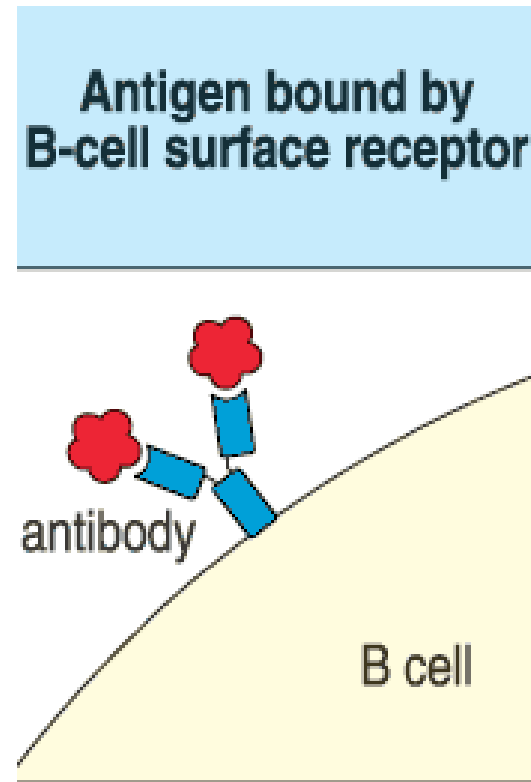
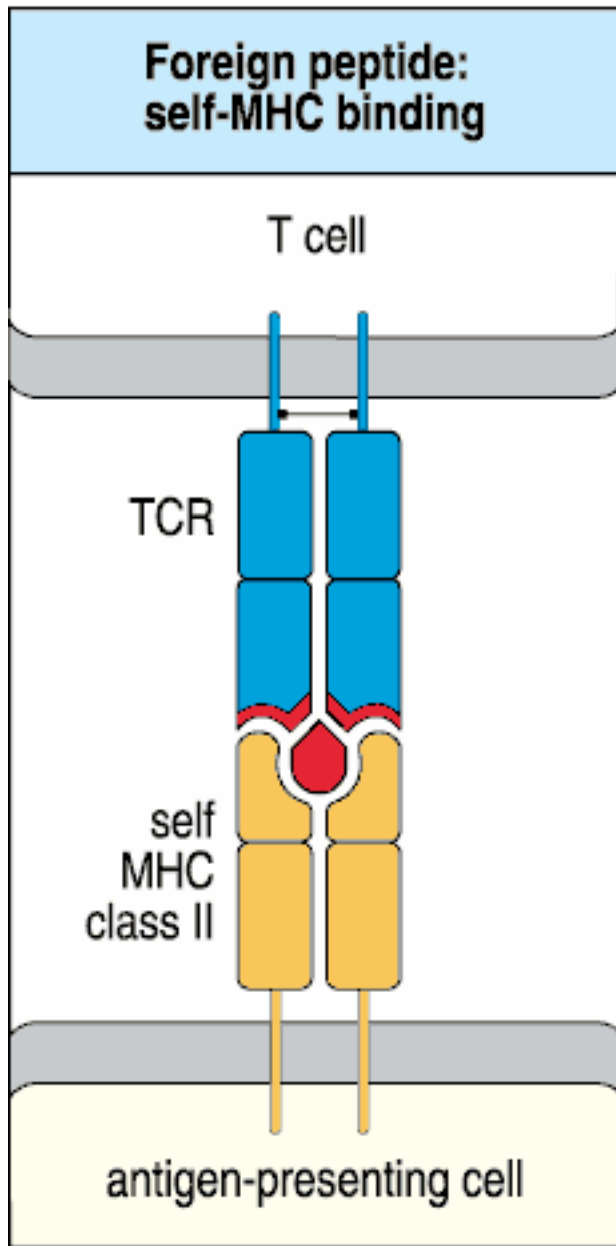


Fig 1.29 © 2001 Ga



T cell receptor
(TCR):

recognizes Ag bound
in cleft of MHC

Fig 5.17 © 2001 Garland S

Questions

- Where do cells of the immune system come from?
- How is diversity in Ag receptors (Ig or TCR) accomplished?
- How are lymphocytes activated in response to Ag?
- Where does activation occur?

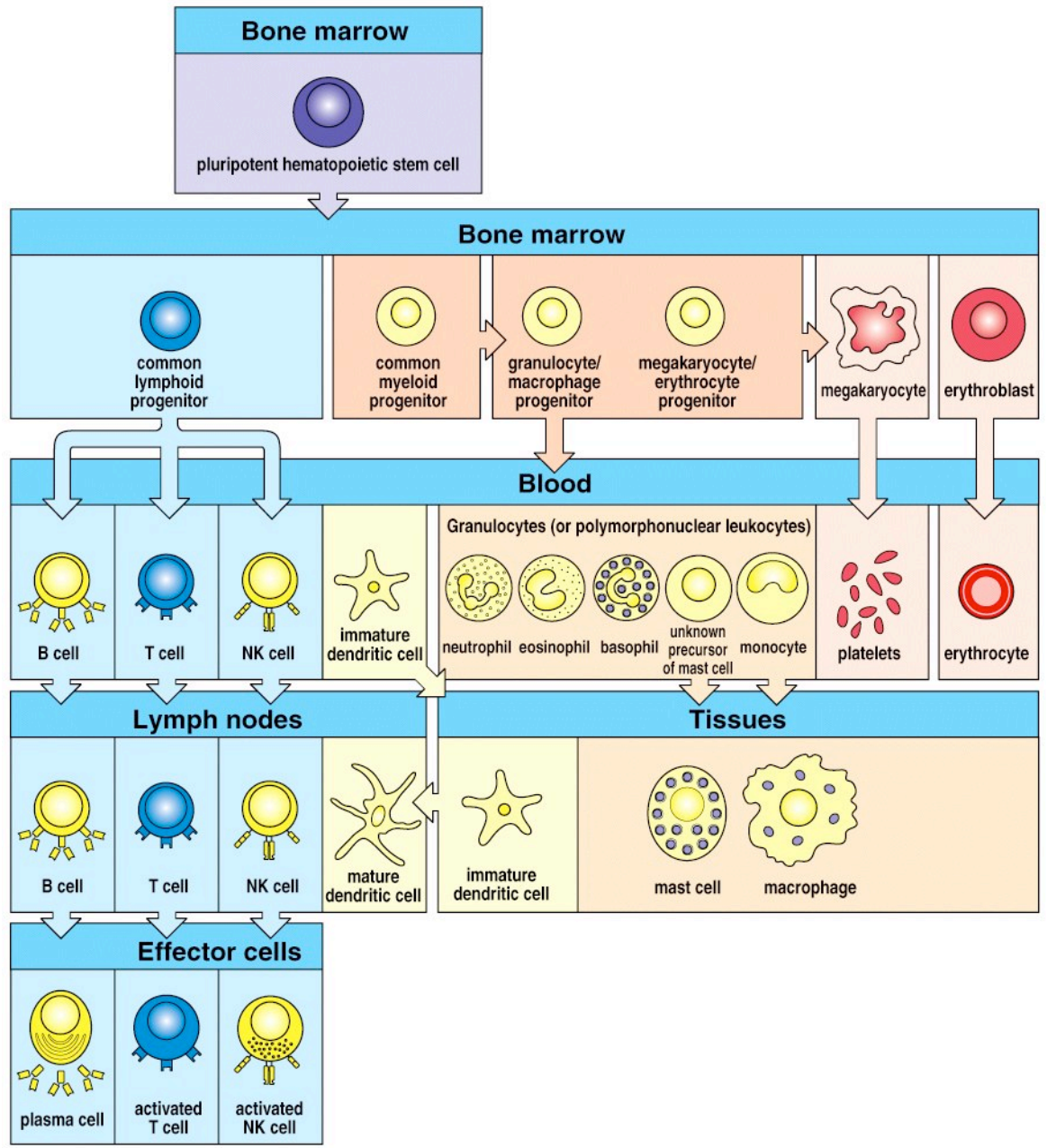


Figure 1-3 Immunobiology, 6/e. (© Garland Science 2005)

Bone marrow: Origin of cells of the immune system

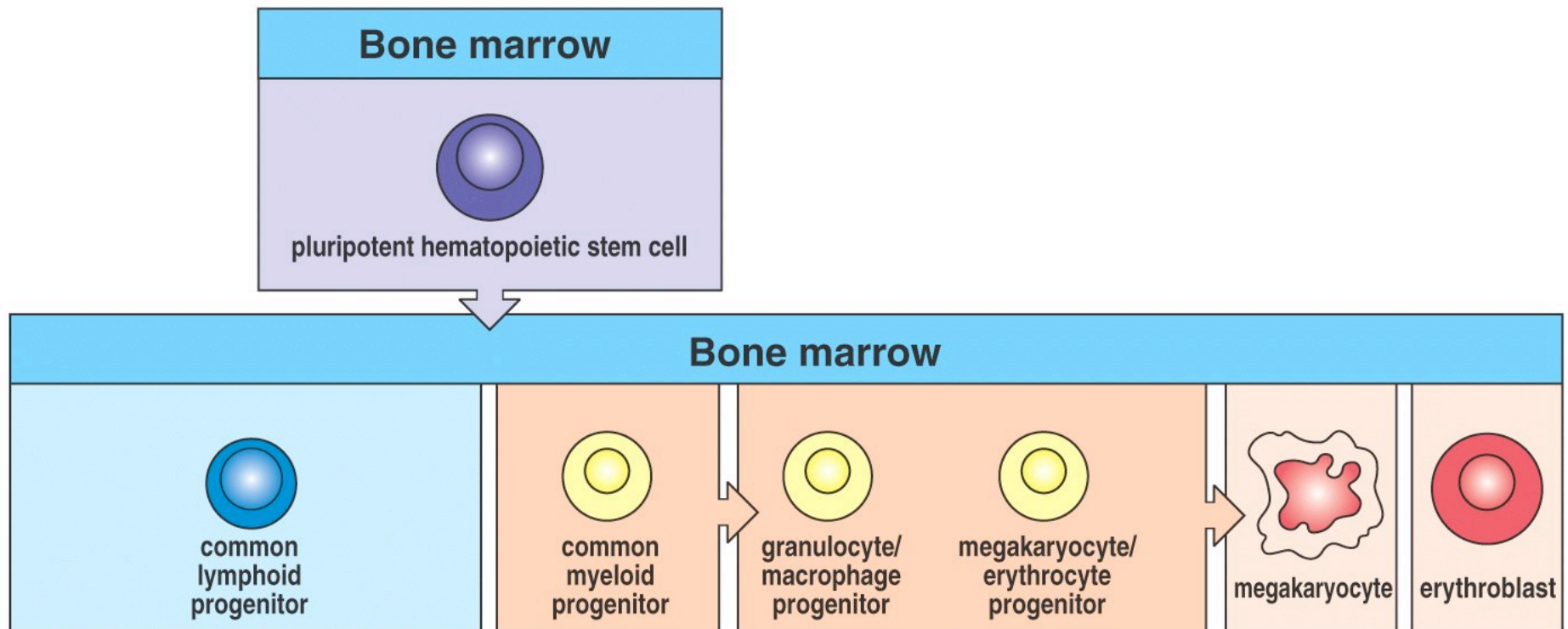


Figure 1-3 part 1 of 4 Immunobiology, 6/e. (© Garland Science 2005)

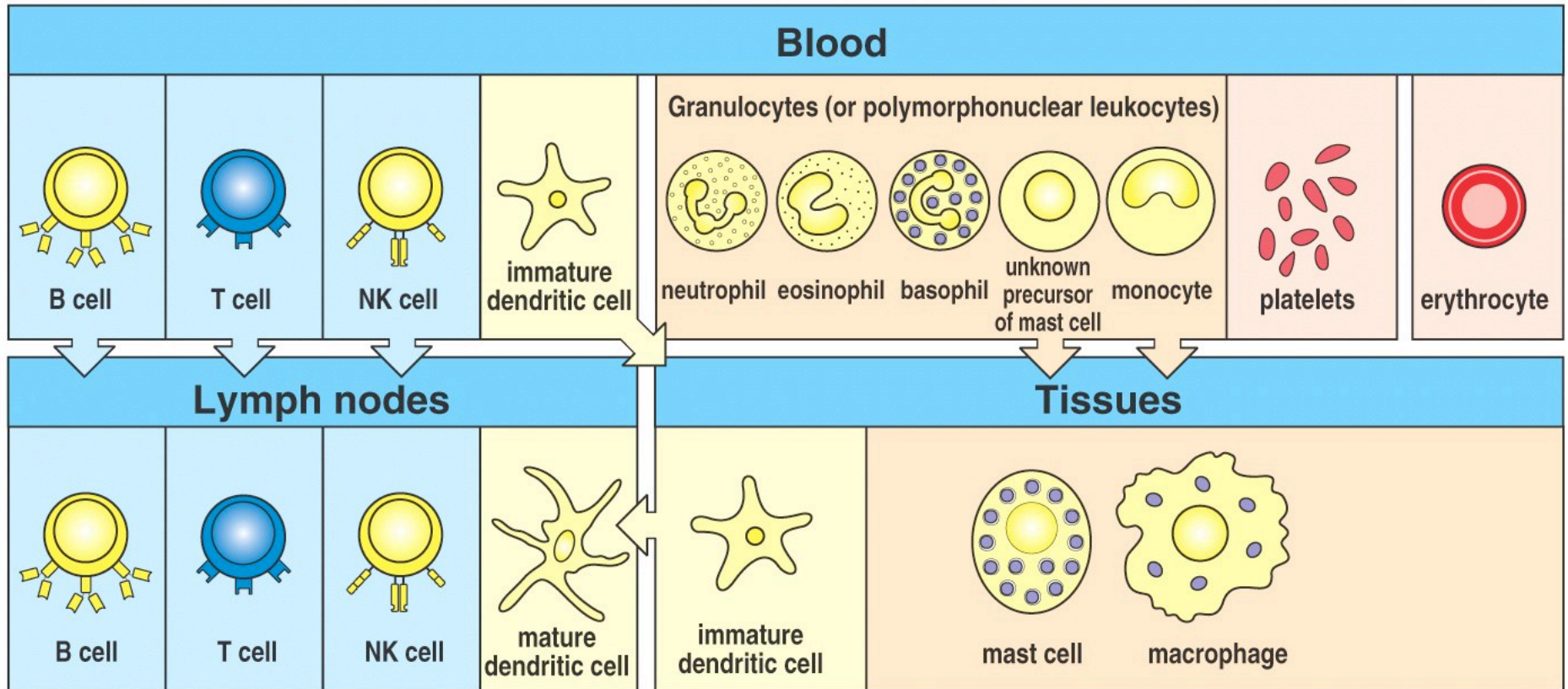


Figure 1-3 part 3 of 4 Immunobiology, 6/e. (© Garland Science 2005)

Myeloid lineage

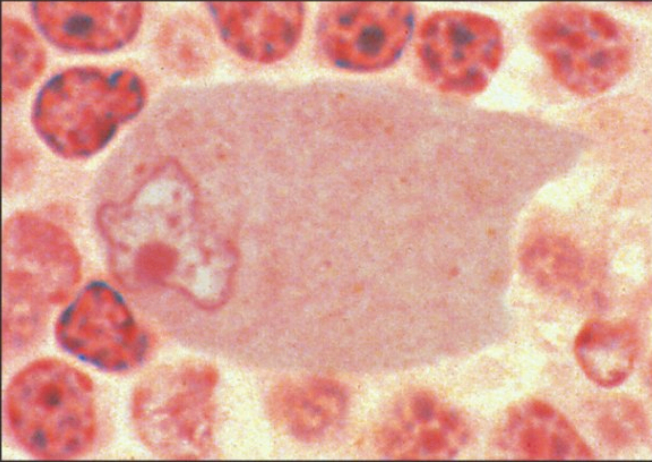

Cell		Activated function
Macrophage	 A micrograph showing a large, irregularly shaped macrophage with a prominent nucleus and several smaller, dark-staining nuclei of other cells in the background.	Phagocytosis and activation of bactericidal mechanisms Antigen presentation
Dendritic cell	 A micrograph showing a dendritic cell with a central body and several long, thin processes extending outwards, characteristic of its role in antigen presentation.	Antigen uptake in peripheral sites Antigen presentation in lymph nodes

Figure 1-4 part 1 of 3 Immunobiology, 6/e. (© Garland Science 2005)

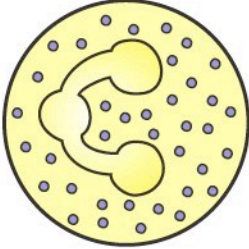
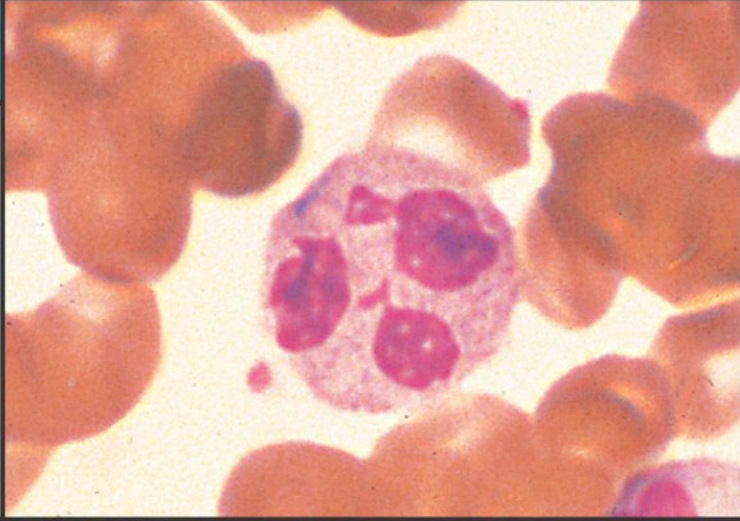
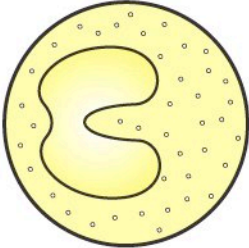
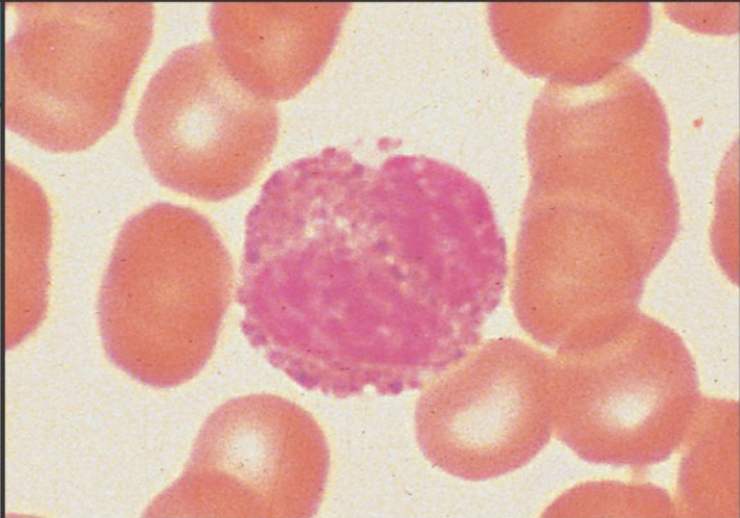
Cell		Activated function
<p>Neutrophil</p> 		<p>Phagocytosis and activation of bactericidal mechanisms</p>
<p>Eosinophil</p> 		<p>Killing of antibody-coated parasites</p>

Figure 1-4 part 2 of 3 Immunobiology, 6/e. (© Garland Science 2005)

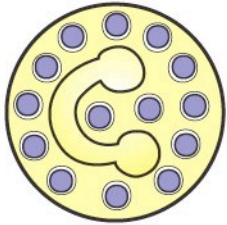
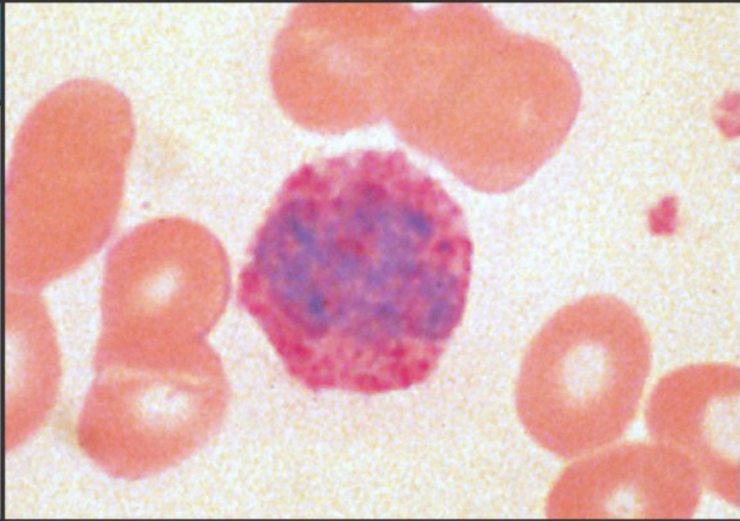
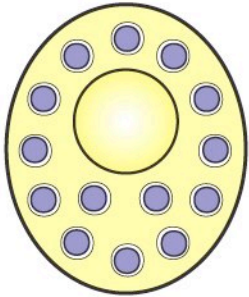
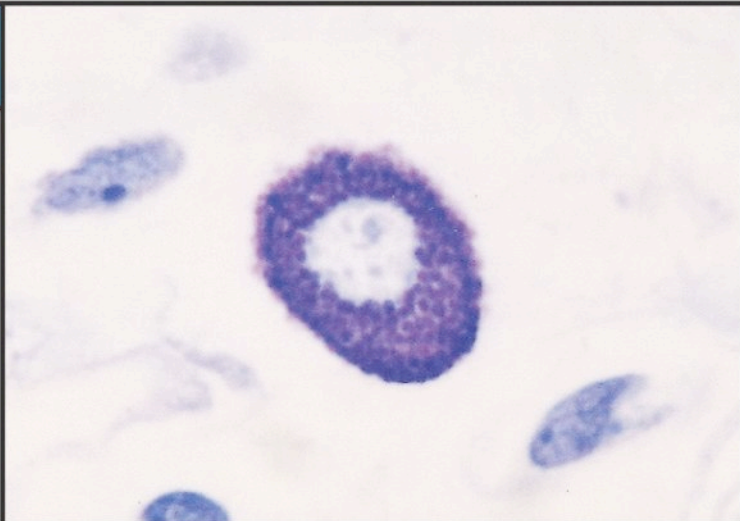
Cell		Activated function
Basophil 		Unknown
Mast cell 		Release of granules containing histamine and other active agents

Figure 1-4 part 3 of 3 Immunobiology, 6/e. (© Garland Science 2005)

Neutrophils, macrophages, dendritic cells

- Pathogen destruction by phagocytosis:
 - Neutrophils, macrophages
- Antigen presentation:
 - Macrophages, dendritic cells

Eosinophils, Mast cells, Basophils

- Degranulate to have major effect
 - Histamine
 - Cytokines
 - Perforins
- Usually triggered by binding to Ab bound to cell surface
- Important first defense in reinfection, allergies

Lymphoid lineage=

NK cells

B cells

T cells

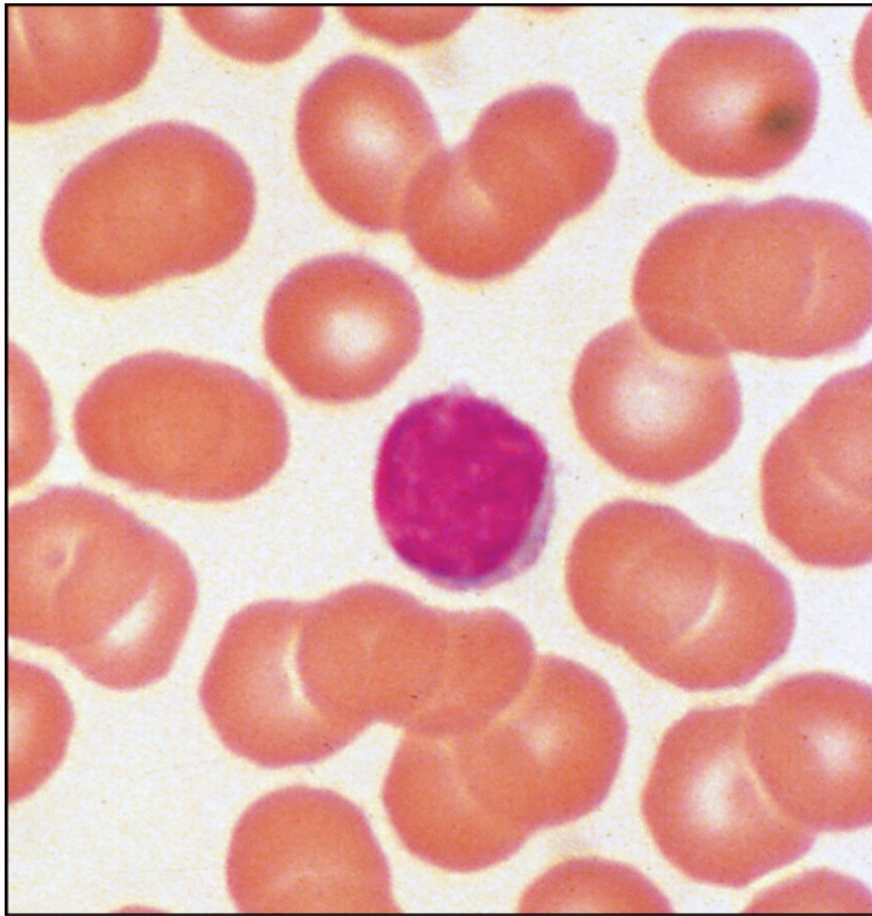
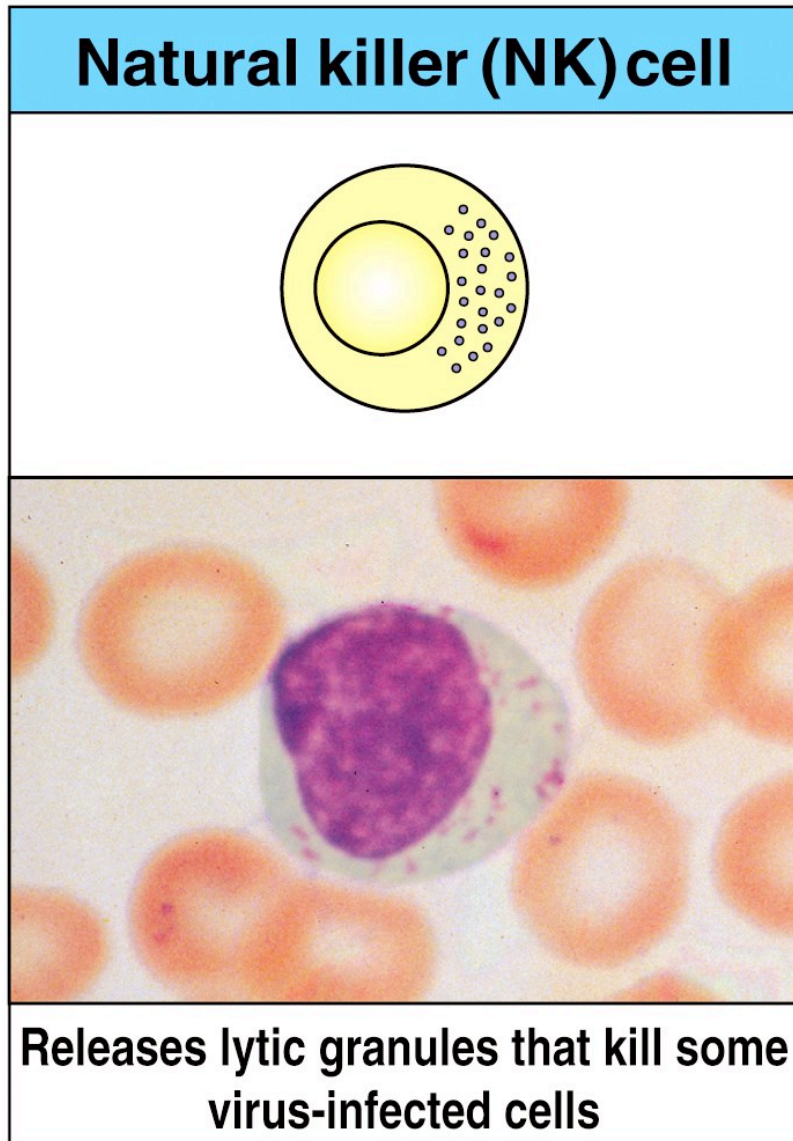


Figure 1-5 Immunobiology, 6/e. (© Garland Science 2005)

Natural killer cells (NK cells)

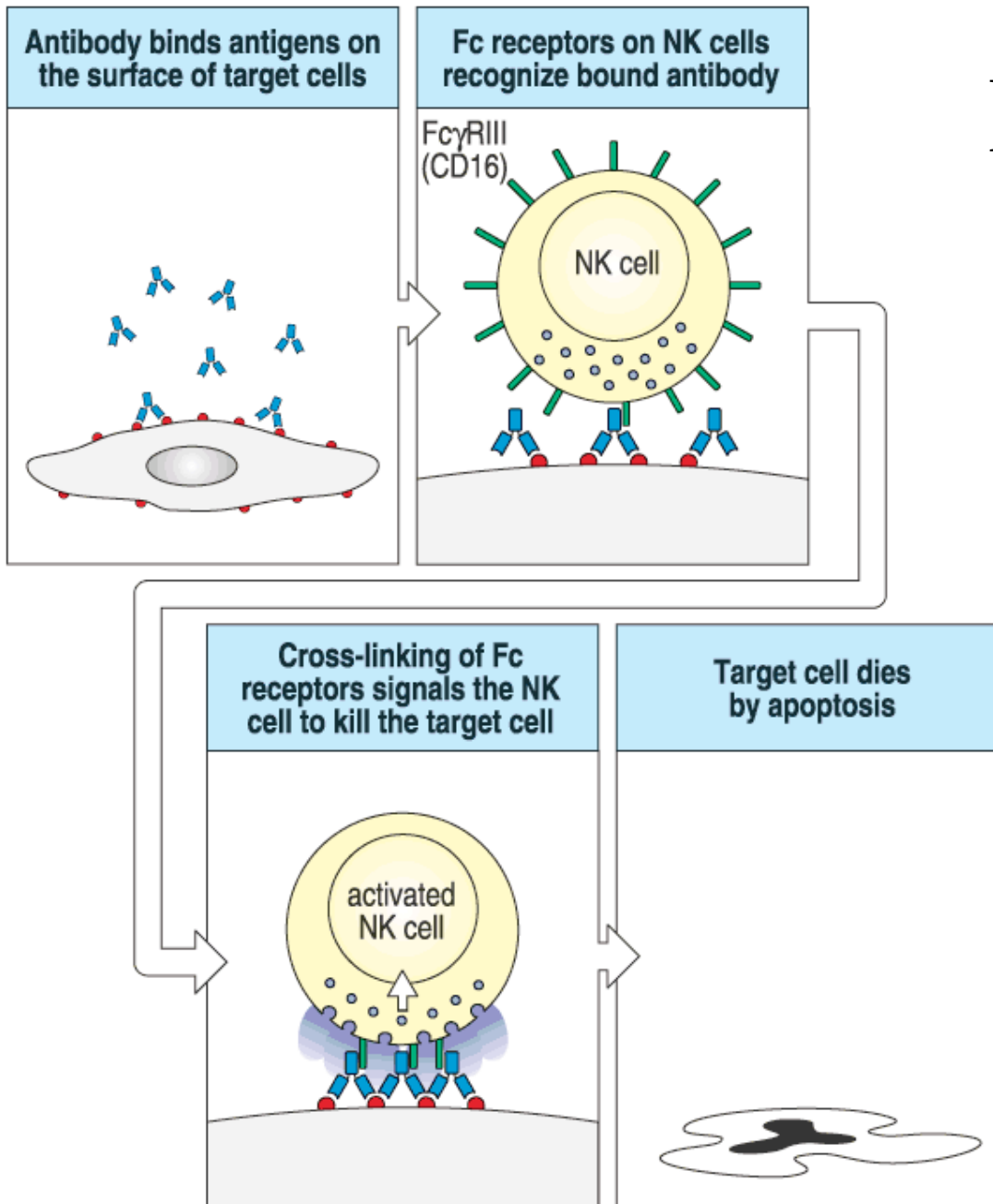


Innate:

-□interferon secretion:
activates macrophages

-Cytotoxicity: kill
cells with decreased
MHC expression

Natural Killer Cells



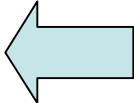
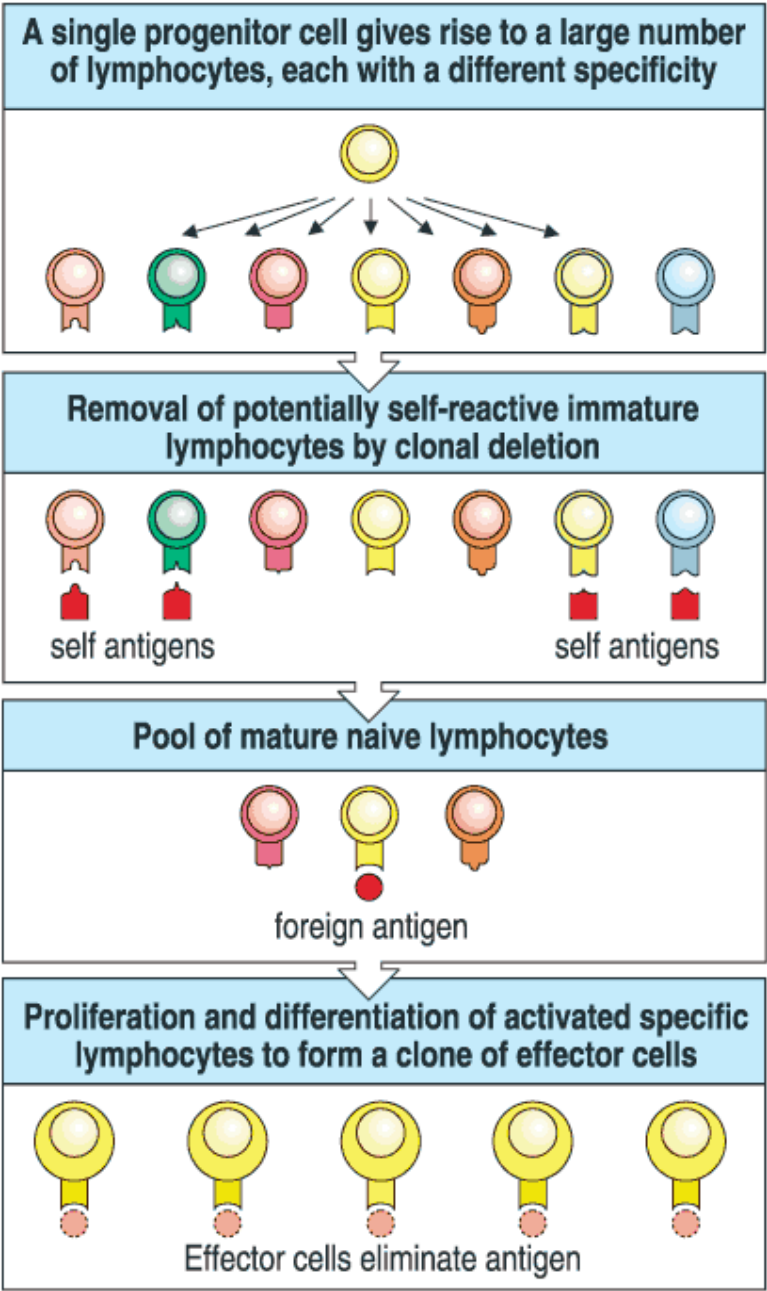
Role in adaptive immunity:
Antibody-dependent cell cytotoxicity (ADCC)

Fig 9.34 © 2001 Garland Science

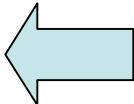
Lymphocytes: T and B cells

- Antibody production (B cells)
- Cell mediated response (T cells)
 - Cytotoxic T cells= kill infected cells
 - Helper T cells= increase activity of other cells of the immune system (Macrophages, B cells)
- Potentiate the function of accessory cells:
 - NK cells
 - Macrophages/neutrophils
 - Eosinophils
 - Basophils
 - Mast cells

Clonal selection hypothesis



Bone marrow: B lymphocytes
Thymus: T lymphocytes



Peripheral lymphoid tissue

Fig 1.14 © 2001 Garland Science

Postulates of the clonal selection hypothesis

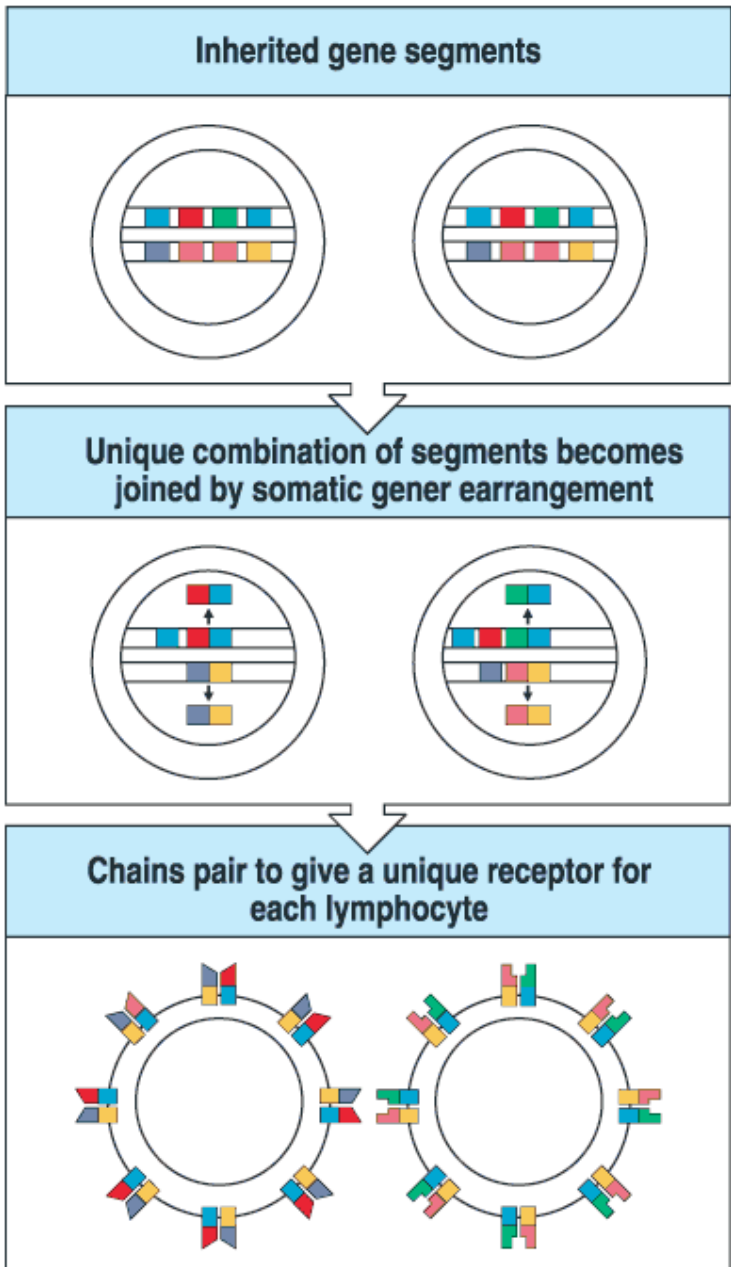
Each lymphocyte bears a single type of receptor with a unique specificity

Interaction between a foreign molecule and a lymphocyte receptor capable of binding that molecule with high affinity leads to lymphocyte activation

The differentiated effector cells derived from an activated lymphocyte will bear receptors of identical specificity to those of the parental cell from which that lymphocyte was derived

Lymphocytes bearing receptors specific for ubiquitous self molecules are deleted at an early stage in lymphoid cell development and are therefore absent from the repertoire of mature lymphocytes

Figure 1-15 Immunobiology, 6/e. (© Garland Science 2005)



Somatic gene rearrangement creates naïve lymphocyte pool with Ig/TCR diversity

Fig 1.18 © 2001 Garland Science

Lymphoid system

- Central lymphoid organs
- Peripheral lymphoid tissue

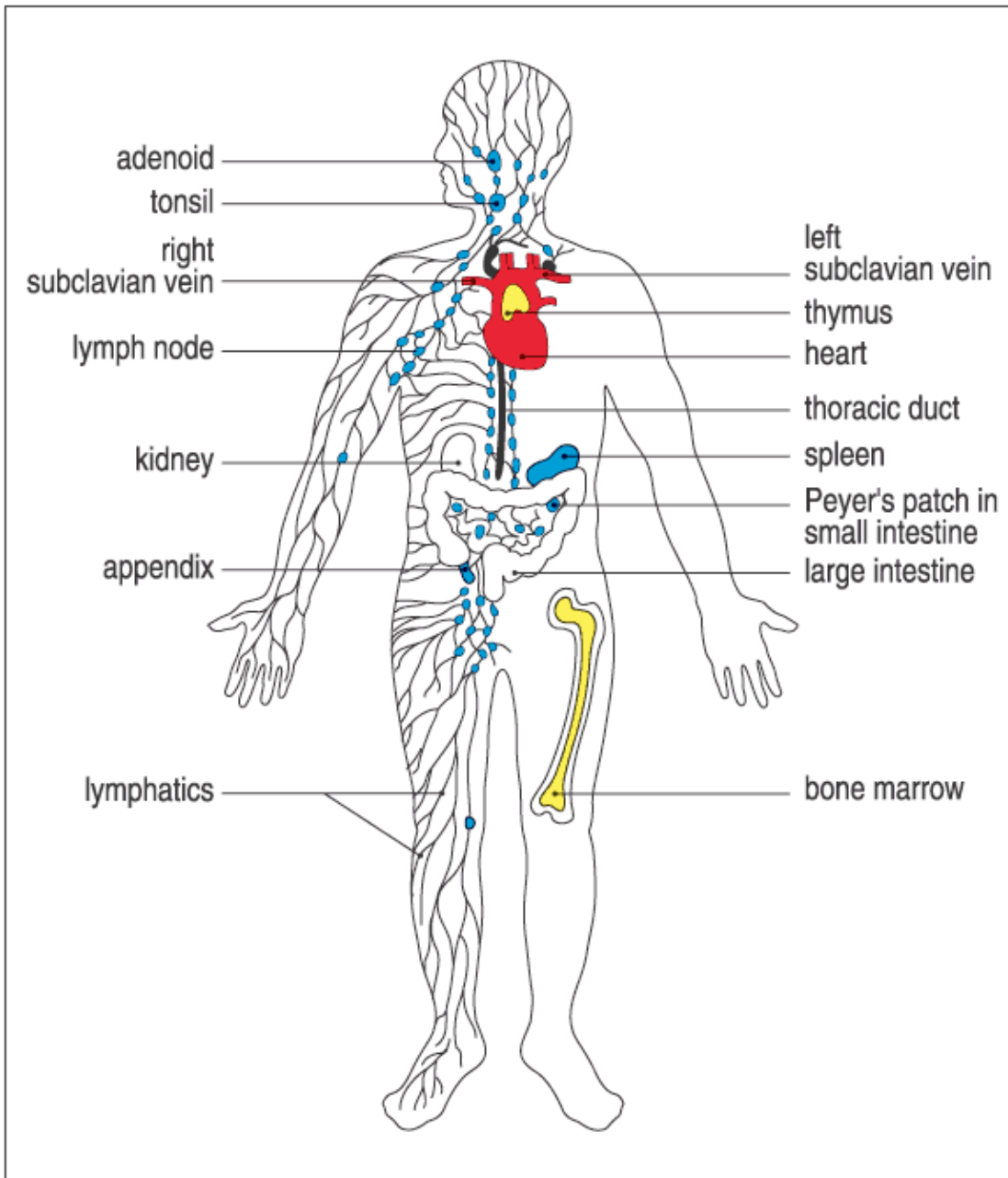
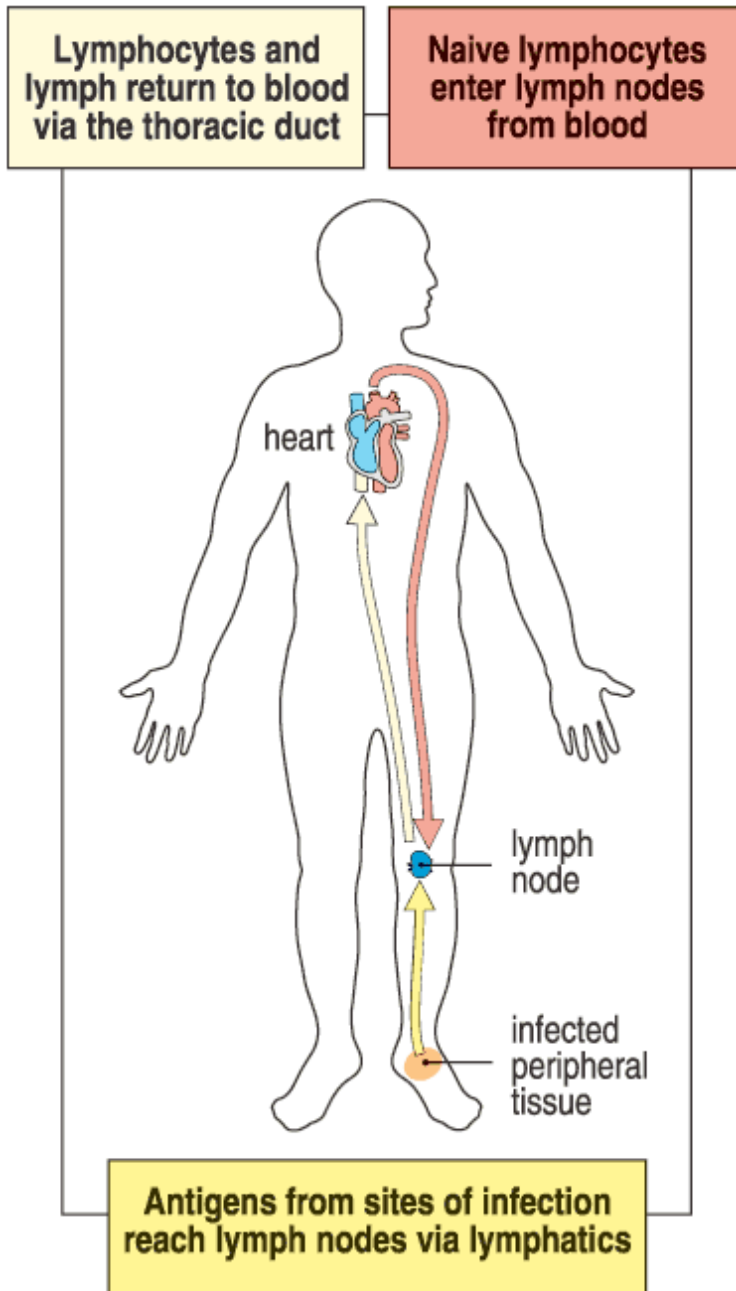


Fig 1.7 © 2001 Garland Science



Routing of naïve lymphocytes through the body

Fig 1.11 © 2001 Garland Science

Lymphocytes must bind Ag to proliferate

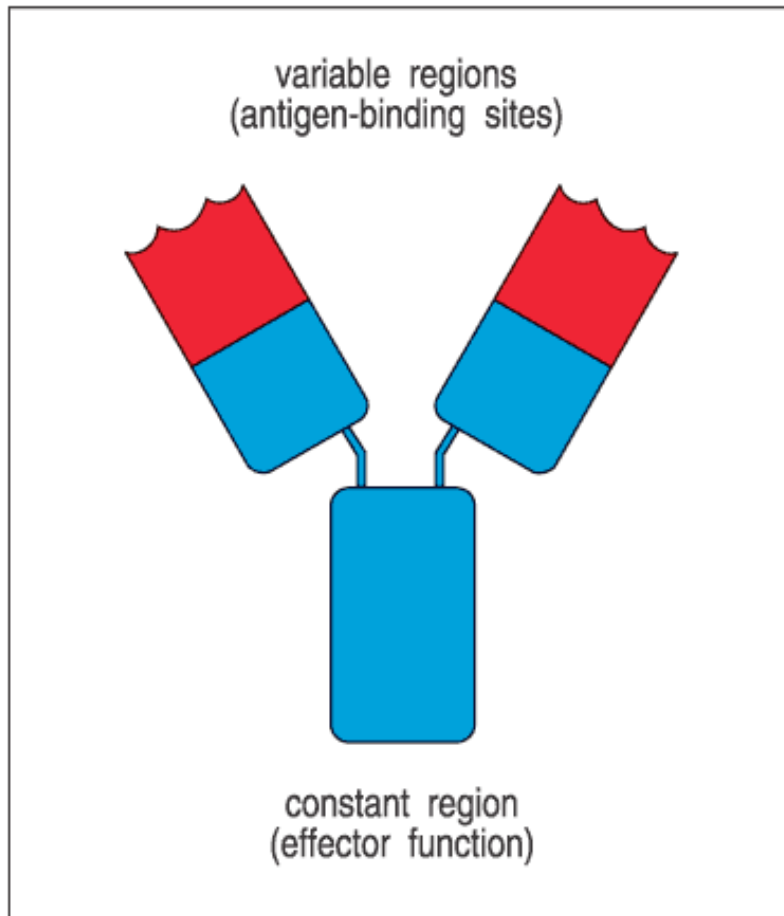


Fig 1.16 © 2001 Garland Science

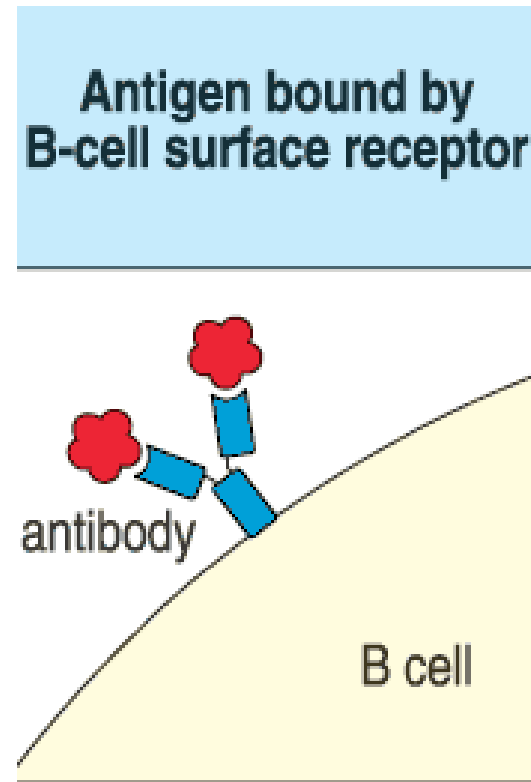
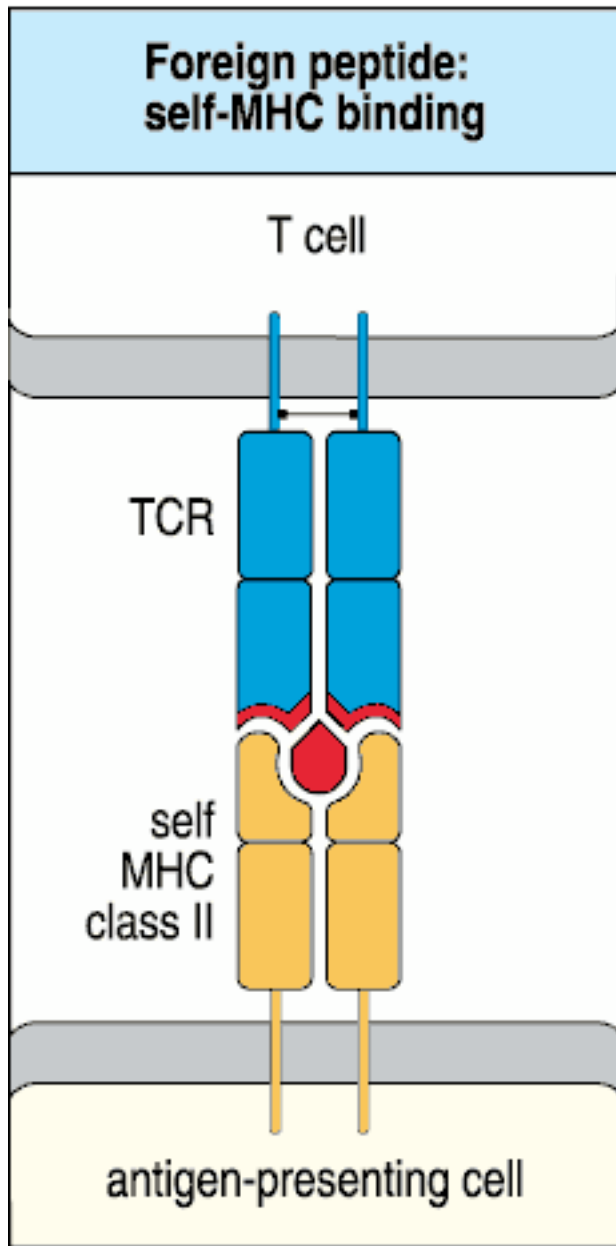


Fig 1.29 © 2001 Ga



T cell receptor
(TCR):

recognizes Ag bound
in cleft of MHC

Fig 5.17 © 2001 Garland S

Major Histocompatibility Complex (MHC)

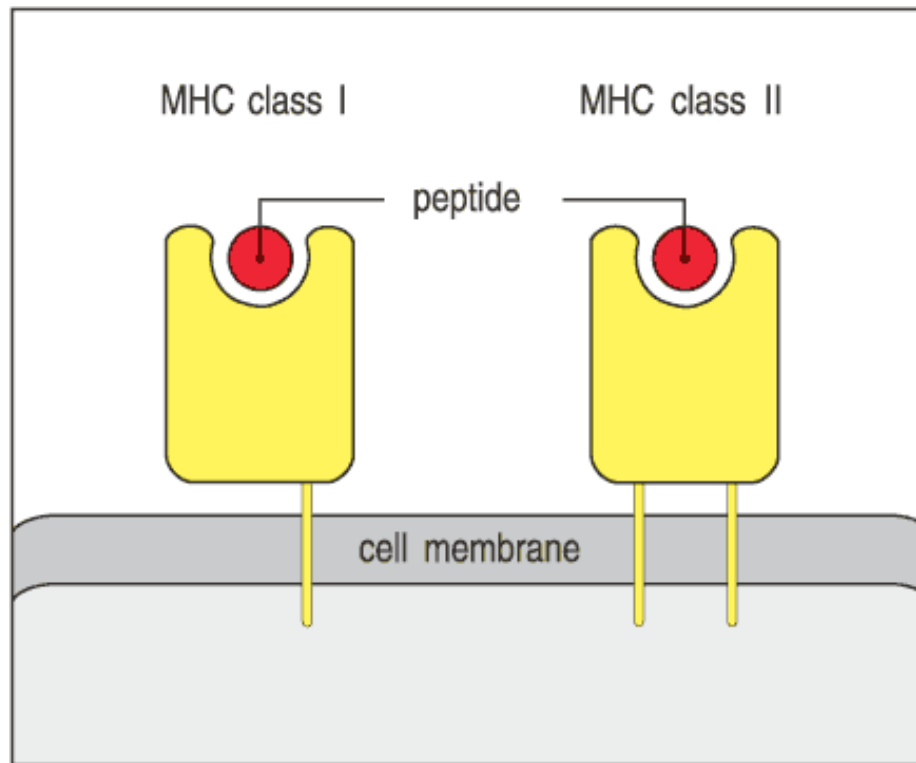


Fig 1.27 © 2001 Garland Science

Antigen processing for MHC class I

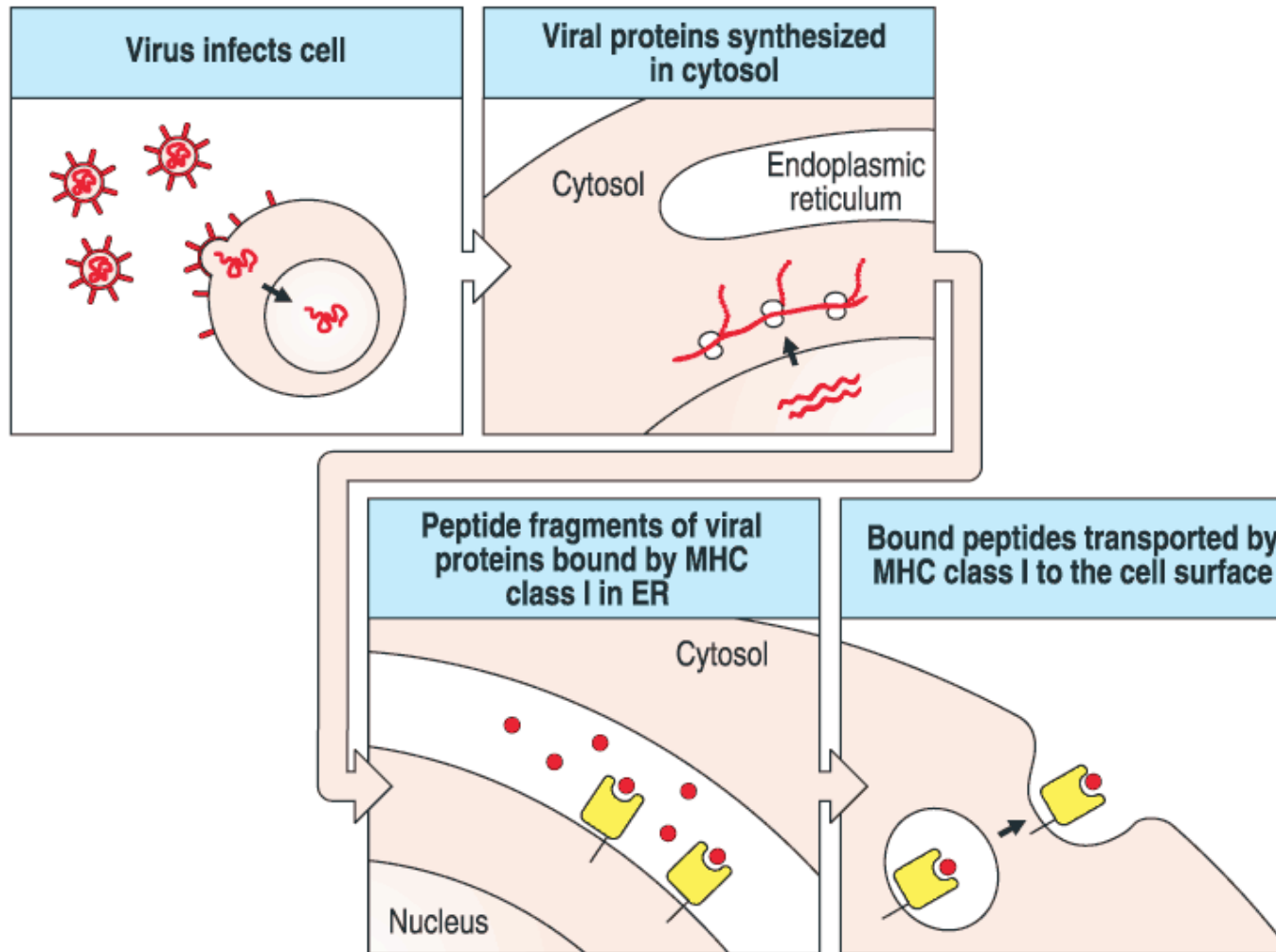


Fig 1.28 © 2001 Garland Science

Antigen processing for MHC class II

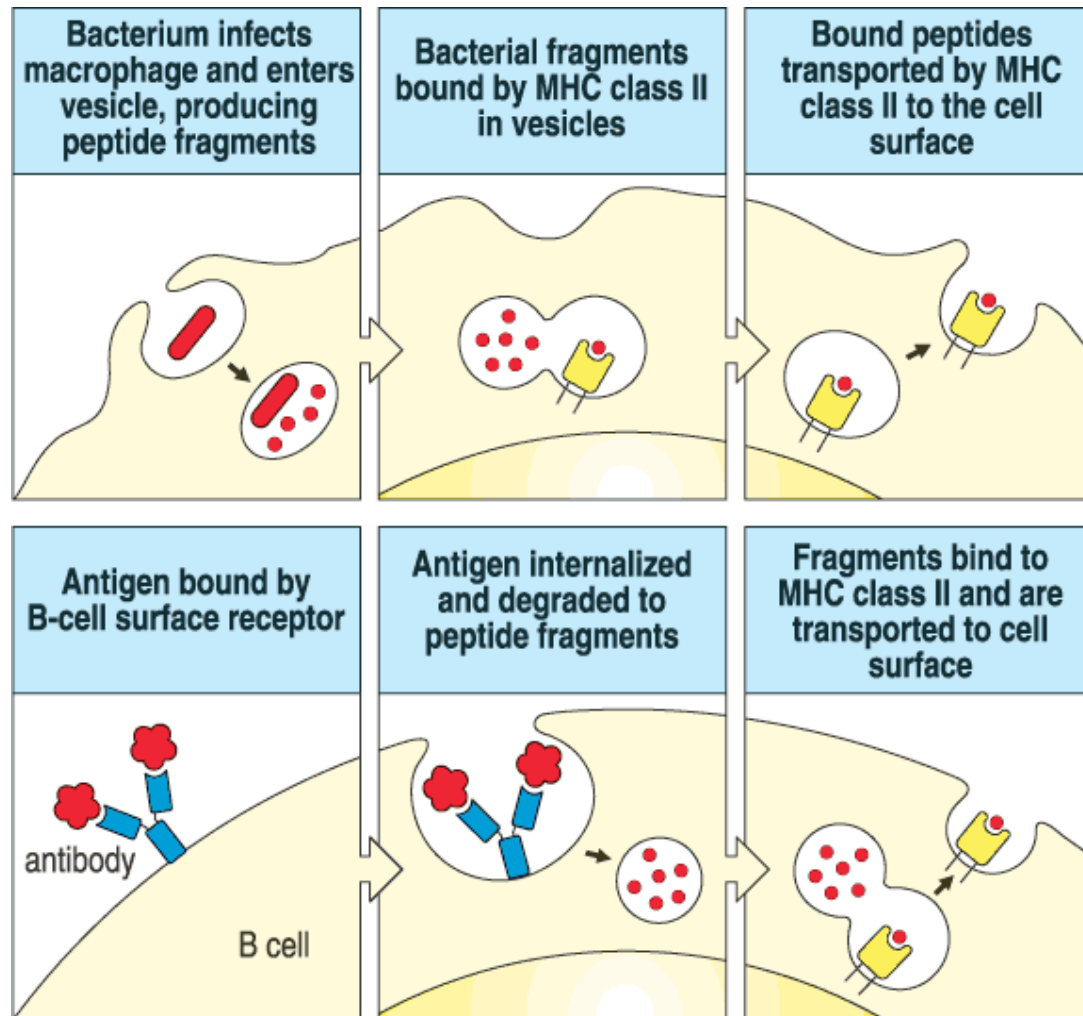


Fig 1.29 © 2001 Garland Science

Antigen presenting cells (APC)

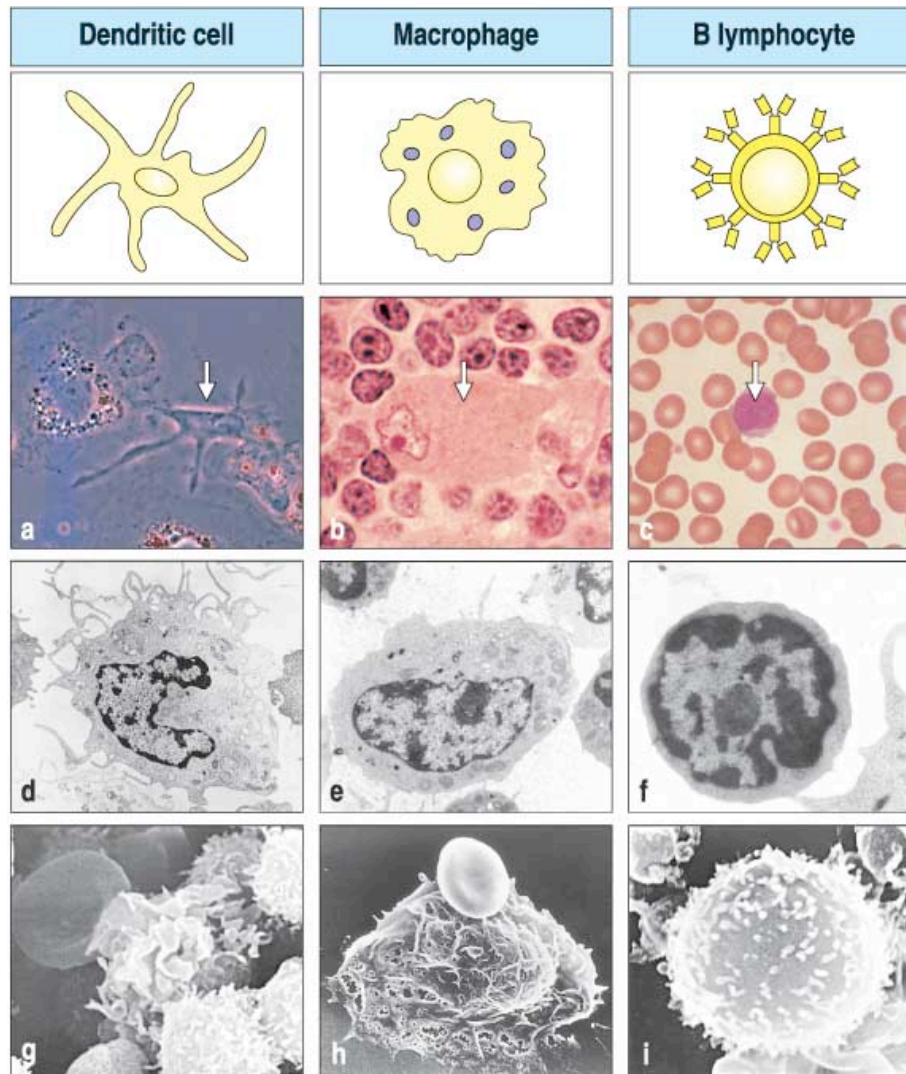


Fig 1.22 © 2001 Garland Science

Activation of lymphocytes

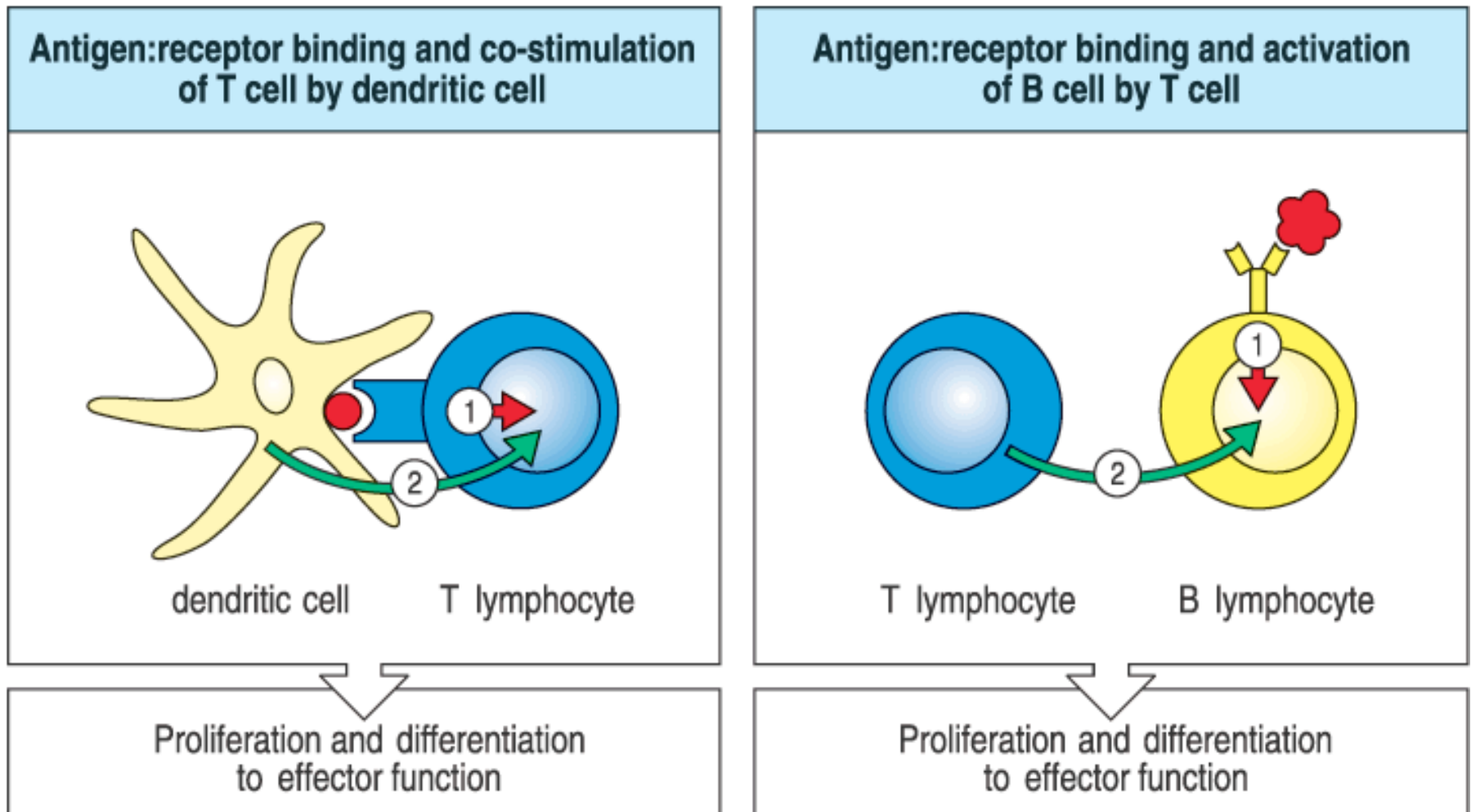
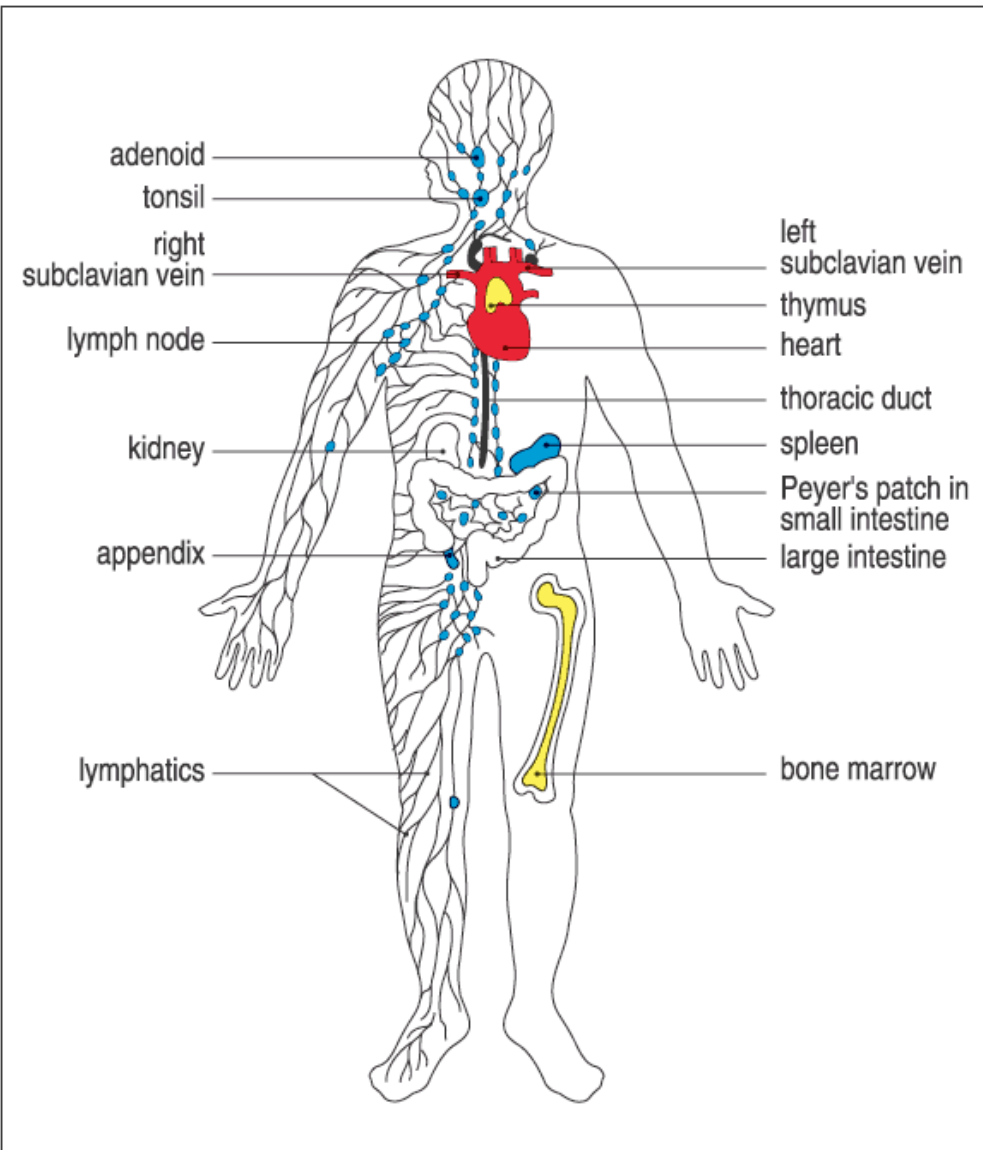


Fig 1.21 © 2001 Garland Science



Lymphocytes
encounter Ag in
peripheral
lymphoid tissue

Fig 1.7 © 2001 Garland Science

Lymph node

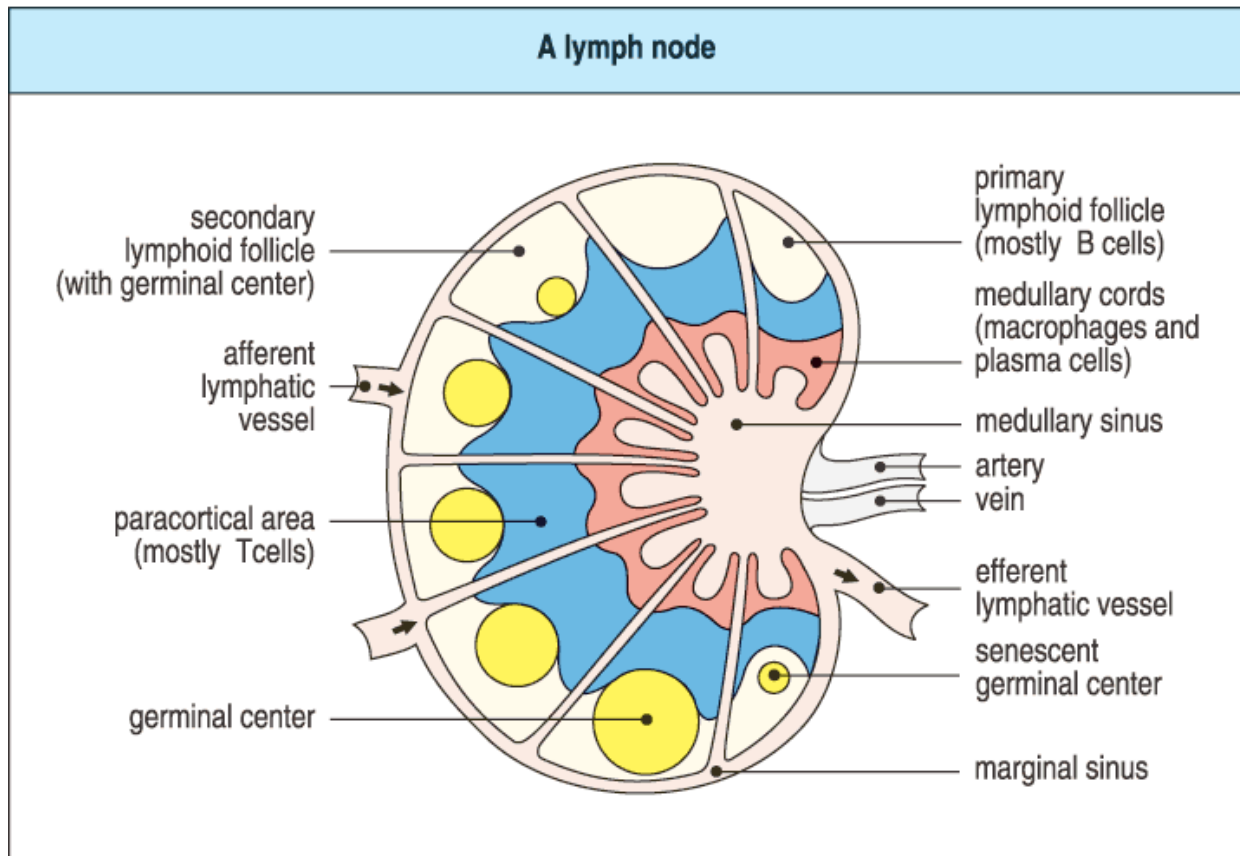


Fig 1.8 part 1 of 2 © 2001 Garland Science



Fig 1.8 part 2 of 2 © 2001 Garland Science

Gut-associated lymph tissue (GALT)

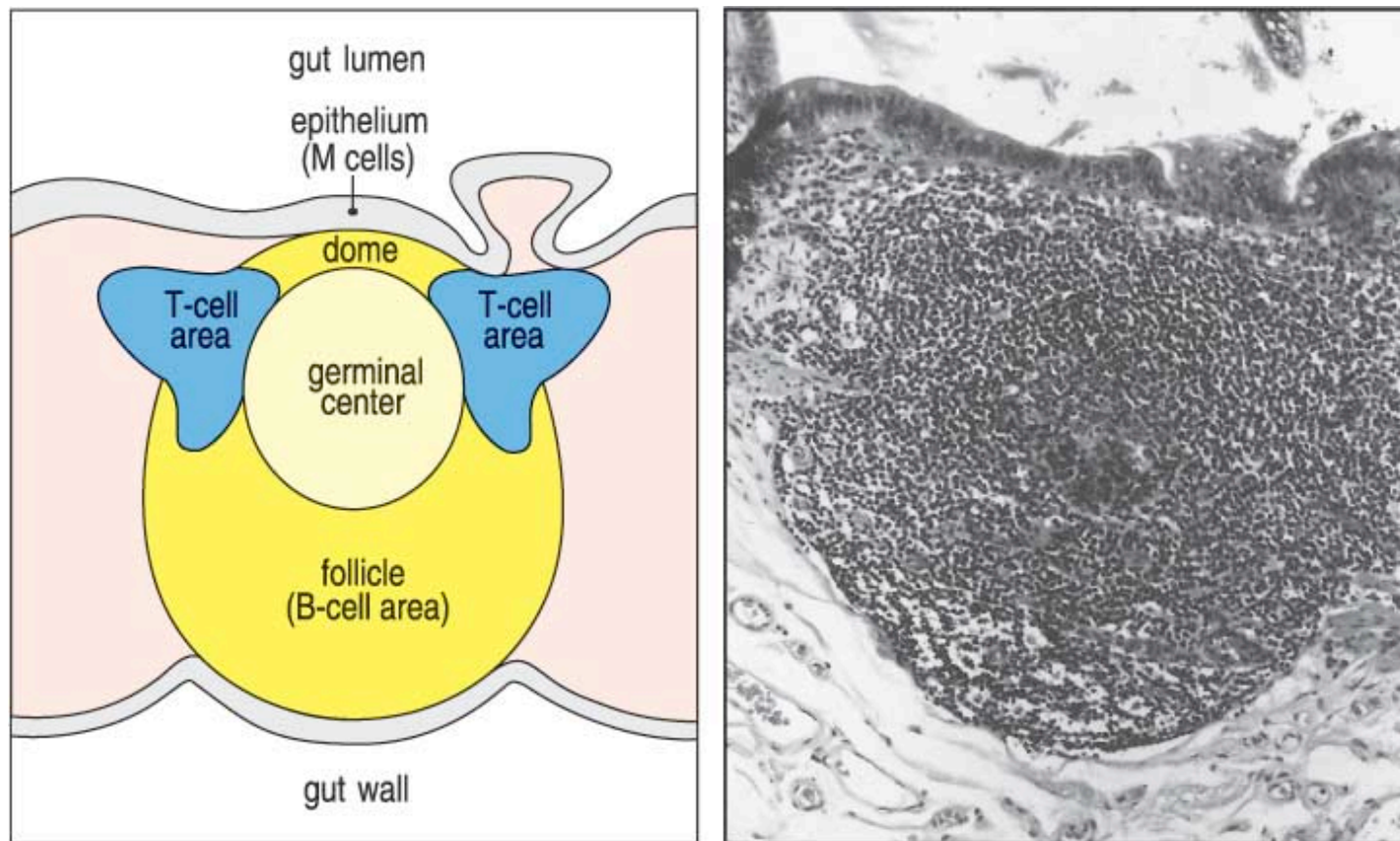


Fig 1.10 © 2001 Garland Science

Humoral response (B cells)

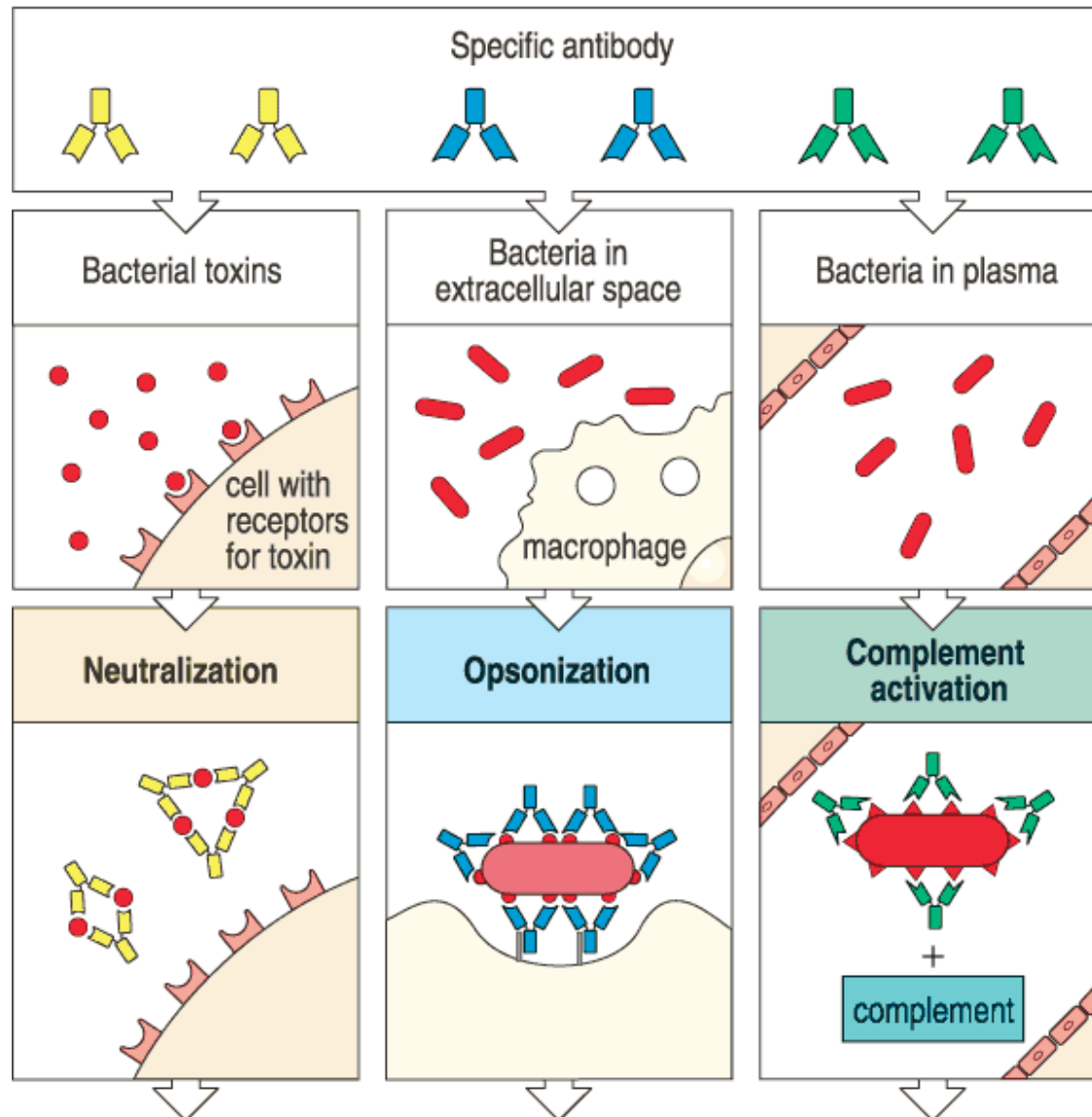


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Complement activation

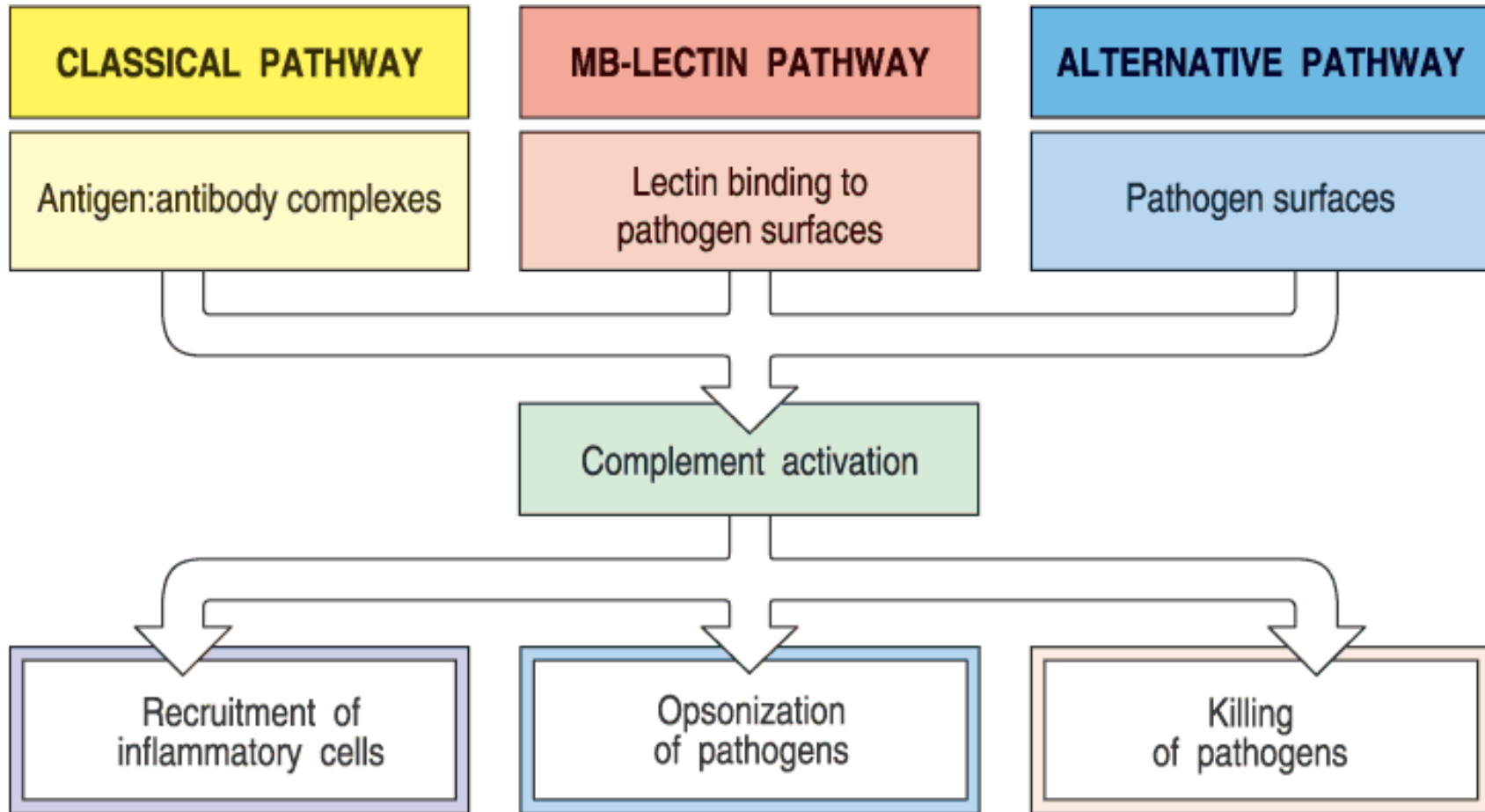


Fig 2.7 © 2001 Garland Science

Cytotoxic T lymphocytes (CTL)

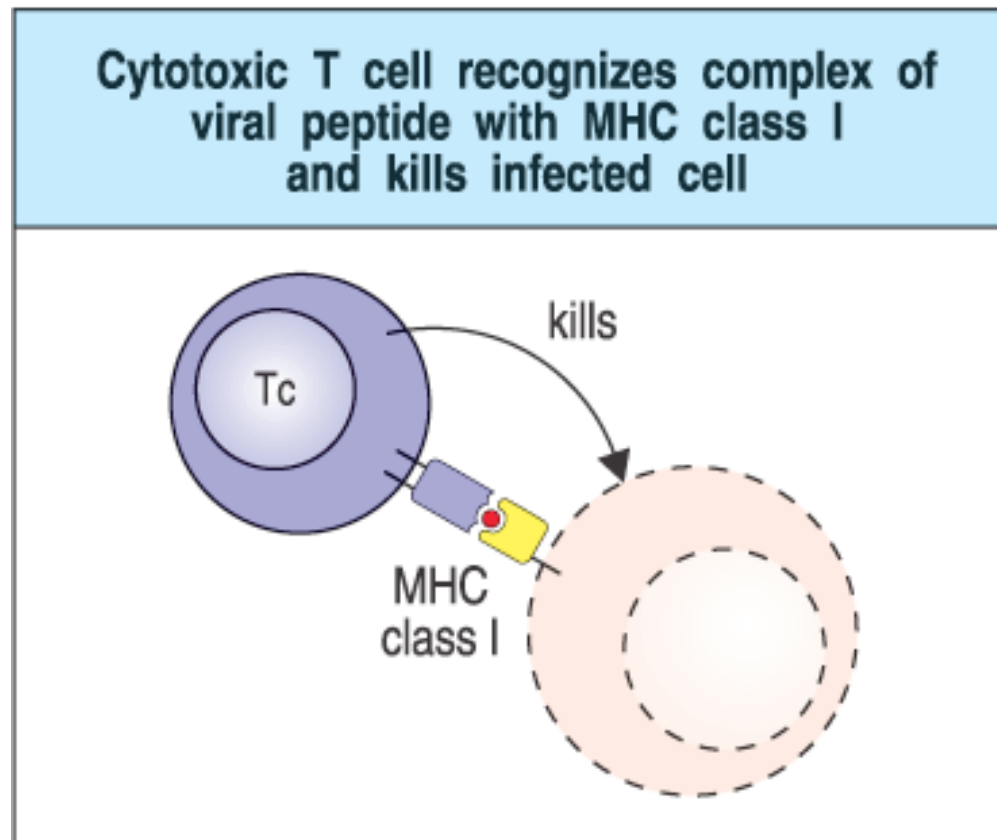


Fig 1.30 © 2001 Garland Science

CTL killing virally infected cell

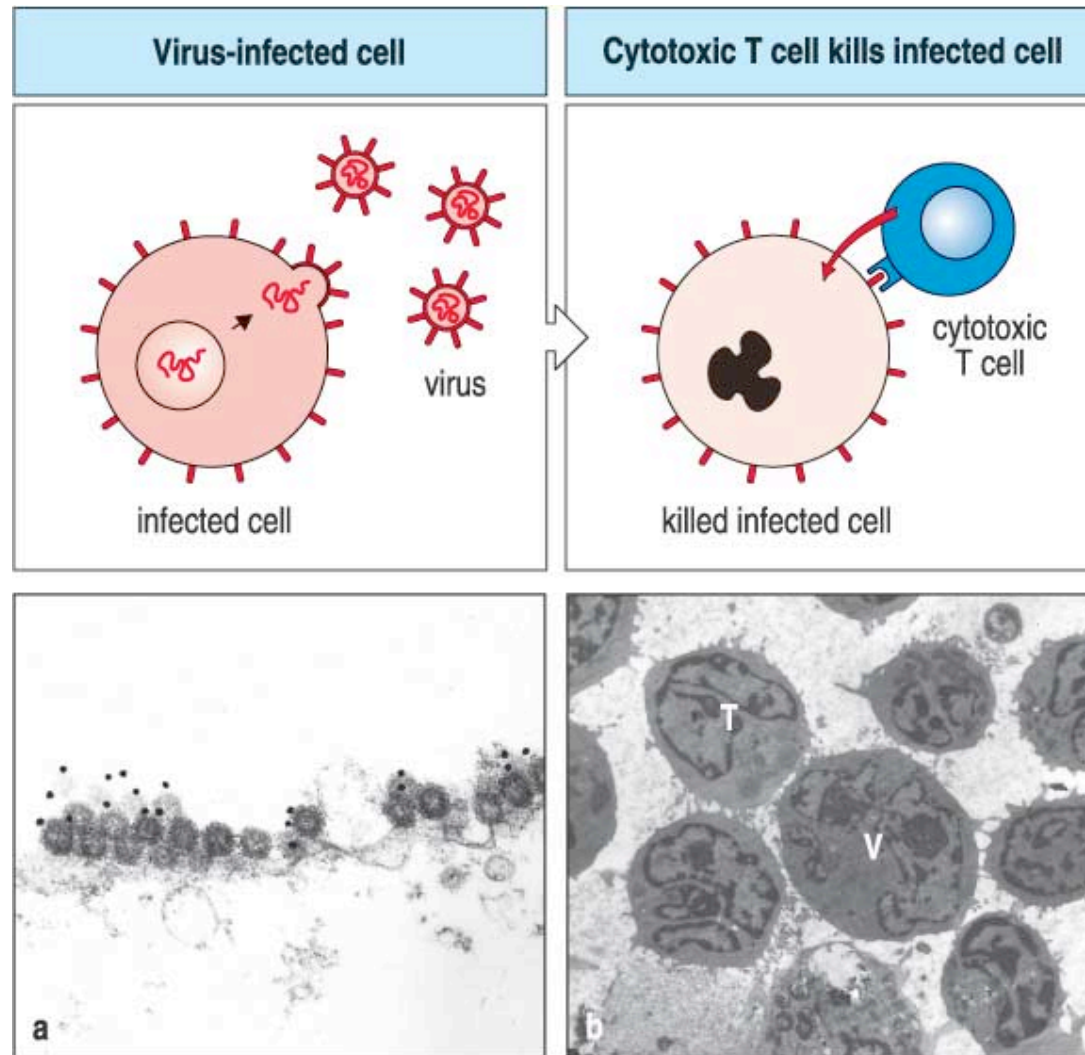


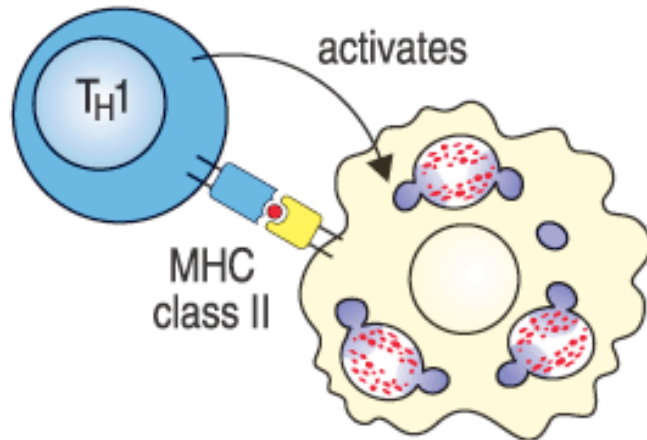
Fig 1.25 © 2001 Garland Science

Helper T cells

T_{H1}

T_{H2}

T_{H1} cell recognizes complex of bacterial peptide with MHC class II and activates macrophage



Helper T cell recognizes complex of antigenic peptide with MHC class II and activates B cell

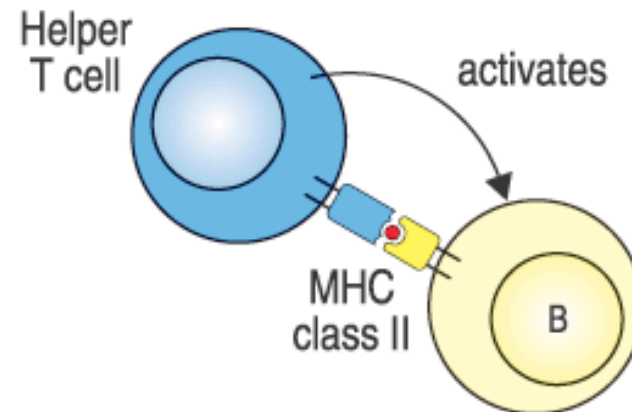


Fig 1.31 © 2001 Garland Science

Time course of adaptive response

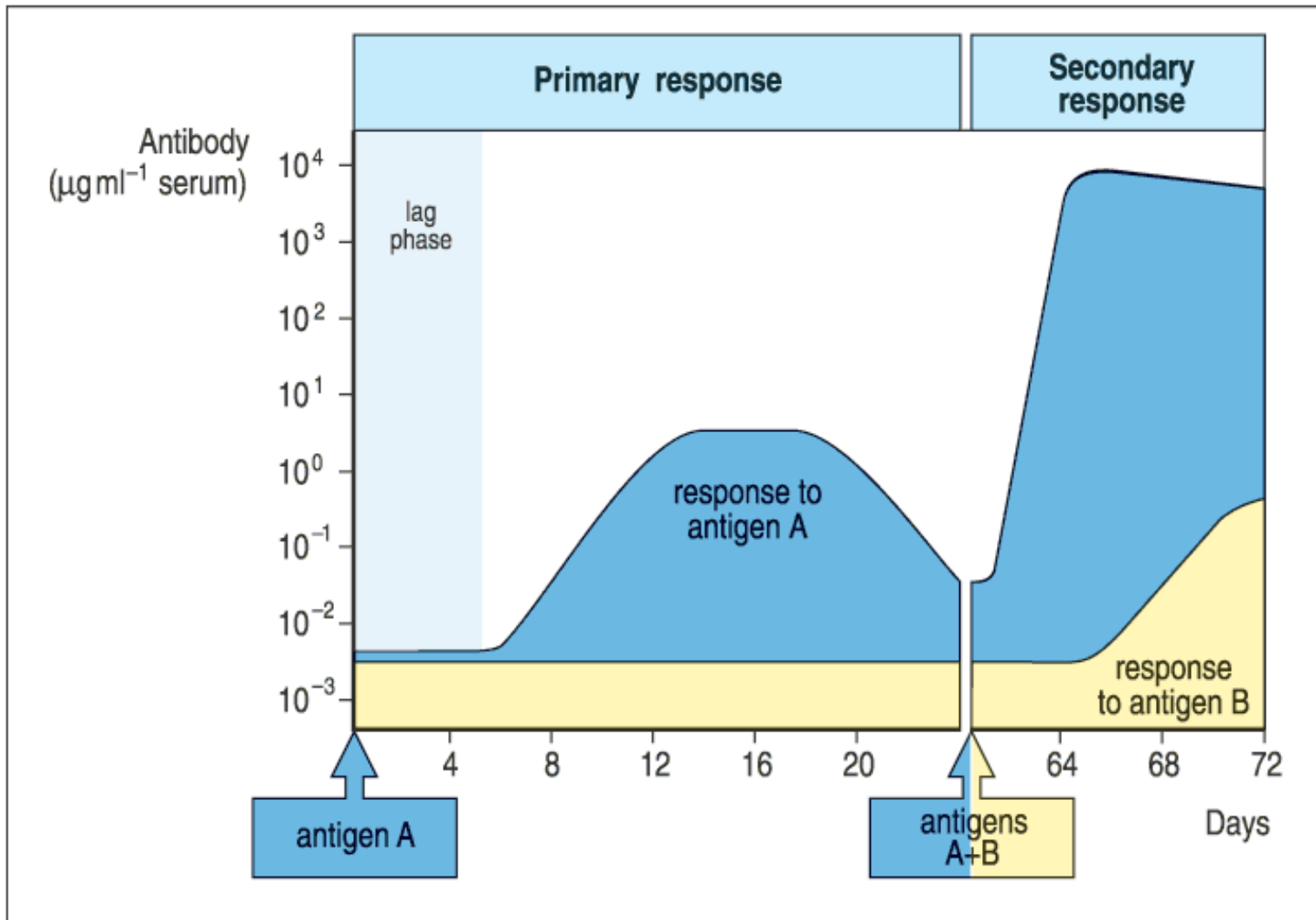


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