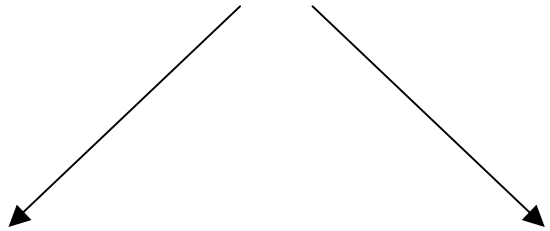
Two branches of immune system



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)

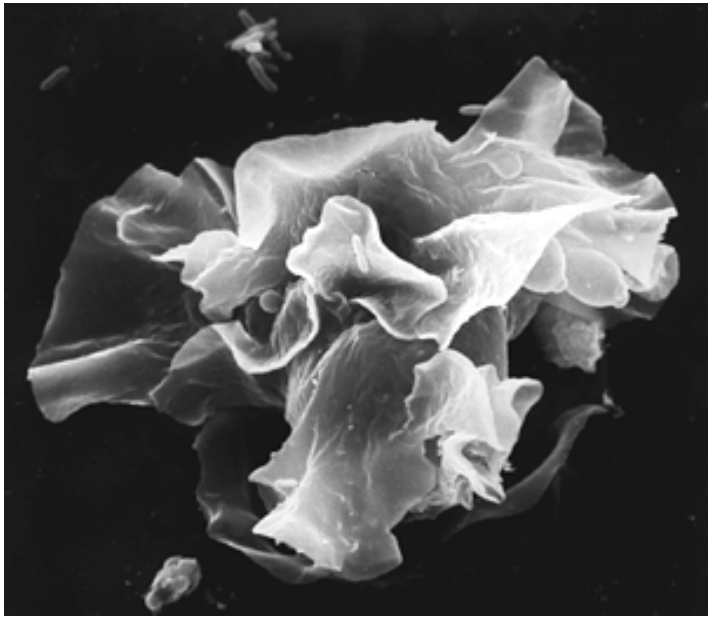
Innate defenses

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

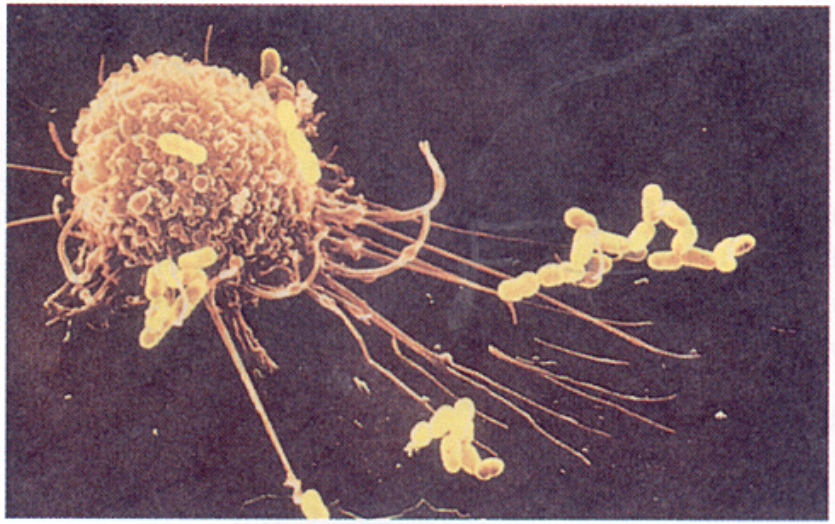
Barriers

- Mechanical/Physical
- Chemical
- Microbiological

Phagocytosis



Neutrophil



Macrophage

Inflammation

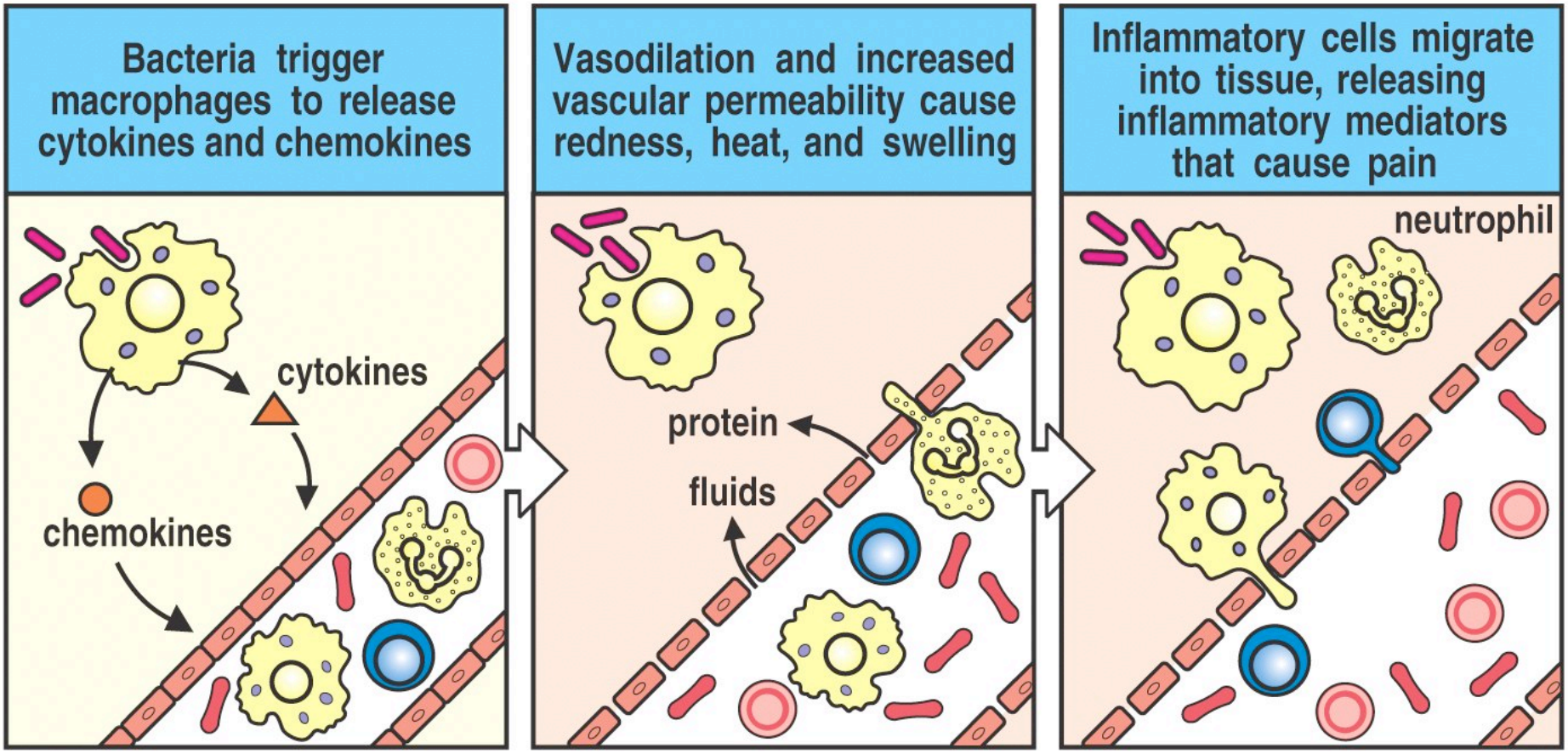


Figure 1-12 Immunobiology, 6/e. (© Garland Science 2005)

Complement activation

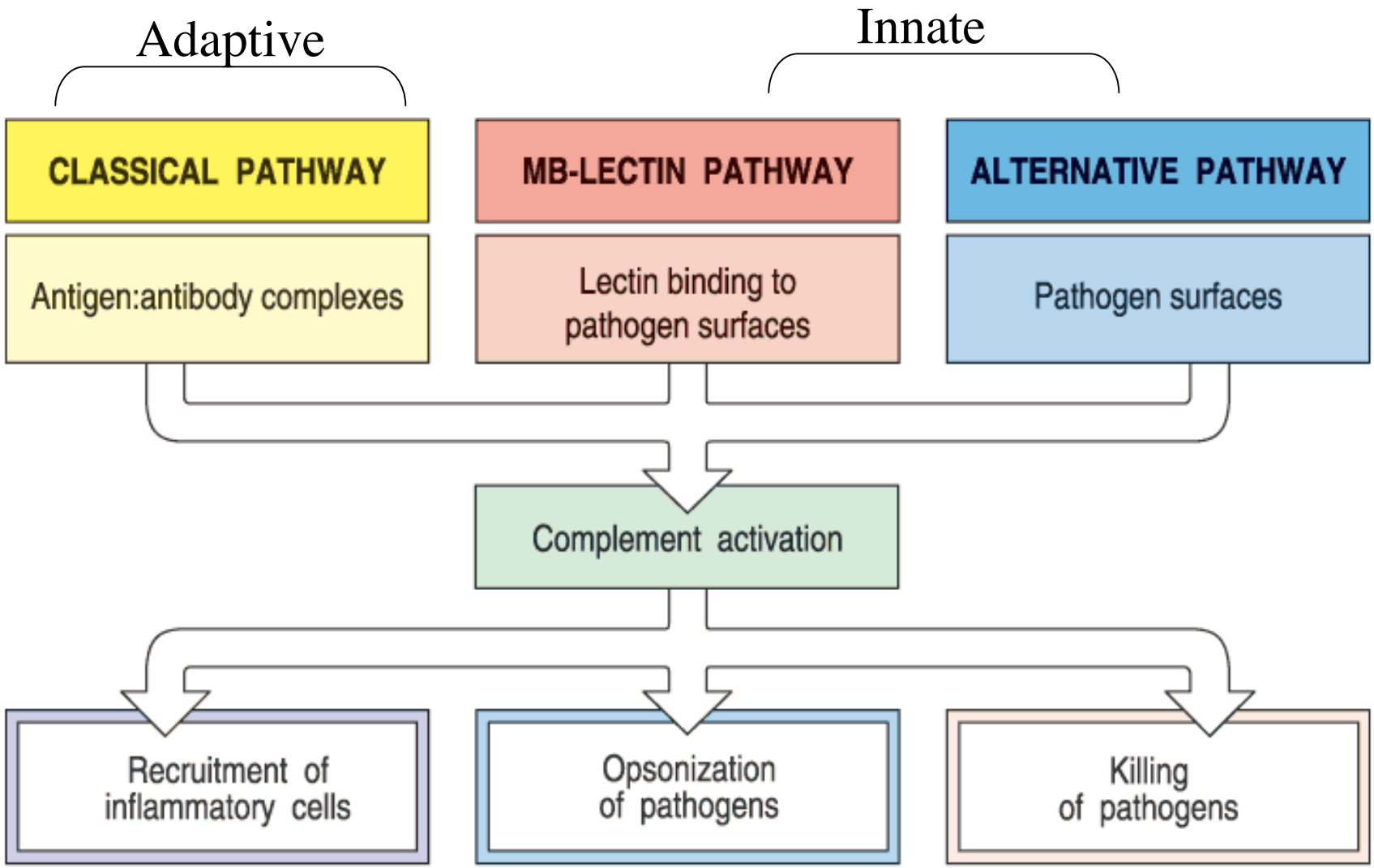


Fig 2.7 © 2001 Garland Science

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

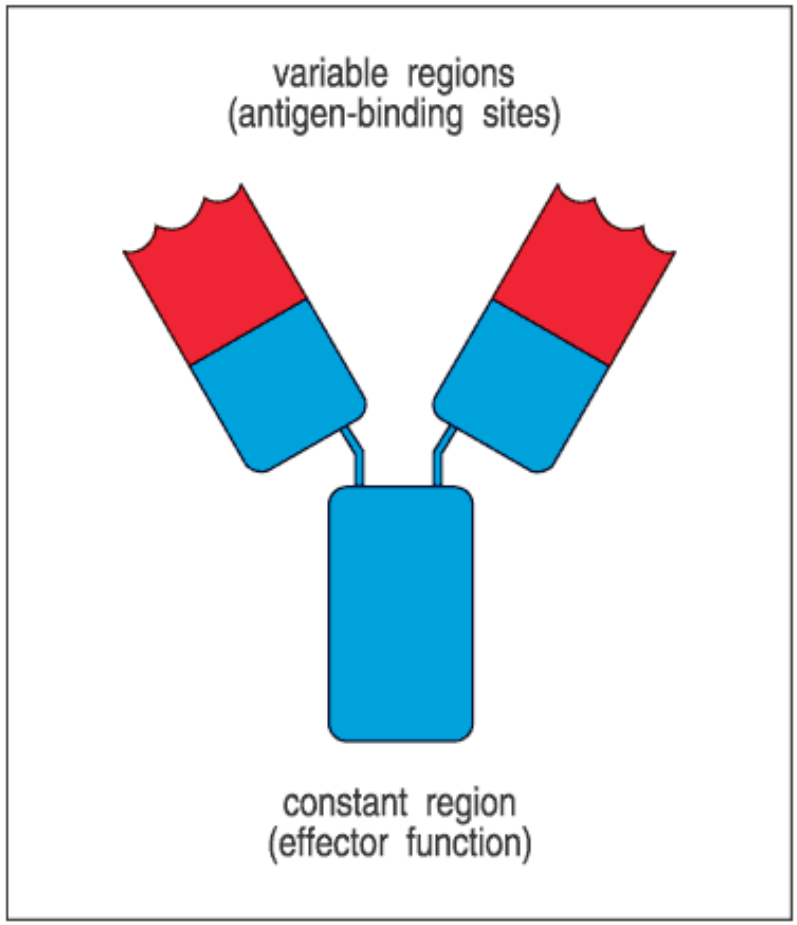


Fig 1.16 © 2001 Garland Science

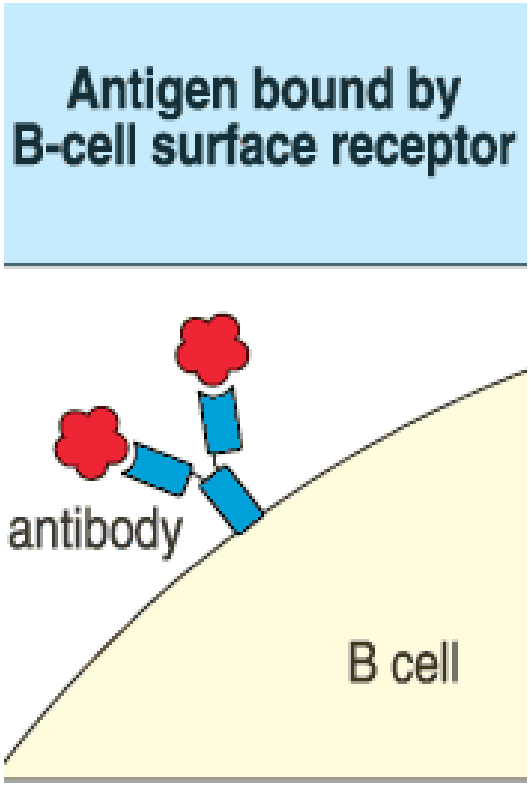


Fig 1.29 © 2001 Ga

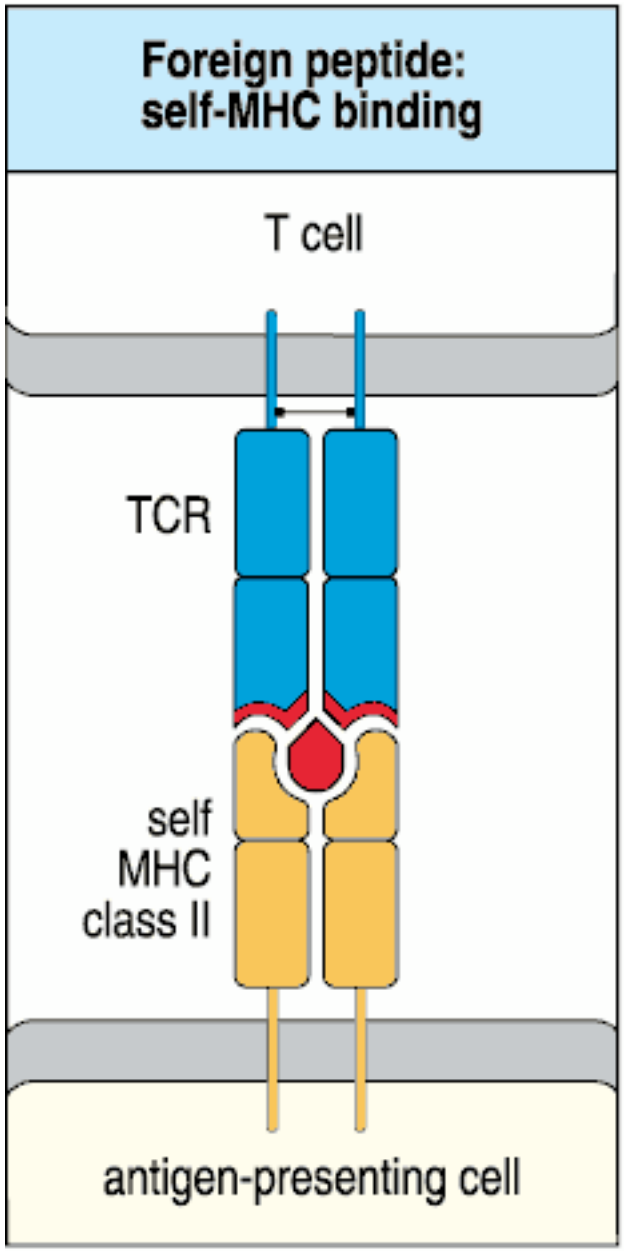


Fig 5.17 © 2001 Garland S

T cell receptor (TCR):

recognizes Ag bound in cleft of MHC

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?

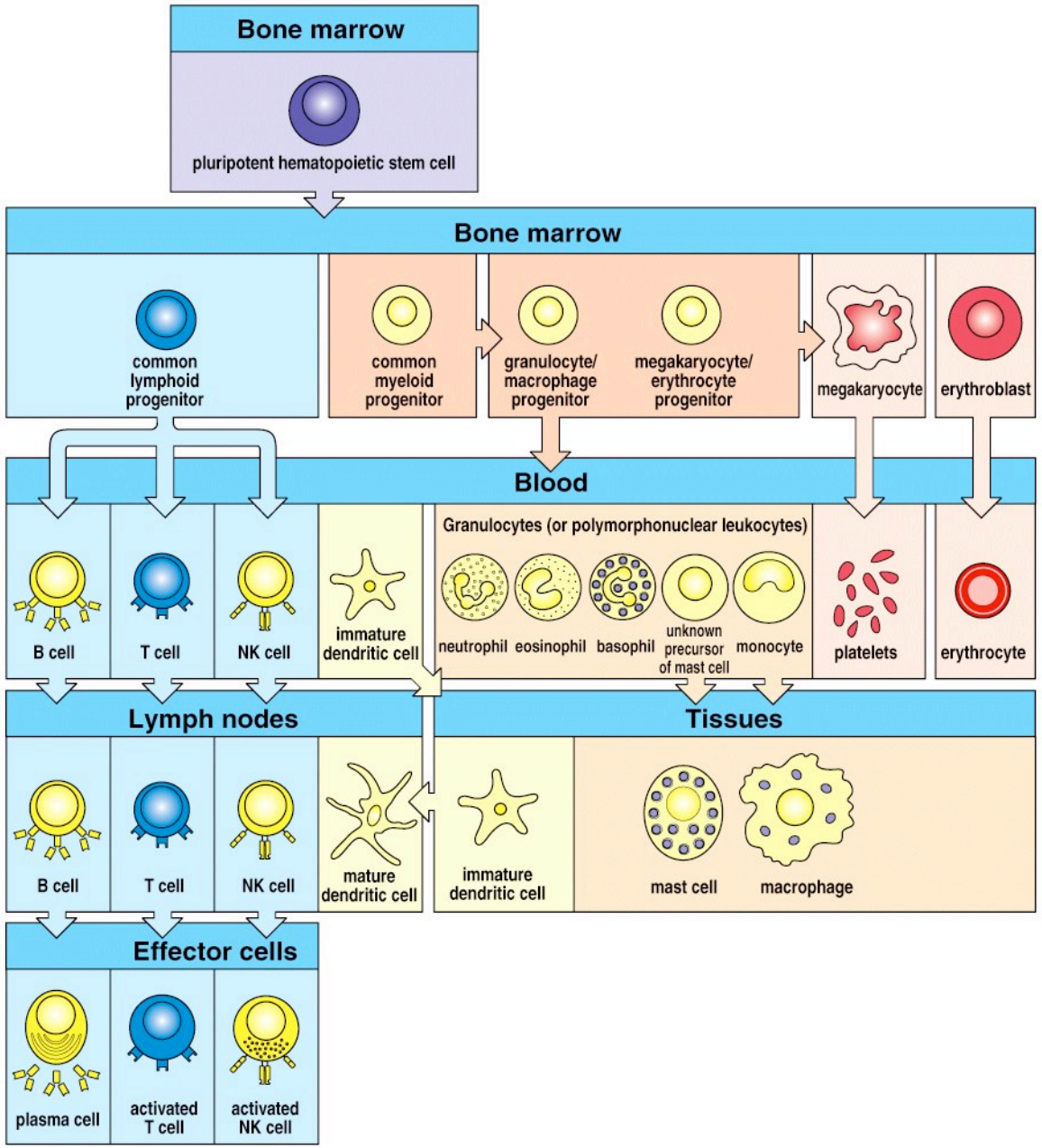


Figure 1-3 Immunobiology, 6/e. (© Garland Science 2005)

Bone marrow: Origin of cells of the immune system

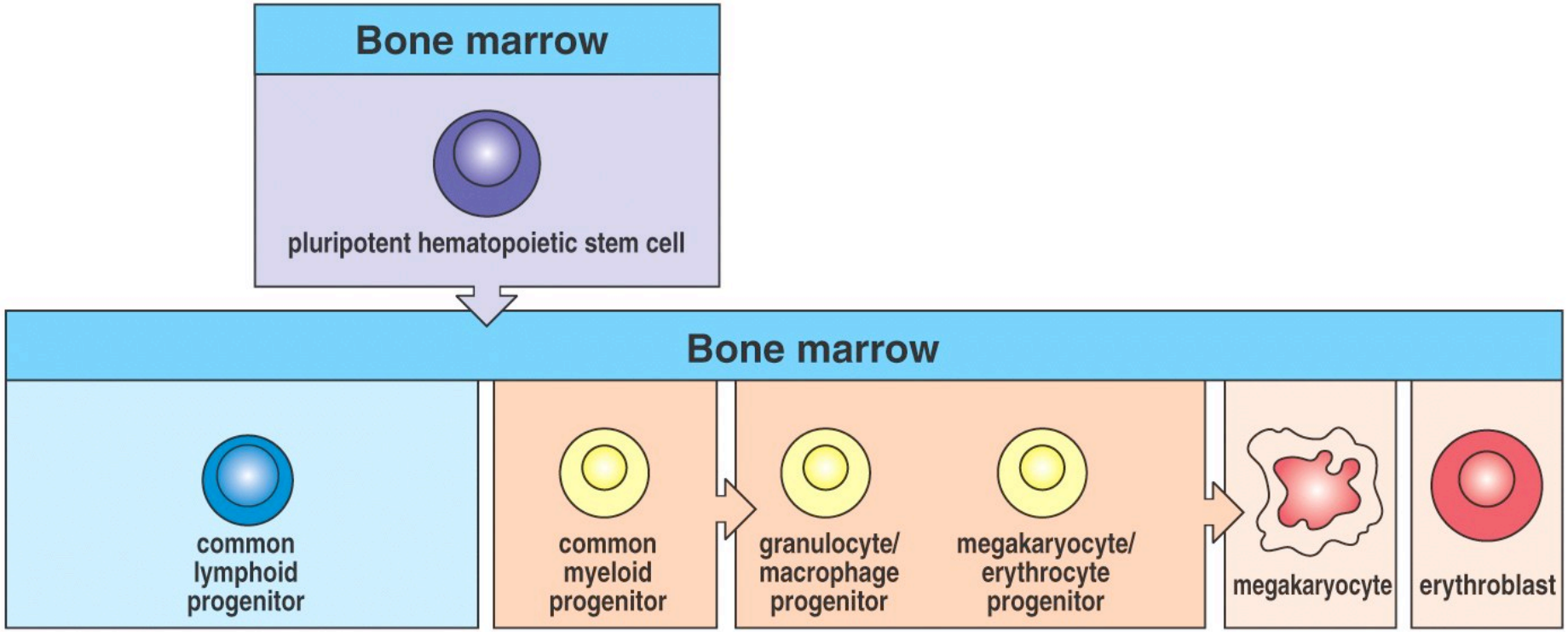


Figure 1-3 part 1 of 4 Immunobiology, 6/e. (© Garland Science 2005)

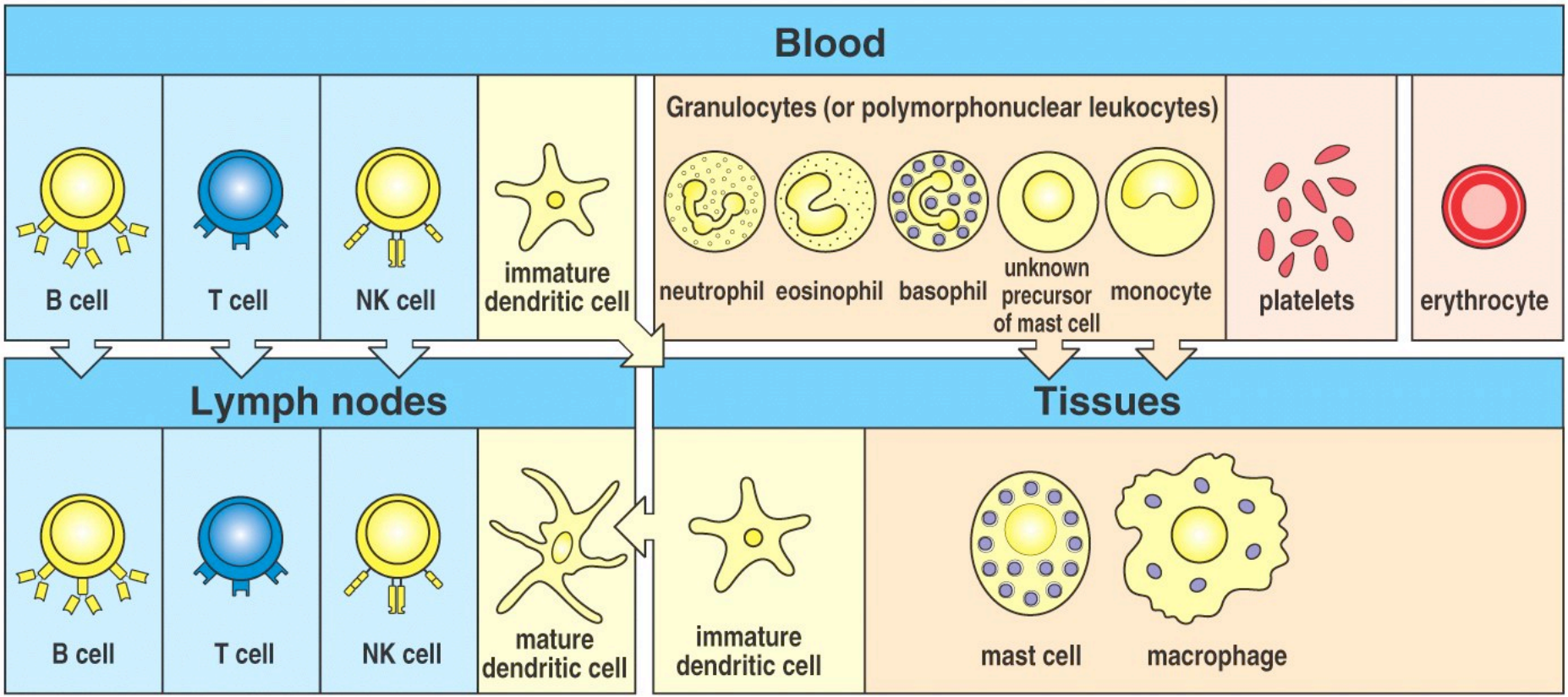


Figure 1-3 part 3 of 4 Immunobiology, 6/e. (© Garland Science 2005)

Myeloid lineage

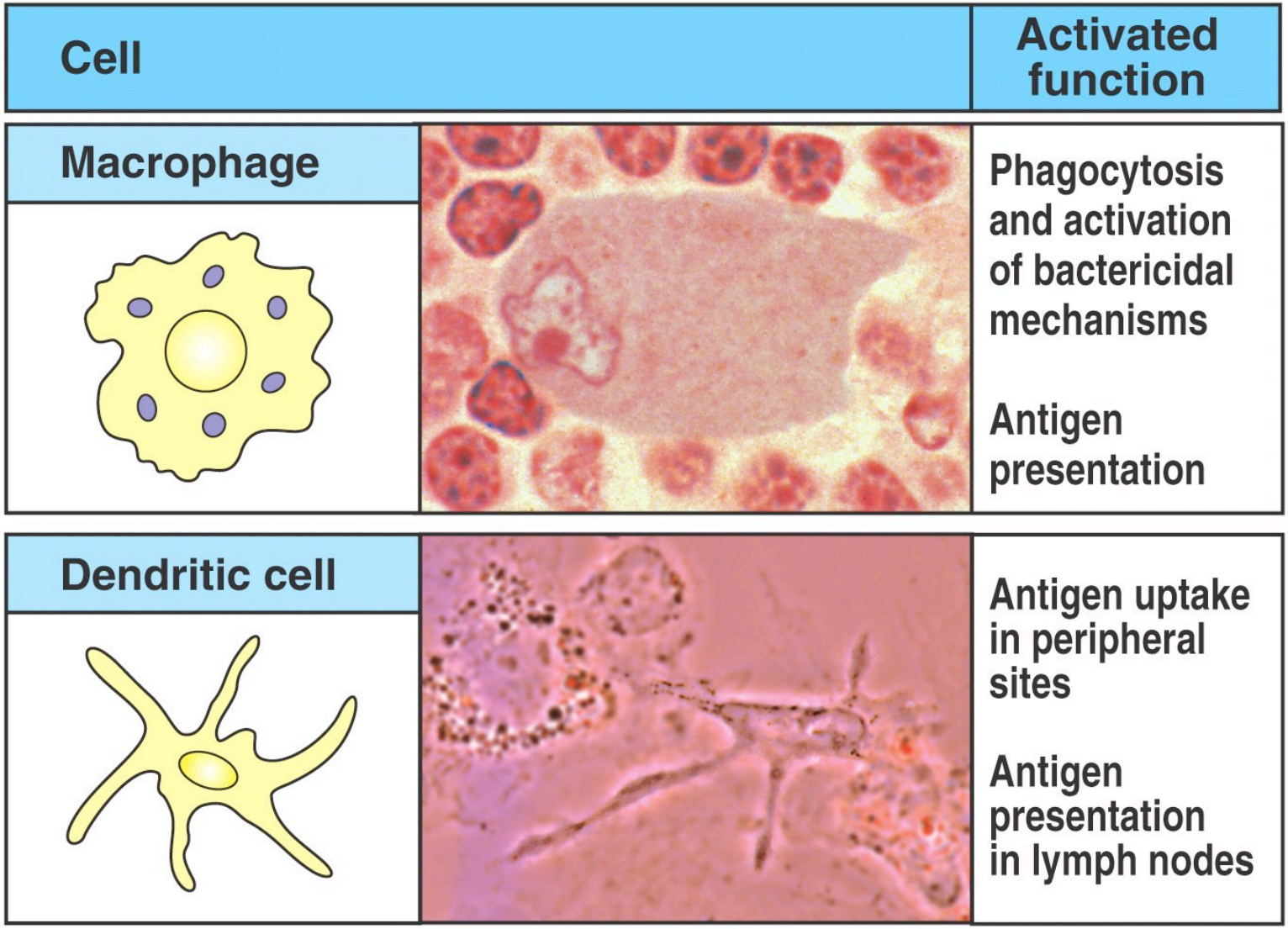


Figure 1-4 part 1 of 3 Immunobiology, 6/e. (© Garland Science 2005)

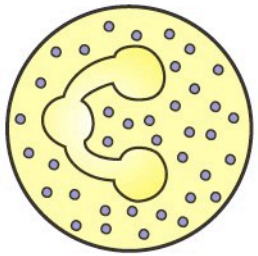
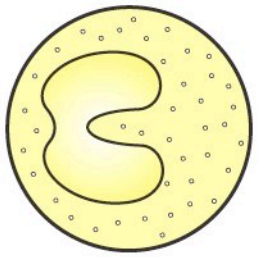
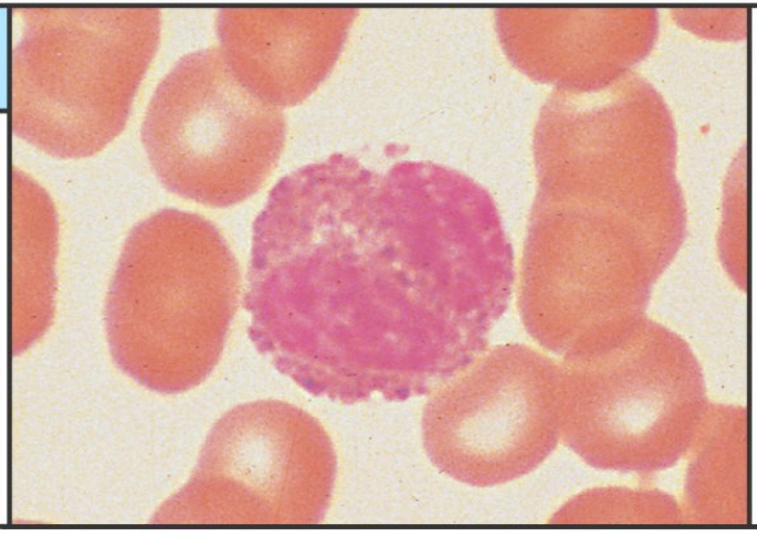
Cell		Activated function
Neutrophil 		Phagocytosis and activation of bactericidal mechanisms
Eosinophil 		Killing of antibody-coated parasites

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

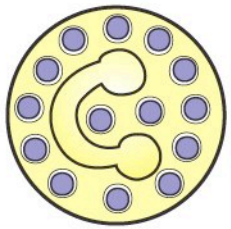
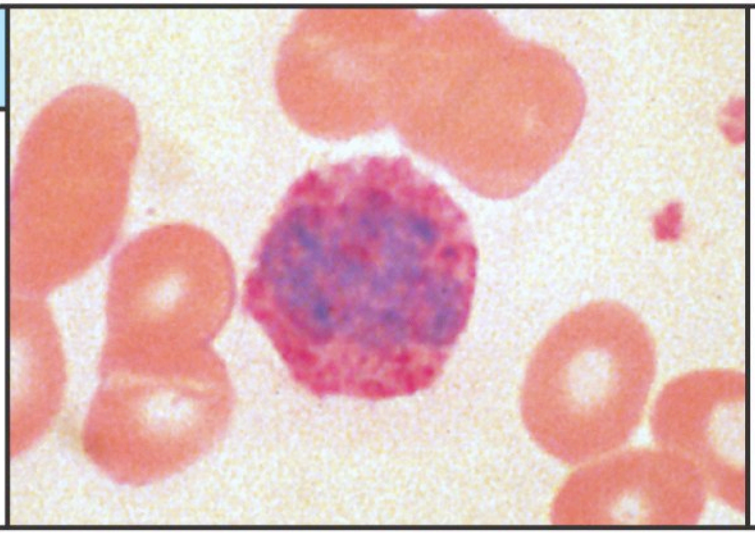
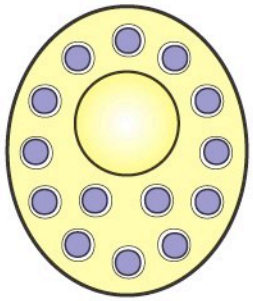
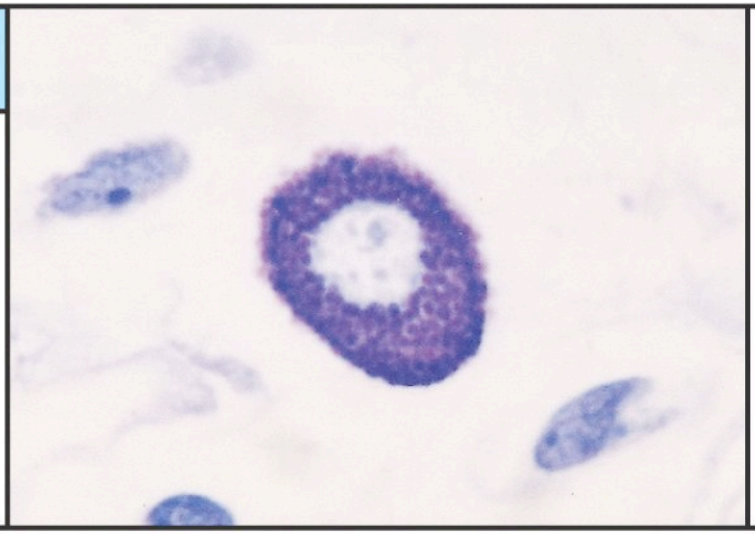
Cell		Activated function
Basophil 		Unknown
Mast cell 		Release of granules containing histamine and other active agents

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

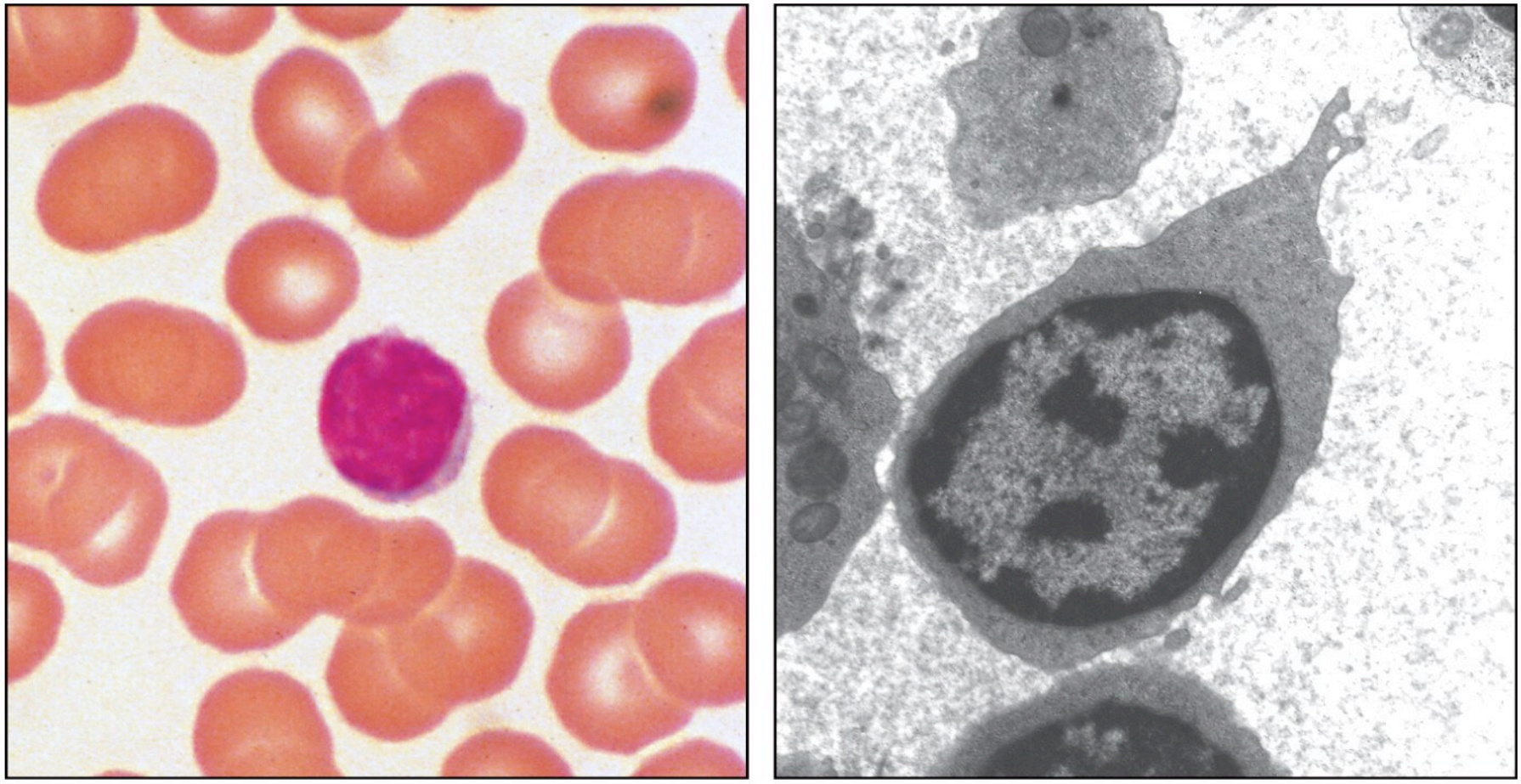


Figure 1-5 Immunobiology, 6/e. (© Garland Science 2005)

Natural killer cells (NK cells)

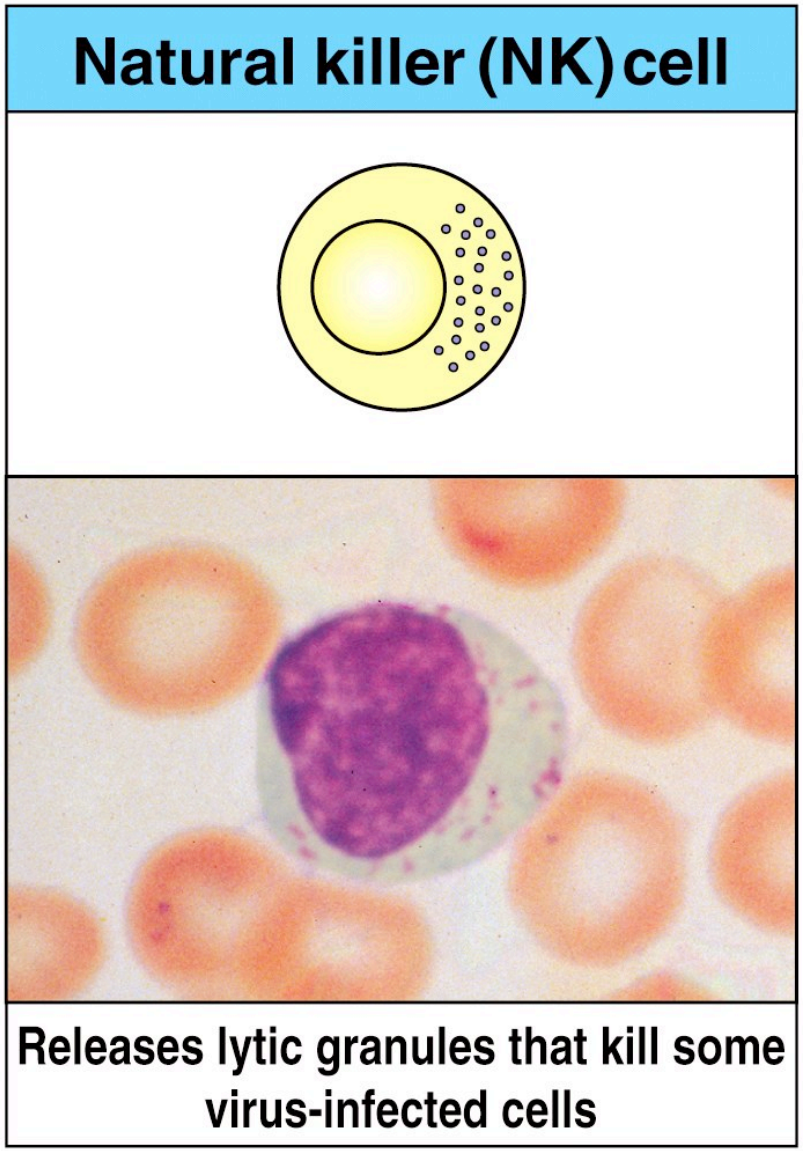


Figure 1-6 Immunobiology, 6/e. (© Garland Science 2005)

Innate:

- -interferon secretion: activates macrophages

-Cytotoxicity: kill cells with decreased MHC expression

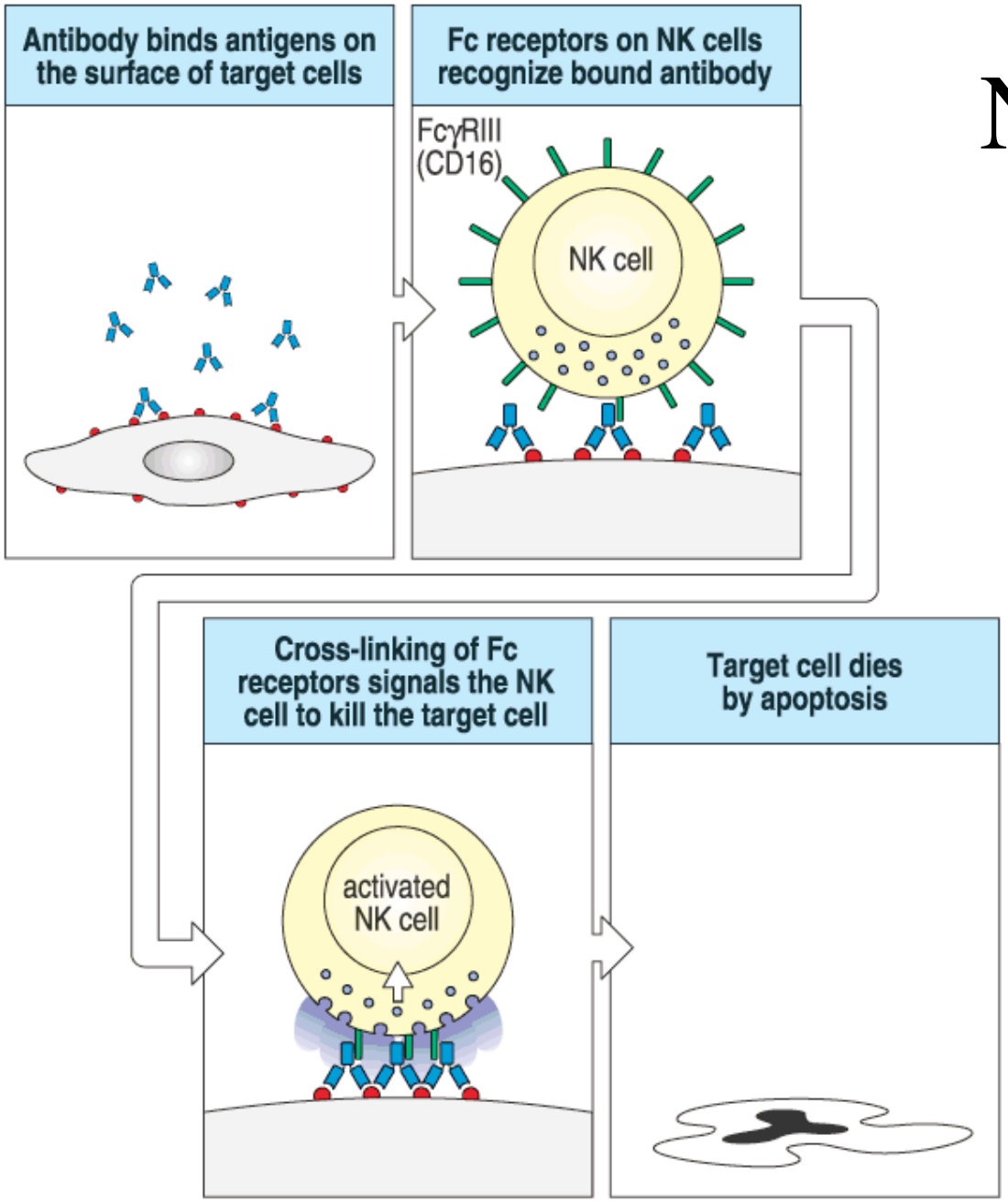


Fig 9.34 © 2001 Garland Science

Natural Killer Cells

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

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

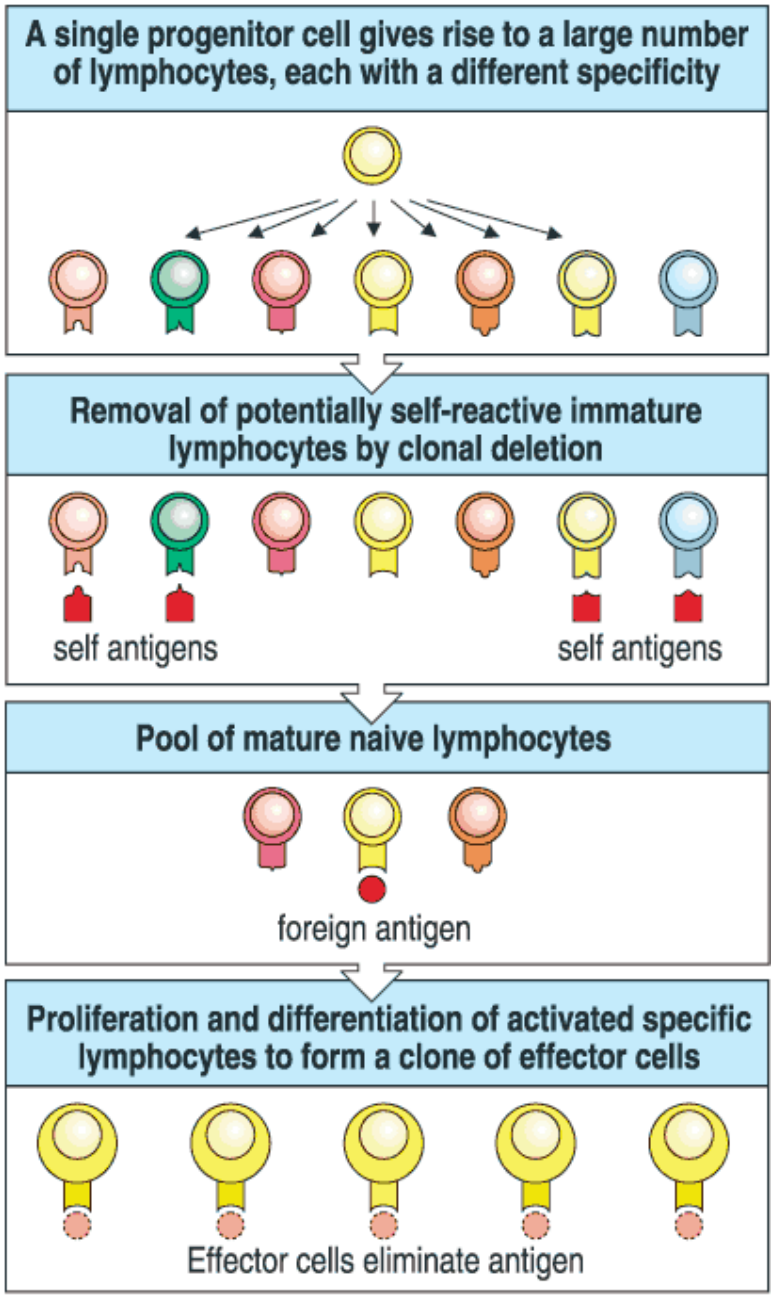


Fig 1.14 © 2001 Garland Science

Bone marrow: B lymphocytes
Thymus: T lymphocytes

Peripheral lymphoid tissue

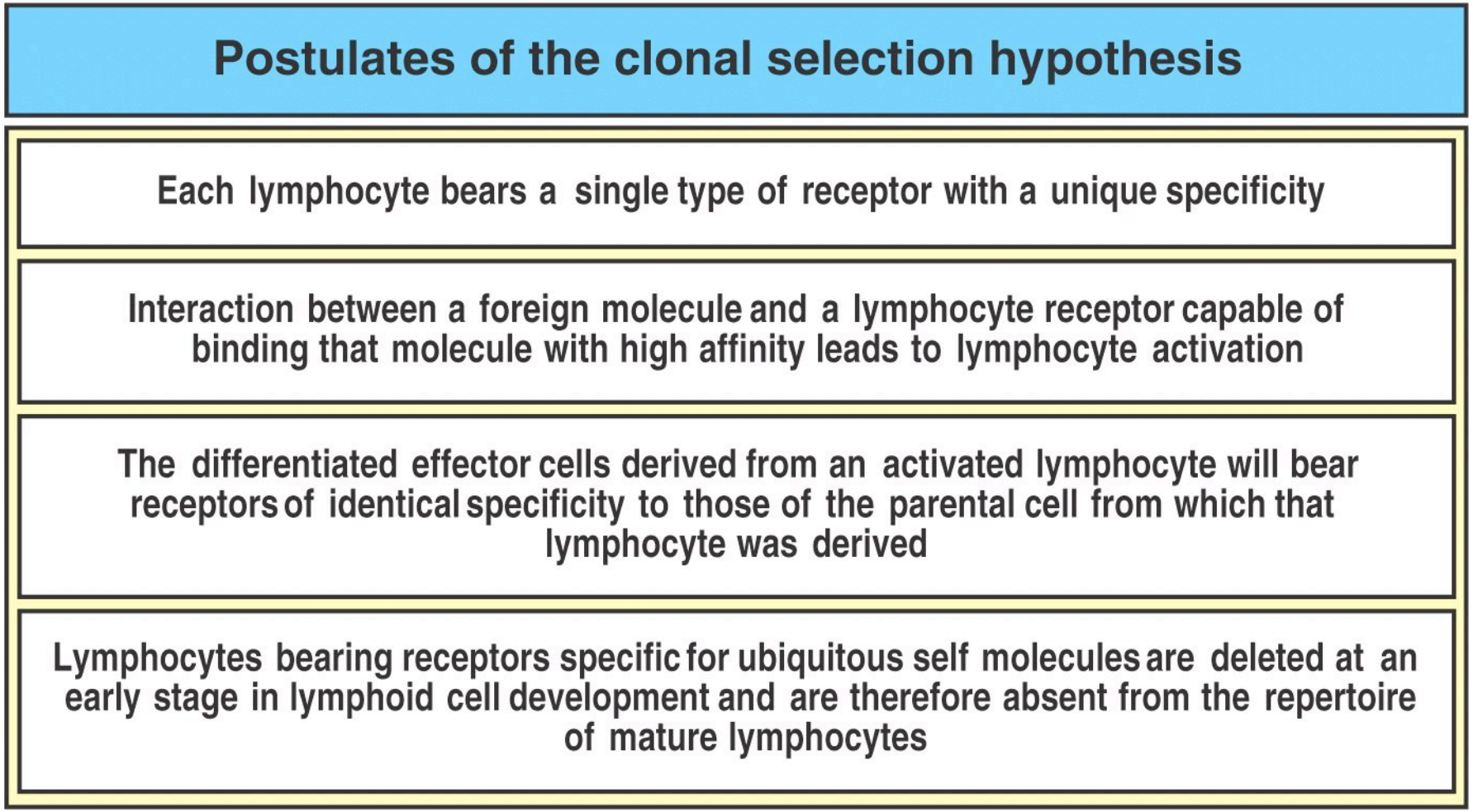


Figure 1-15 Immunobiology, 6/e. (© Garland Science 2005)

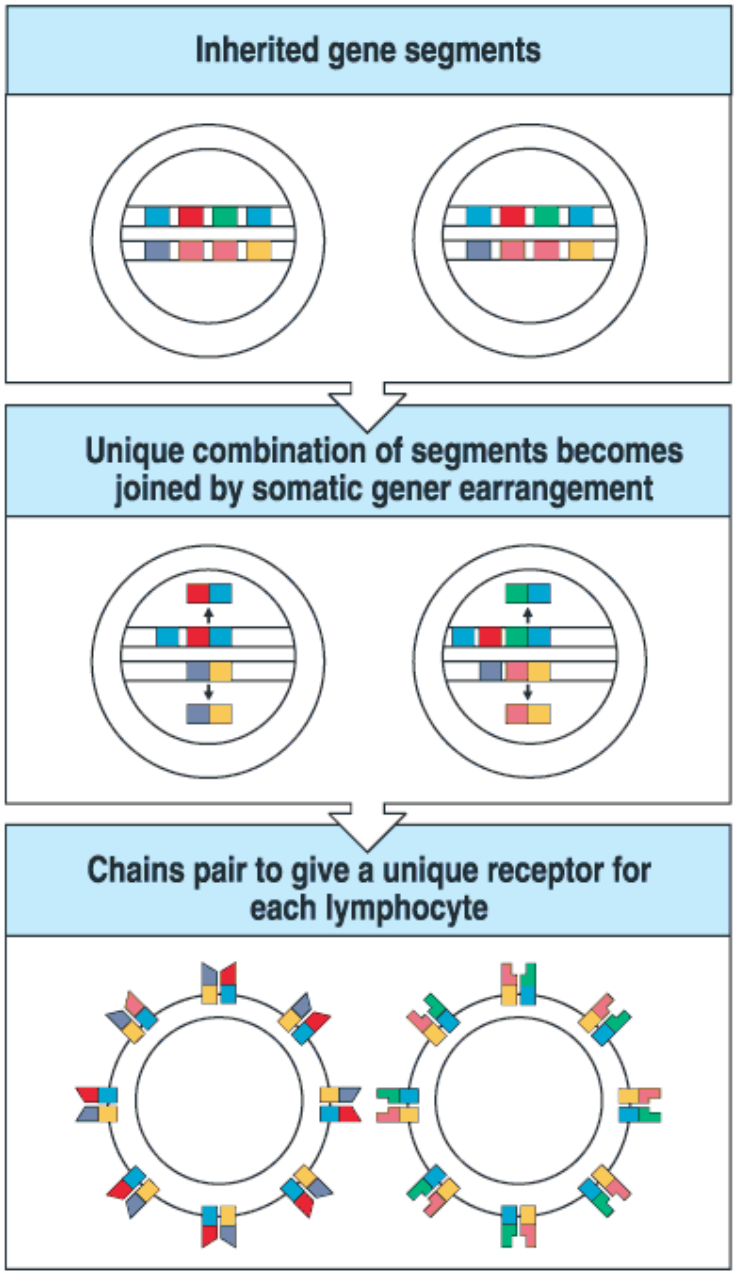


Fig 1.18 © 2001 Garland Science

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

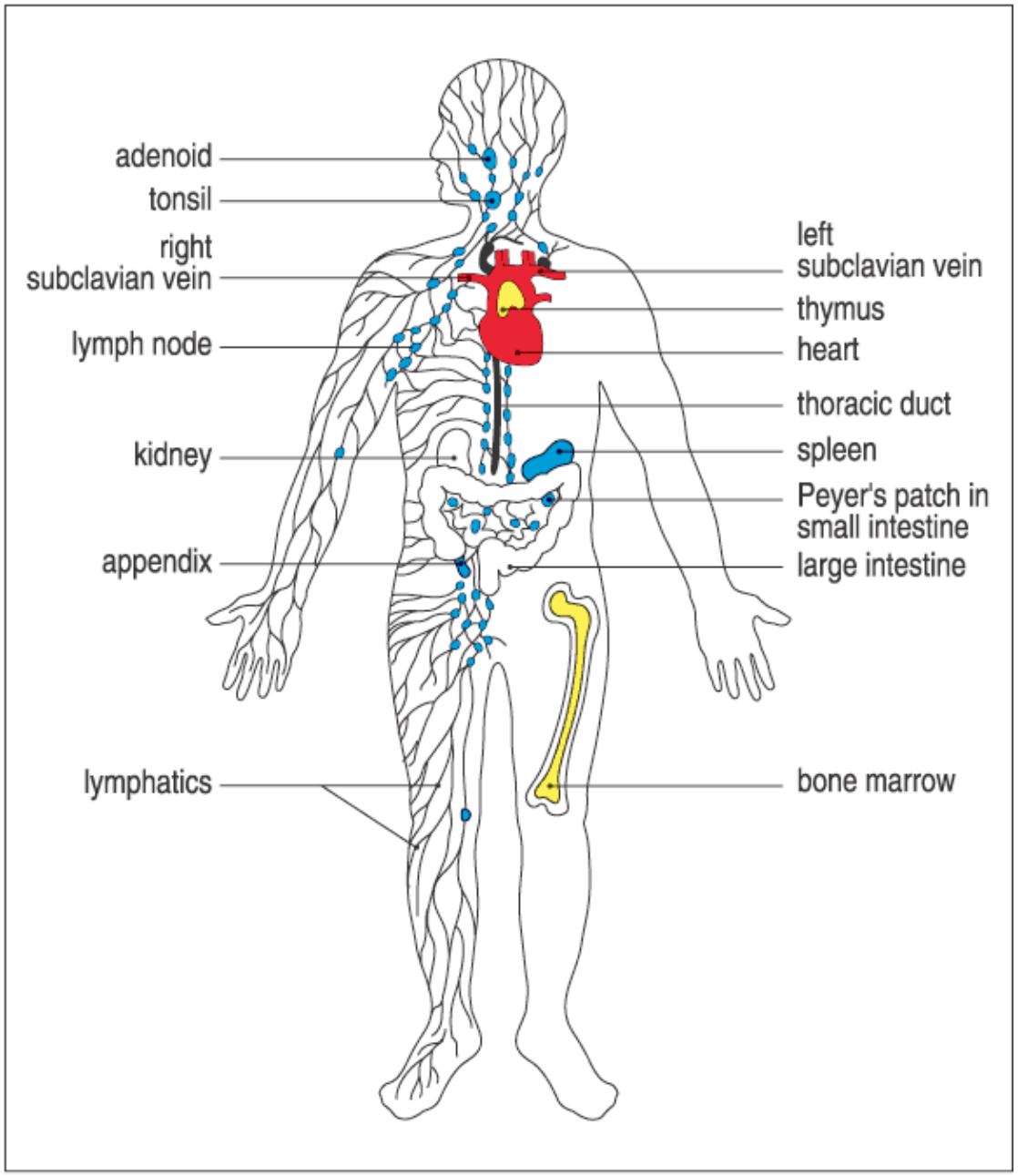


Fig 1.7 © 2001 Garland Science

Lymphoid system

- Central lymphoid organs
- Peripheral lymphoid tissue

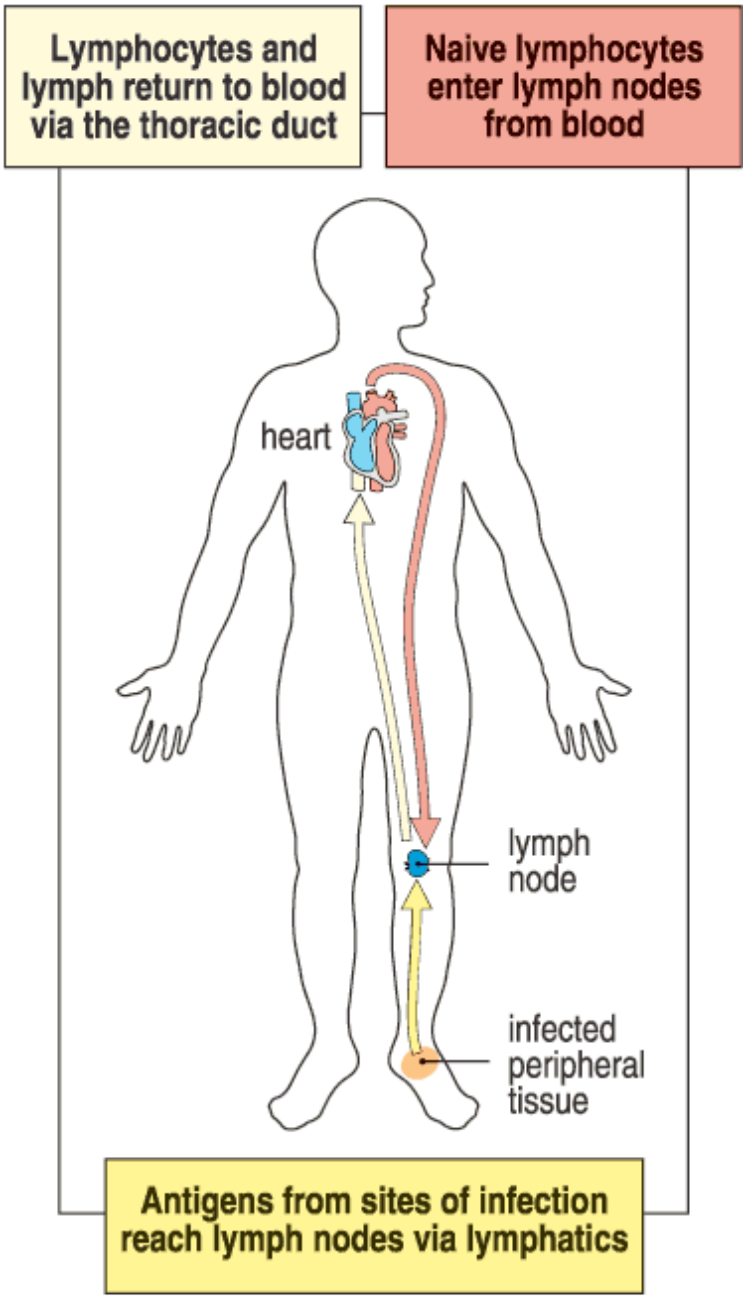


Fig 1.11 © 2001 Garland Science

Routing of naïve lymphocytes through the body

Lymphocytes must bind Ag to proliferate

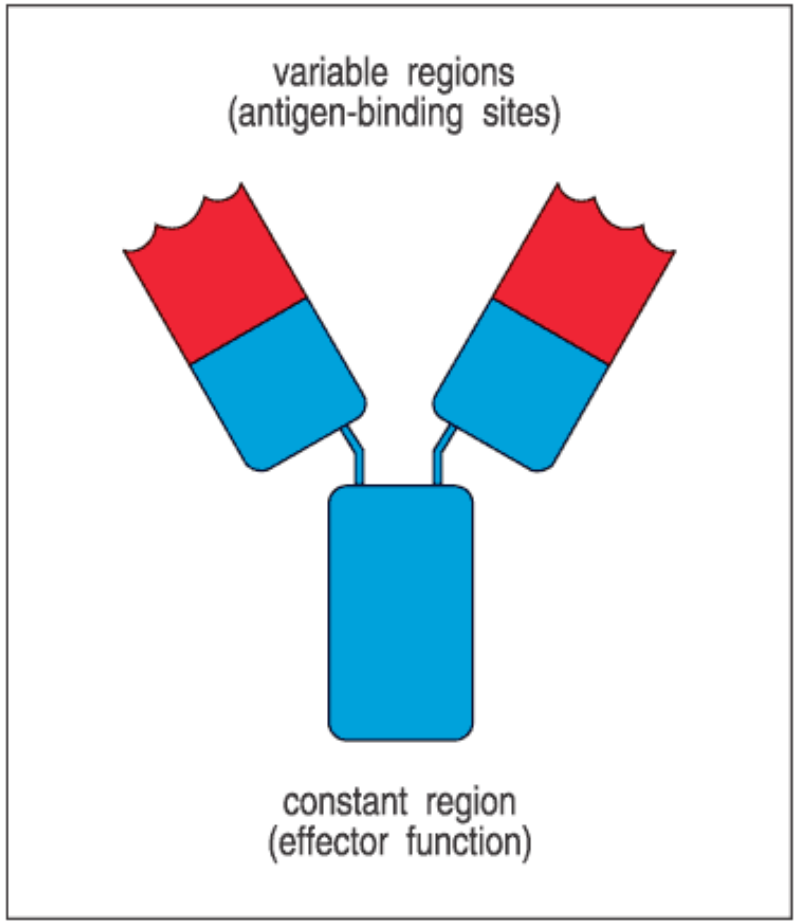


Fig 1.16 © 2001 Garland Science

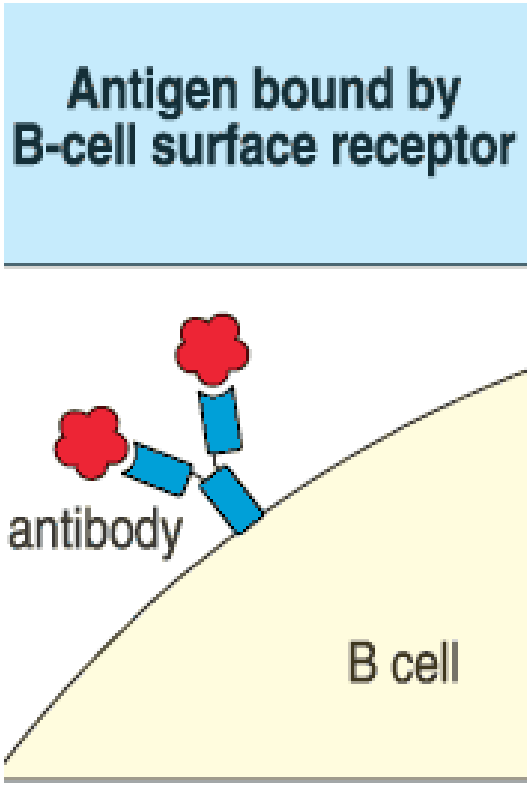


Fig 1.29 © 2001 Ga

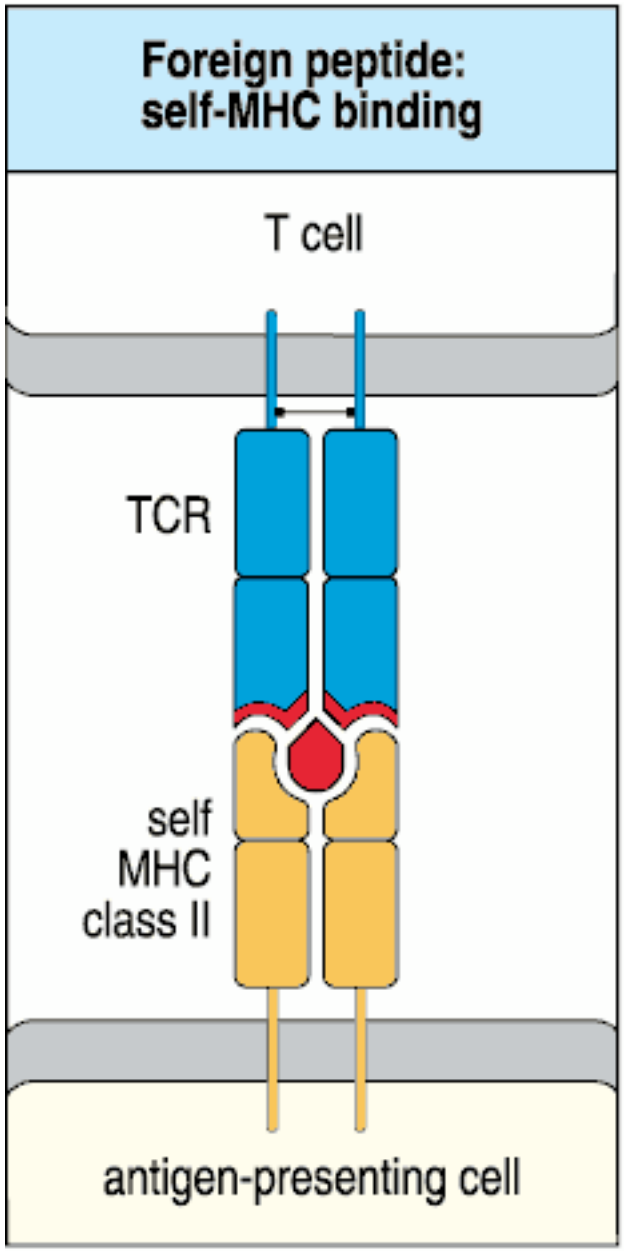


Fig 5.17 © 2001 Garland S

T cell receptor (TCR):

recognizes Ag bound in cleft of MHC

Major Histocompatability Complex (MHC)

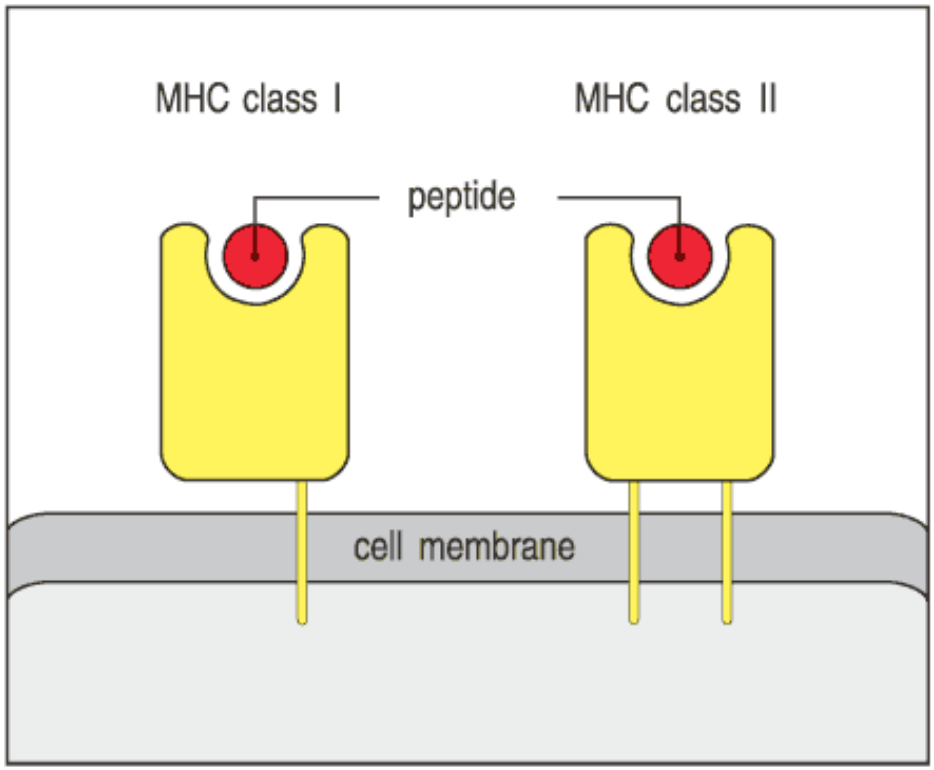


Fig 1.27 © 2001 Garland Science

Antigen processing for MHC class I

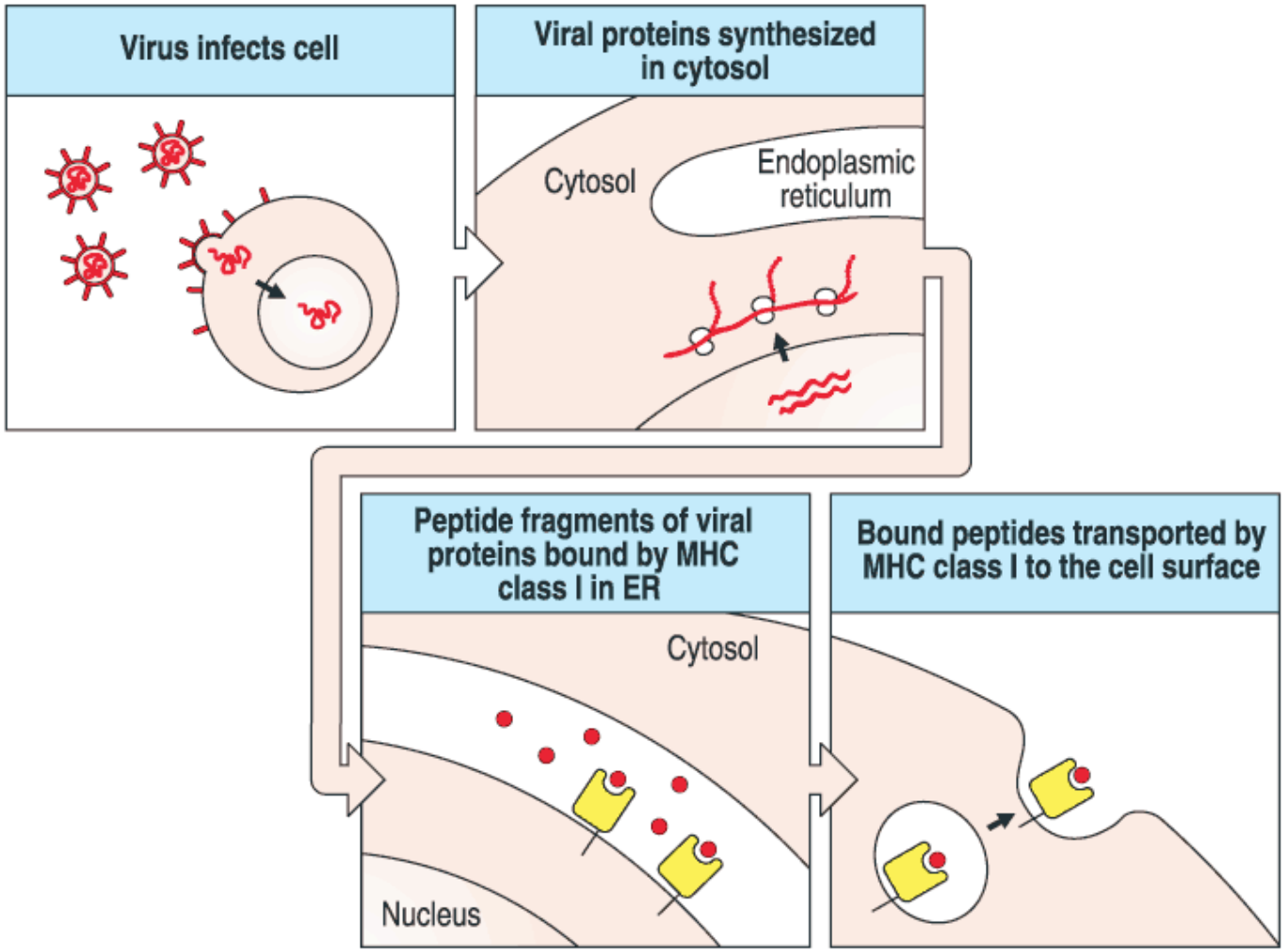


Fig 1.28 © 2001 Garland Science

Antigen processing for MHC class II

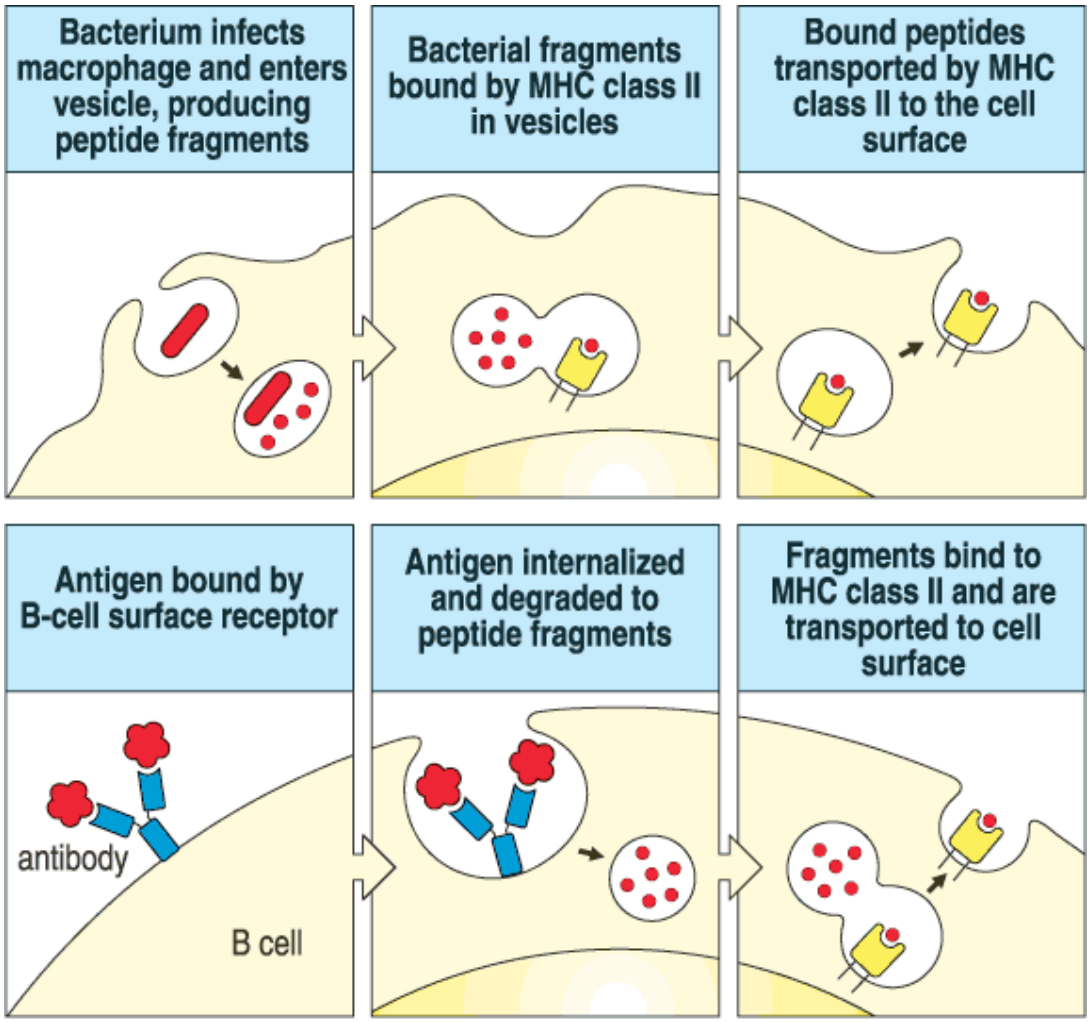


Fig 1.29 © 2001 Garland Science

Antigen presenting cells (APC)

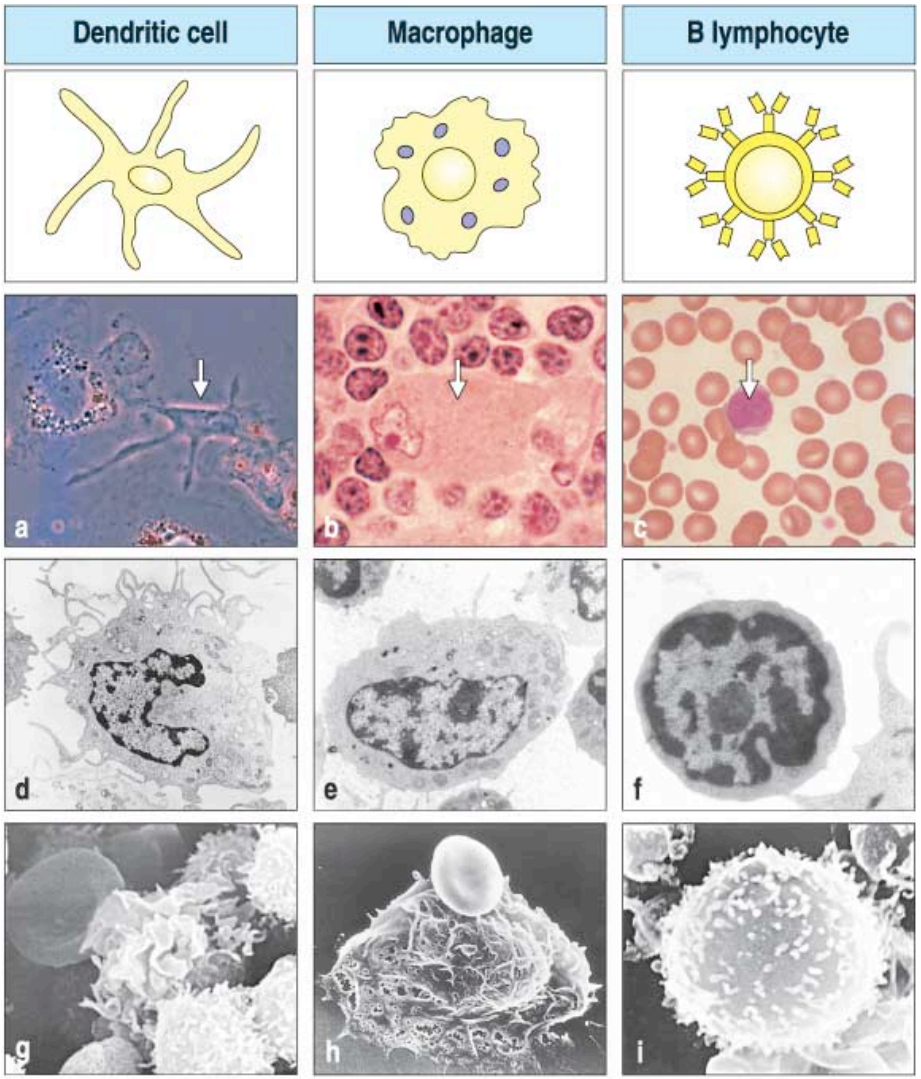


Fig 1.22 © 2001 Garland Science

Activation of lymphocytes

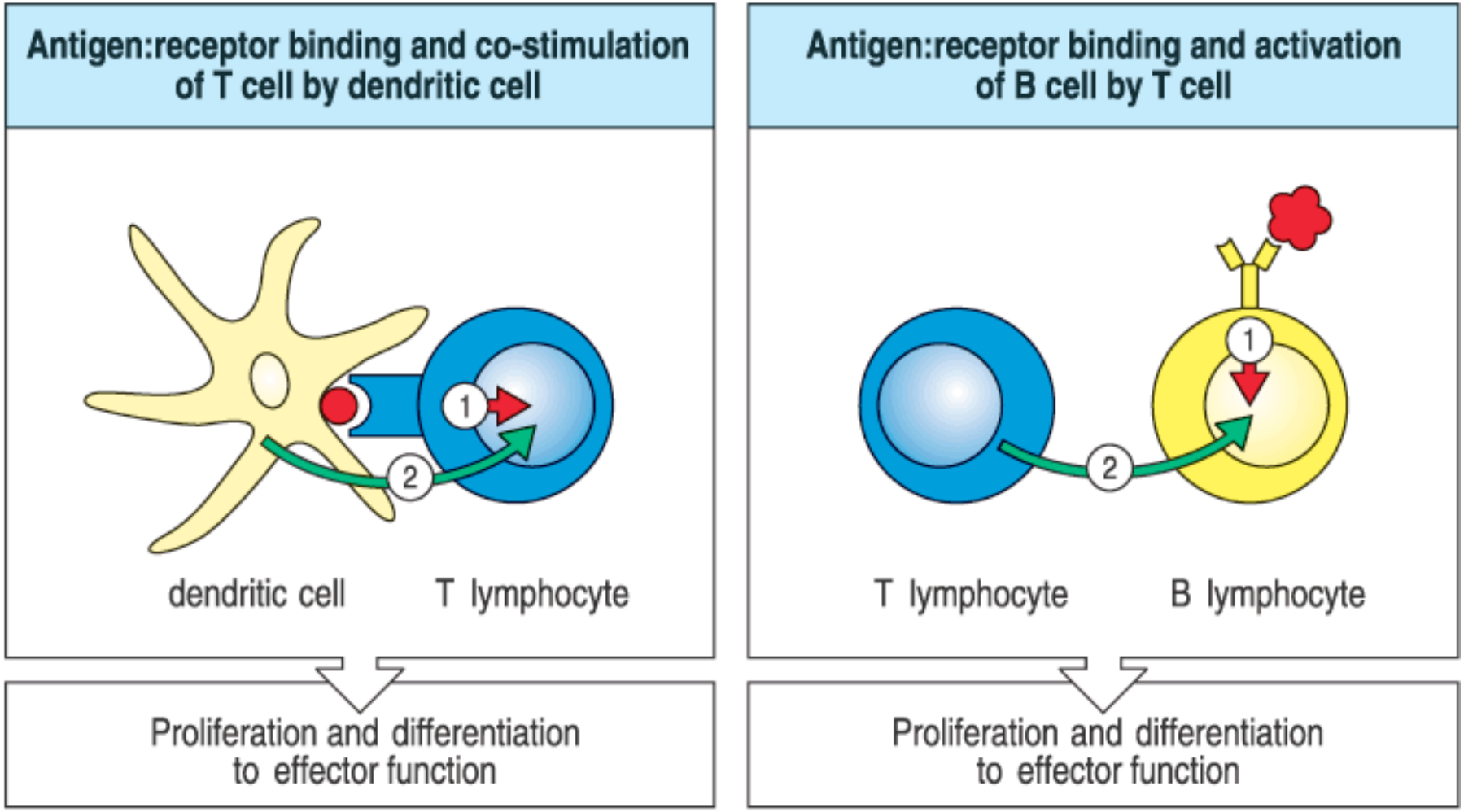


Fig 1.21 © 2001 Garland Science

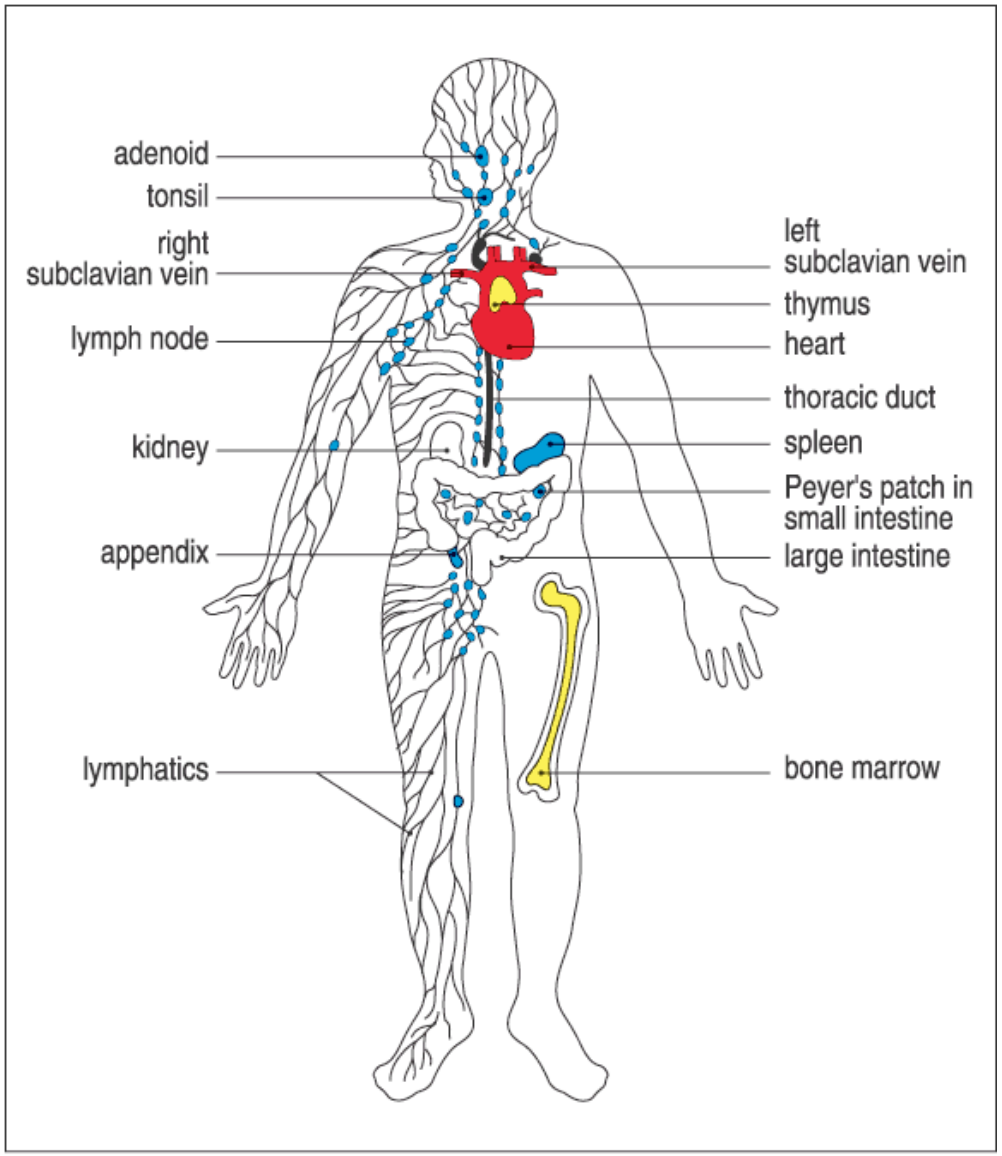


Fig 1.7 © 2001 Garland Science

Lymphocytes encounter Ag in peripheral lymphoid tissue

Lymph node

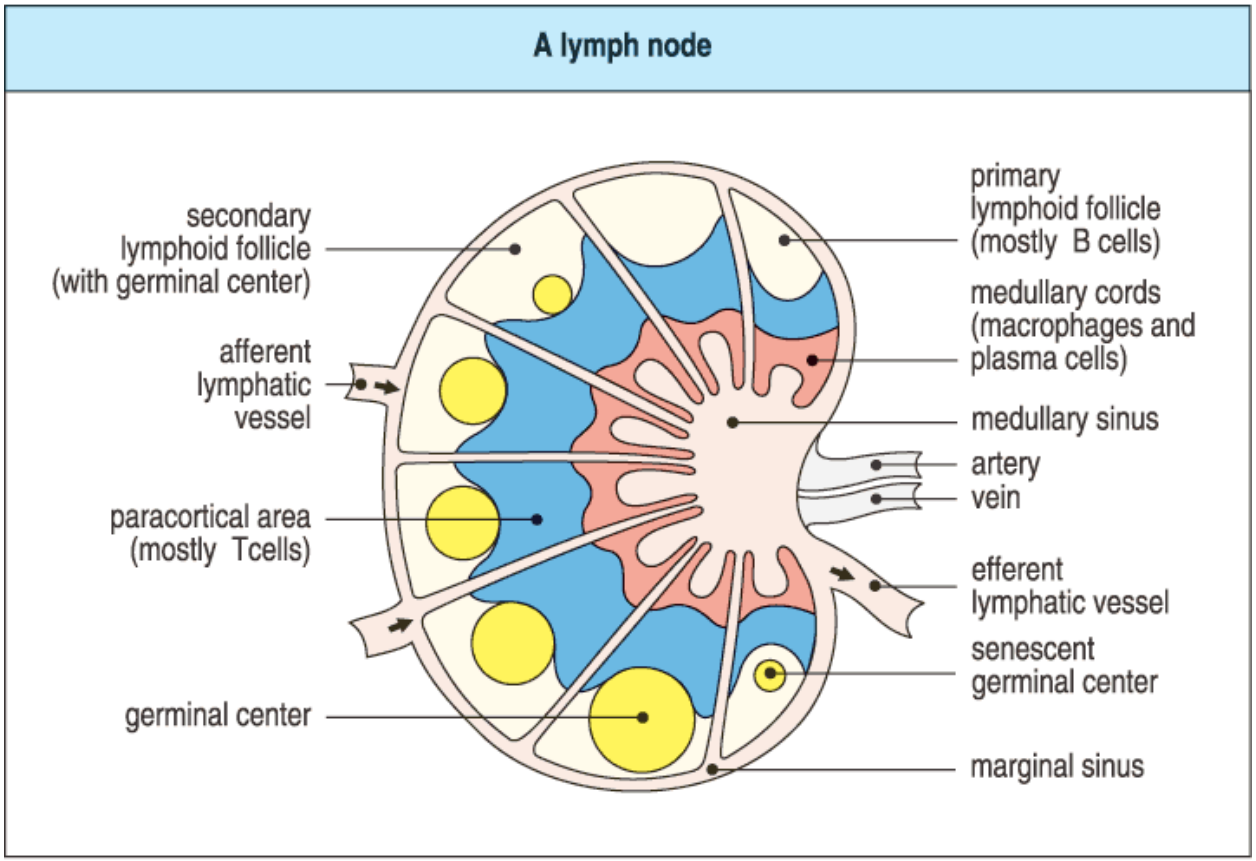


Fig 1.8 part 1 of 2 © 2001 Garland Science

Fig 1.8 part 2 of 2 © 2001 Garland Science

Gut-associated lymph tissue (GALT)

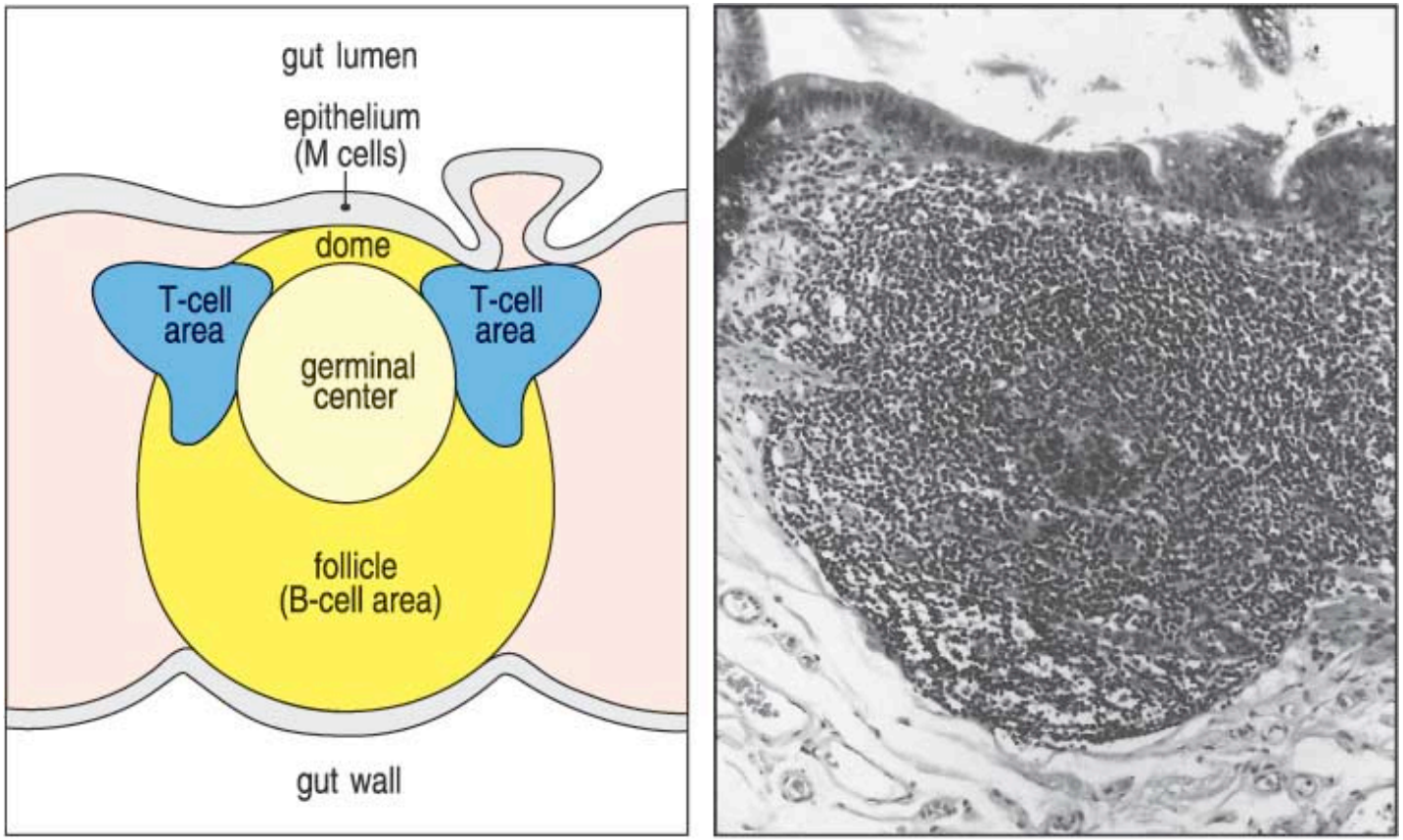


Fig 1.10 © 2001 Garland Science

Humoral response (B cells)

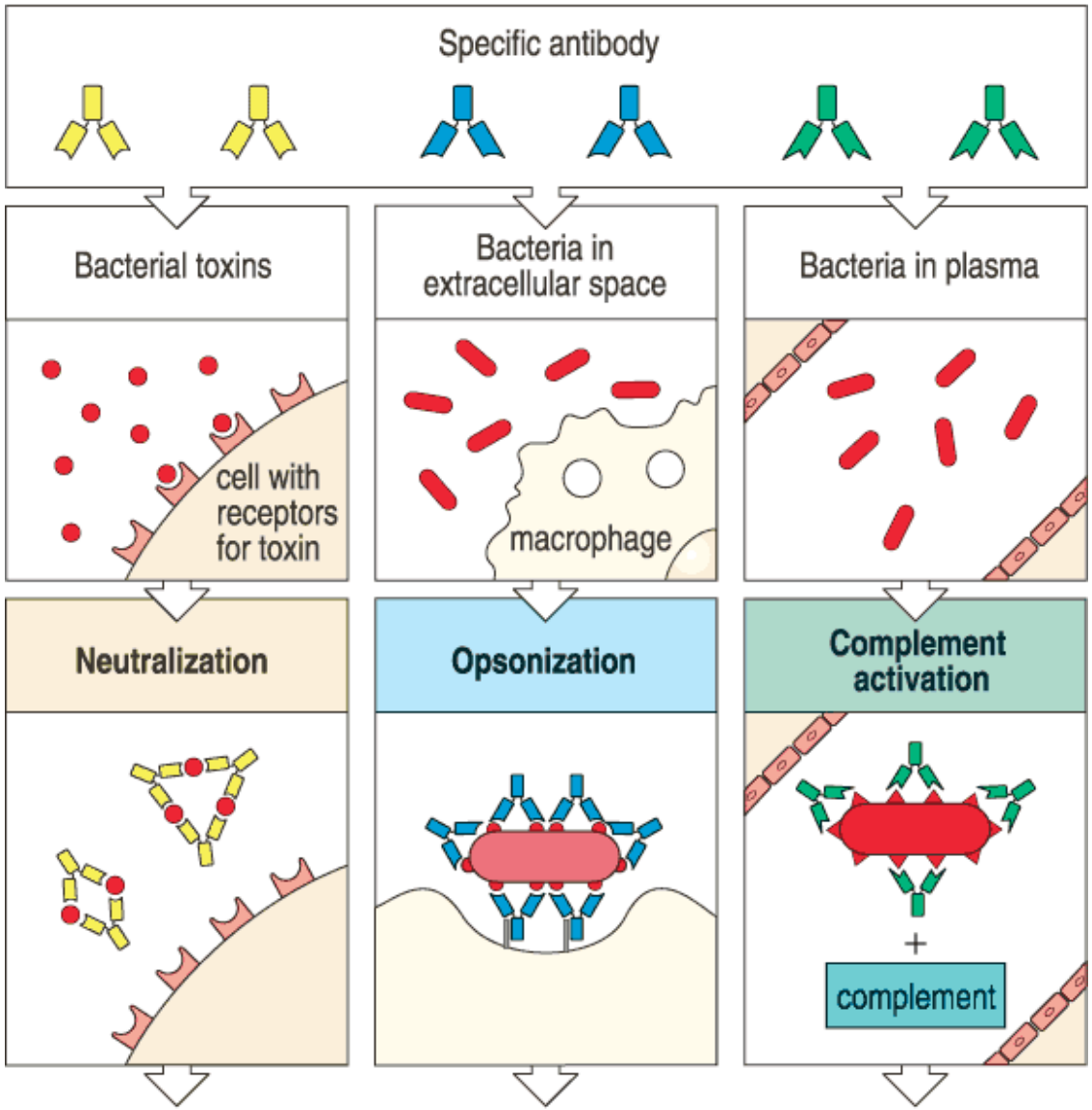


Fig 1.24 part 1 of 2 © 2001 Garland Science

Complement activation

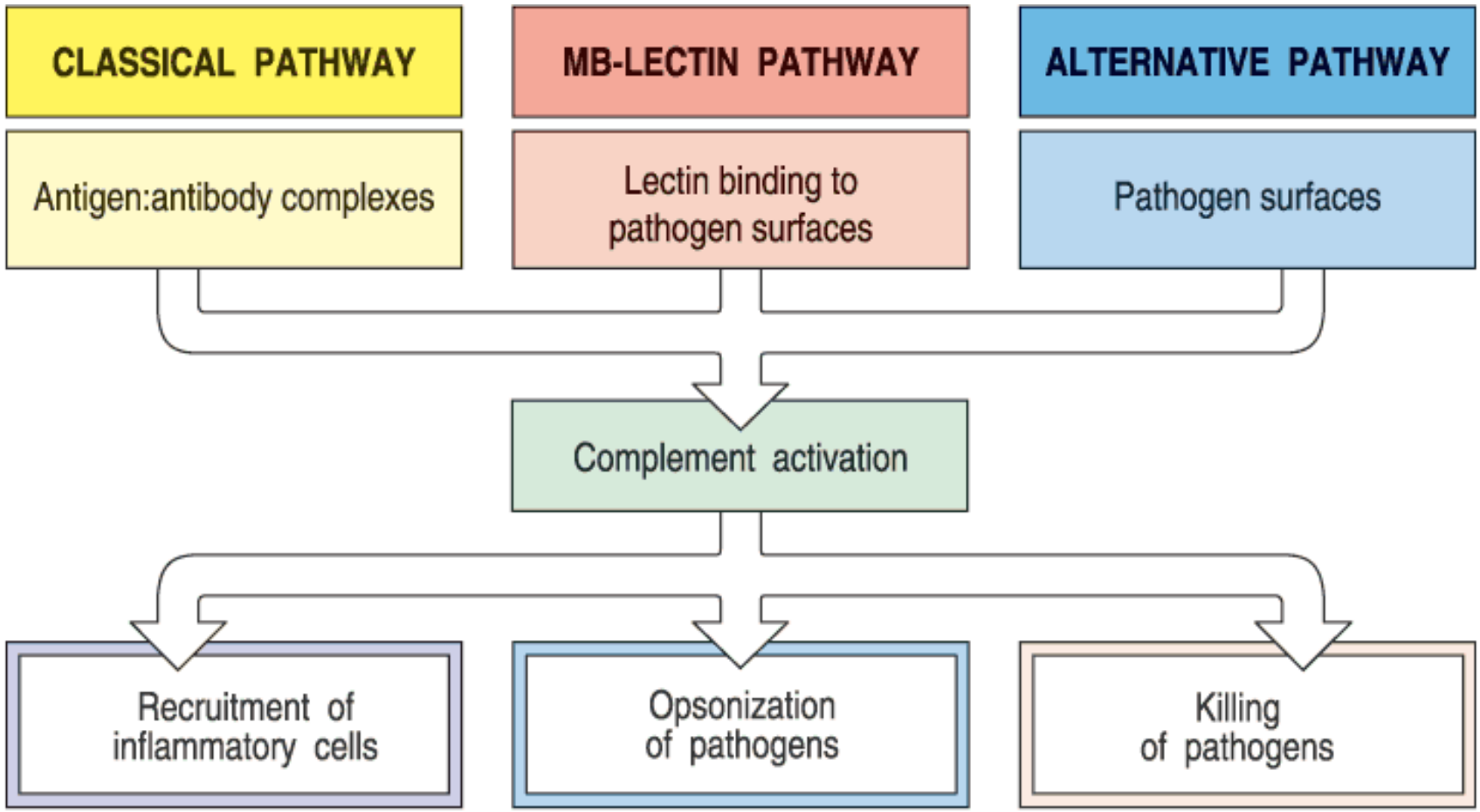


Fig 2.7 © 2001 Garland Science

Cytotoxic T lymphocytes (CTL)

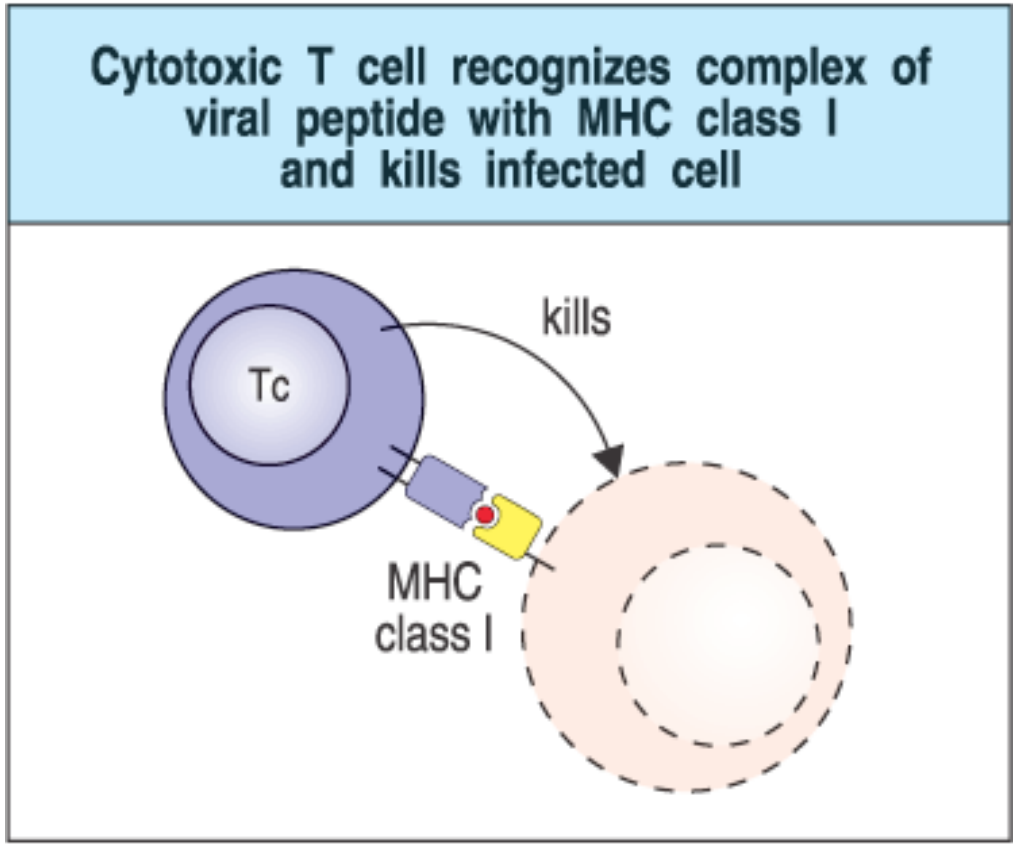


Fig 1.30 © 2001 Garland Science

CTL killing virally infected cell

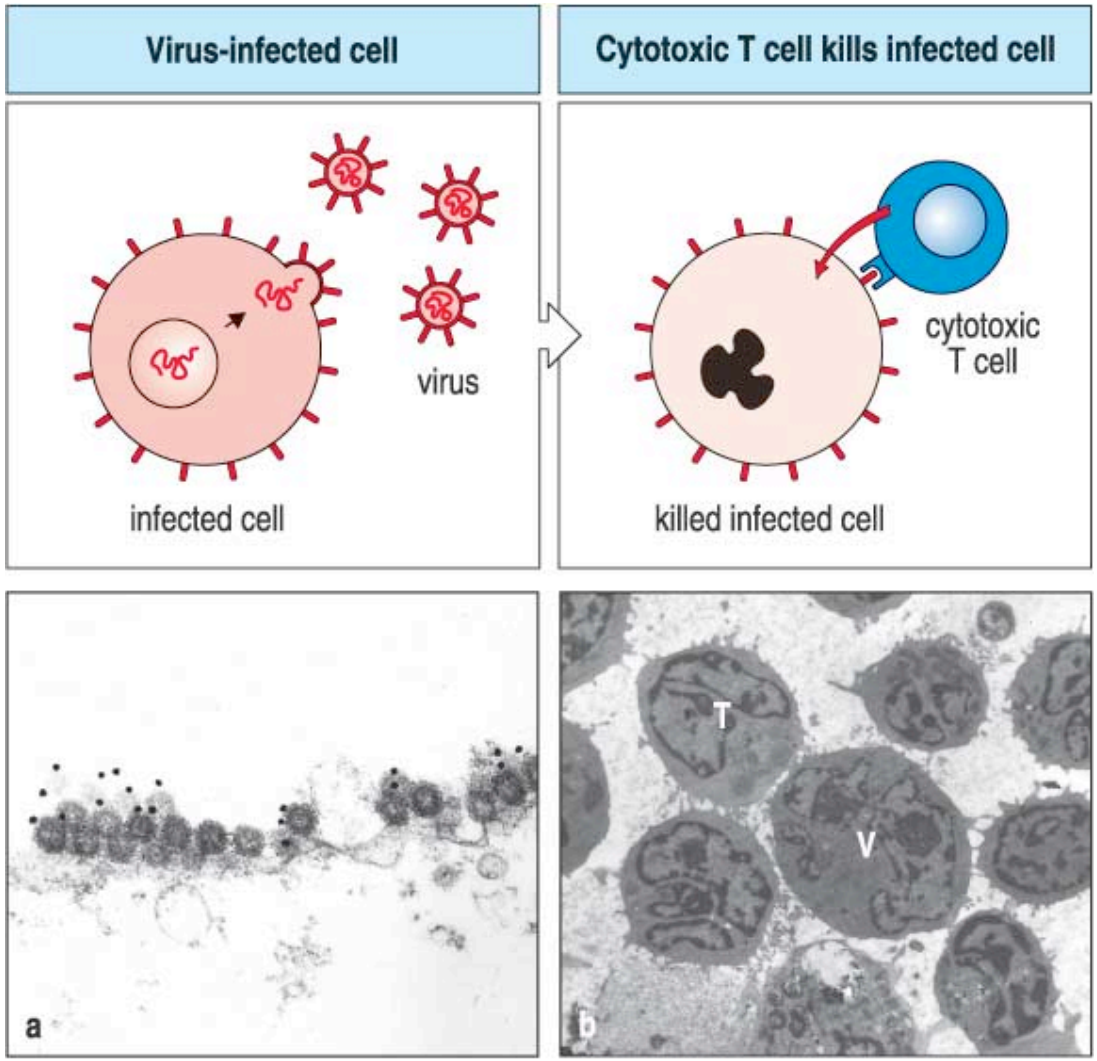


Fig 1.25 © 2001 Garland Science

Helper T cells

T_H1 T_H2

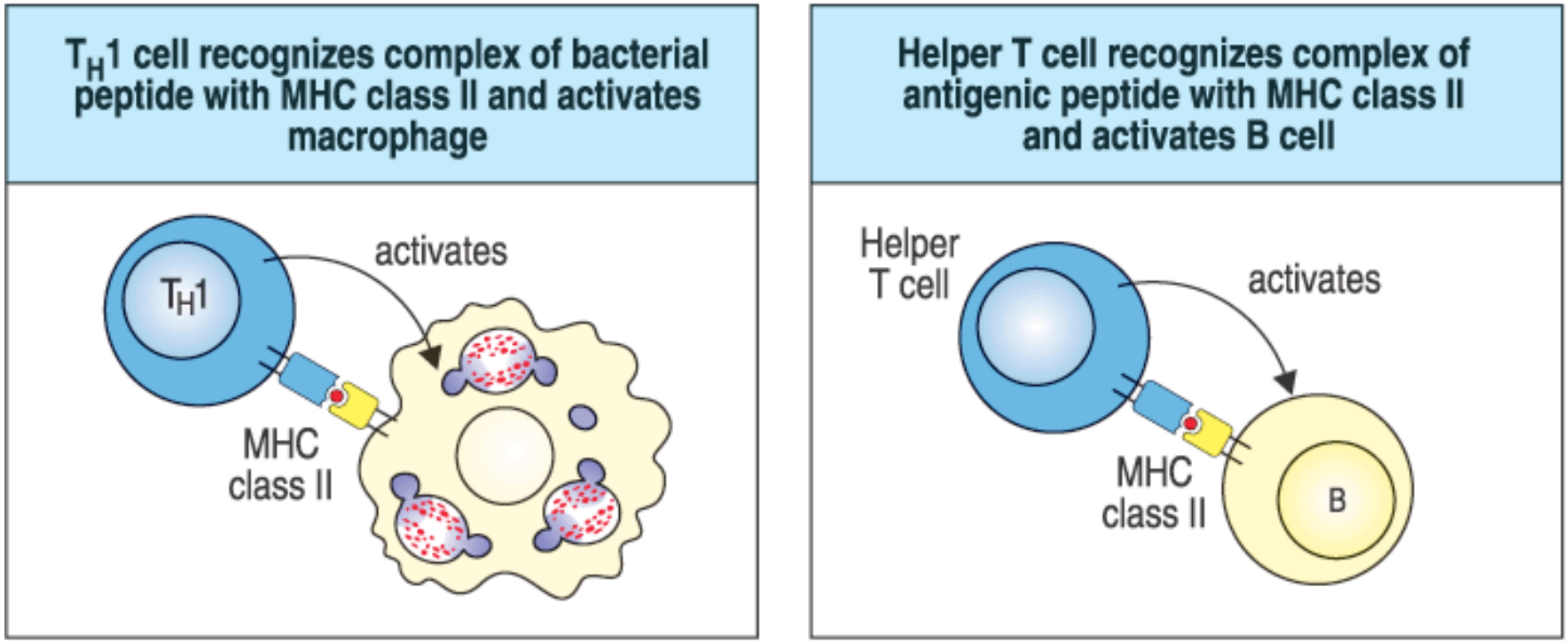


Fig 1.31 © 2001 Garland Science

Time course of adaptive response

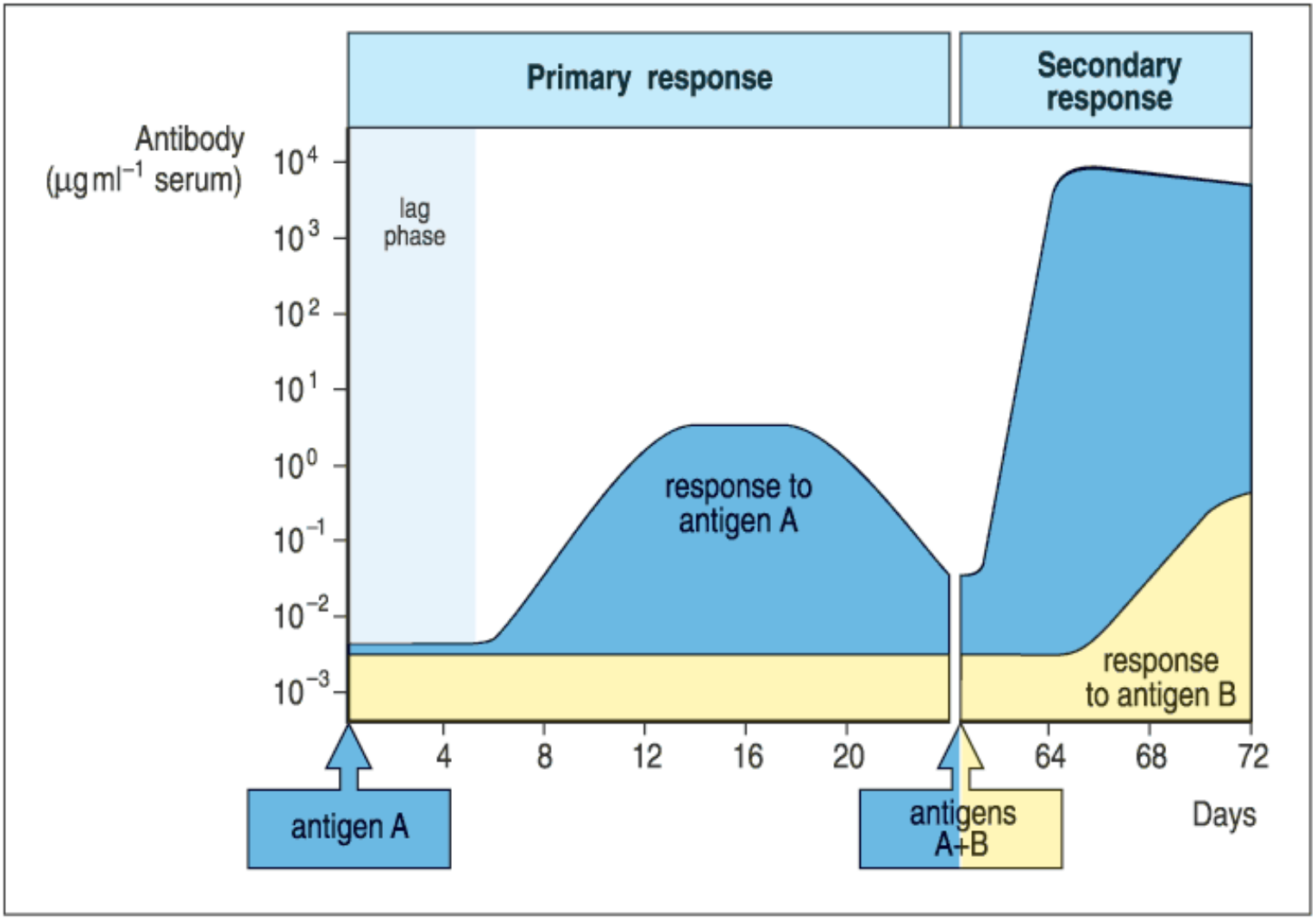


Fig 1.20 © 2001 Garland Science