



**STIKES NOTOKUSUMO  
YOGYAKARTA**

# SISTEM IMUN

Pertemuan 11

Desi Novita

# BIOLOGI MOLEKULER

# PENDAHULUAN

**Imunologi** : ilmu yang mempelajari mengenai sistem kekebalan tubuh (respon imun) terhadap infeksi.

Pendekatan biologi molekuler dan imunologi merupakan cara pendekatan untuk pengembangan diagnostik guna mendapatkan perangkat diagnosis penyakit parasit yang sensitif dan spesifik.

- **Imunitas**: Mekanisme /kemampuan tubuh menahan atau mengeliminasi benda asing /sel abnormal yang potensial berbahaya bagi tubuh
- **Fungsi sistem imun**: Mempertahankan tubuh terhadap invasi sel asing dan sel kanker; memperlancar jalan untuk memperbaiki jaringan.
- **Fungsi sistem integument / kulit**: Mencegah masuknya agen eksternal & hilangnya cairan internal dengan berfungsi sebagai sawar protektif antara lingkungan external dan bagian tubuh lain

# FUNGSI SISTEM IMUN

## Pertahanan

- Pertahanan terhadap antigen eksternal (mikroorganisme, parasit).
- Jika imunitas > parasit → imun.
- Jika imunitas < parasit → sakit.

## Homeostasis

- Homeostasis adalah keadaan setimbang (anabolisme, katabolisme) seluler, ekstraseluler, jaringan, organ dan individu organisme. Sistem imun juga berperan dalam degradasi sel-sel rusak/mati untuk dibersihkan dari jaringan/tubuh, misal eritrosit, leukosit yang telah habis masa hidupnya.

## Surveillance

- Memantau/patrol seluruh bagian tubuh atas terjadinya perubahan sel/jaringan (karena mutasi).

# PENGGOLONGAN SISTEM IMUN

Keberadaan/ kemunculan	Komponen yang terlibat
Natural/ <b>Innate</b> / Non Specific	<b>Cellular</b> : melibatkan sel-sel
<b>Adaptive</b> / Acquired/ Specific	<b>Humoral</b> : Ab, komplemen, sitokin, enzim, biokimia lainnya.

## Natural/ innate/ nonspecific

- Humoral: type I IFN (IFN-a/b), lysozyme, Complement proteins
- Cellular: phagocytes (neutrofil, makrofag), NK cells

## Adaptive/ acquired/ specific

- Humoral: B lymphocytes → Abs: IgM, IgG, IgA, IgE, IgD
- Cellular: T lymphocytes: T cells: CD4+ Th, CD8+CTL (cytolytic T lymphocytes)

# CELLULAR IMMUNITY

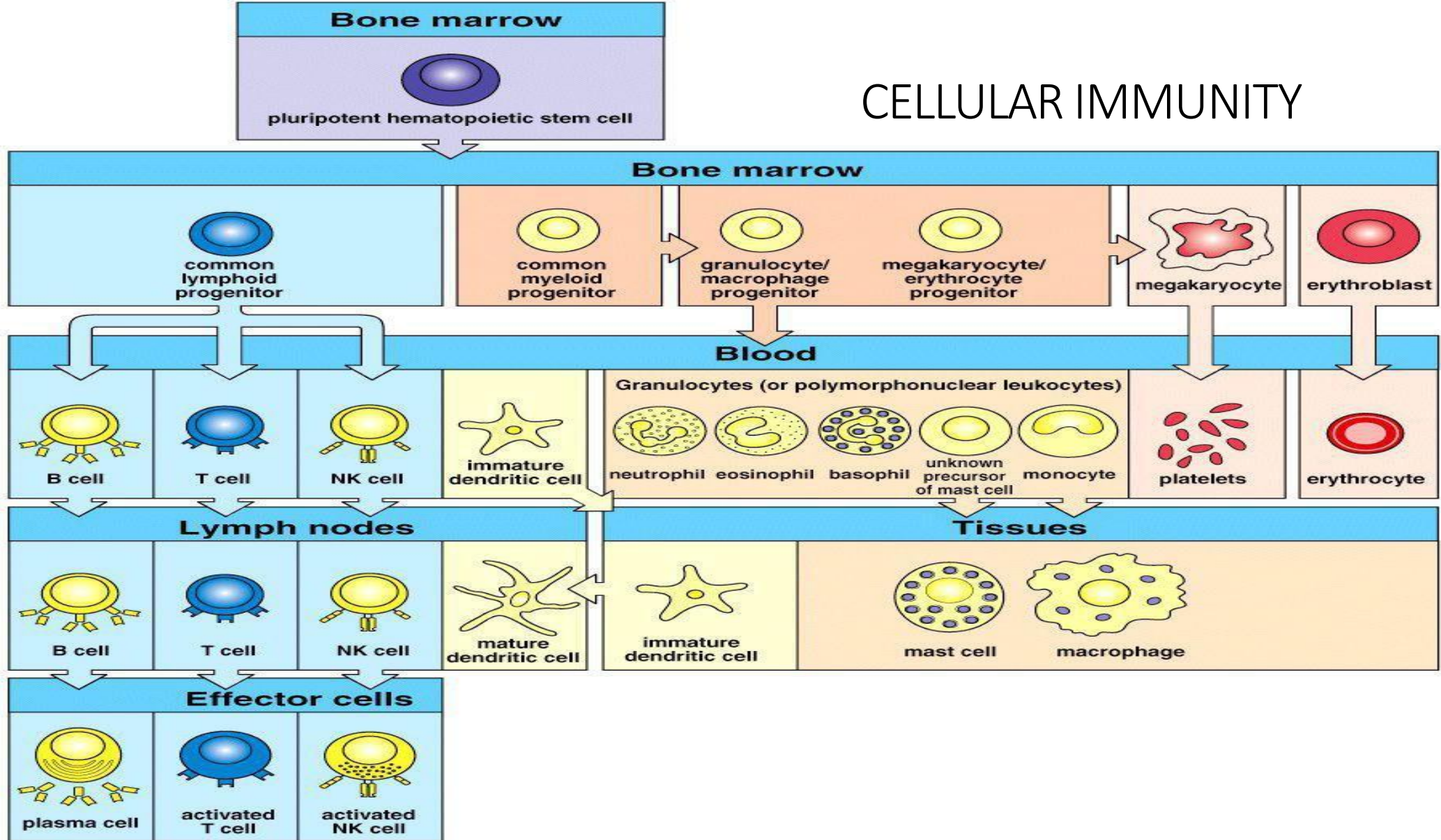


Figure 1-3 Immunobiology, 6/e. (© Garland Science 2005)

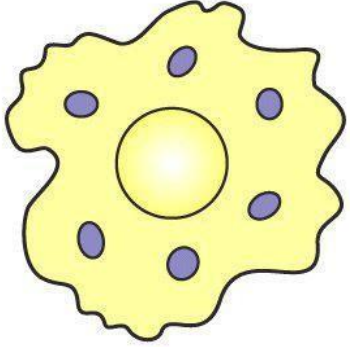
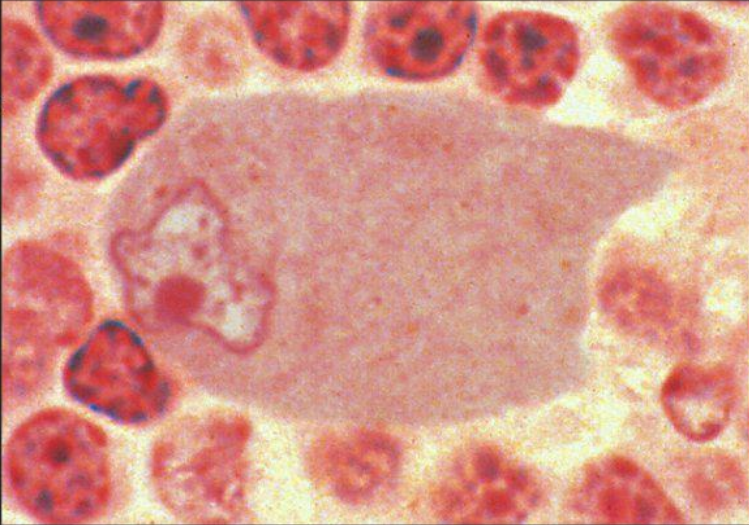
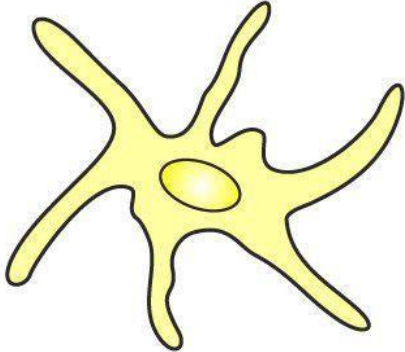

Cell		Activated function
<p><b>Macrophage</b></p> 		<p>Phagocytosis and activation of bactericidal mechanisms</p> <p>Antigen presentation</p>
<p><b>Dendritic cell</b></p> 		<p>Antigen uptake in peripheral sites</p> <p>Antigen presentation in lymph nodes</p>

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

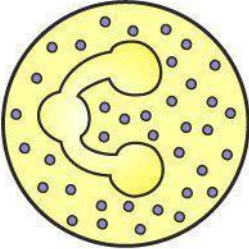
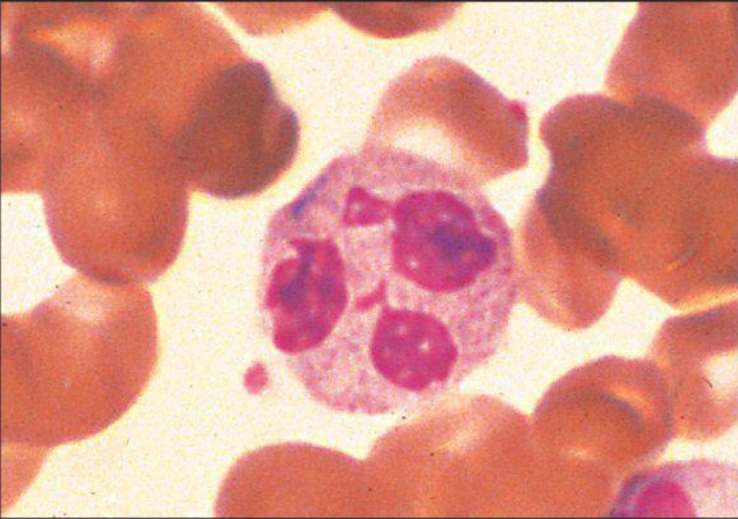
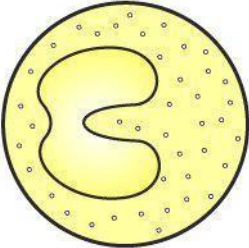
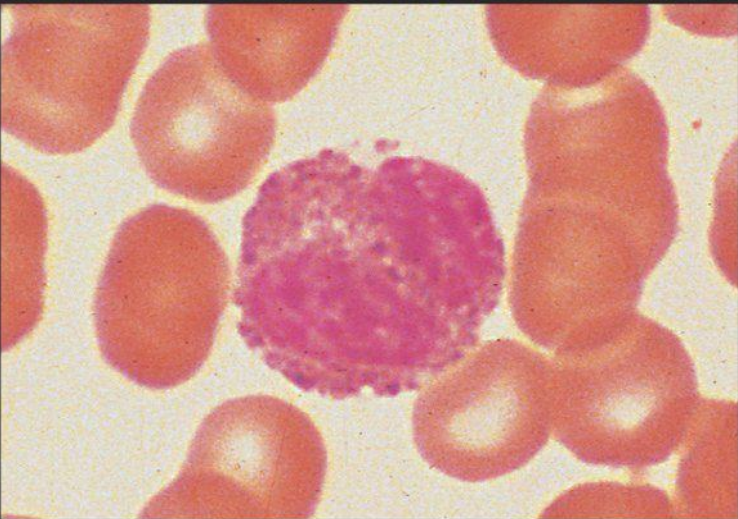
Cell		Activated function
<p><b>Neutrophil</b></p> 		<p>Phagocytosis and activation of bactericidal mechanisms</p>
<p><b>Eosinophil</b></p> 		<p>Killing of antibody-coated parasites</p>

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


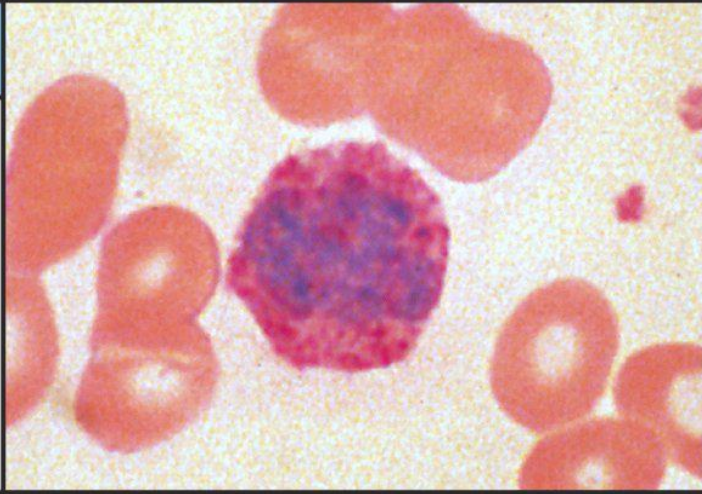
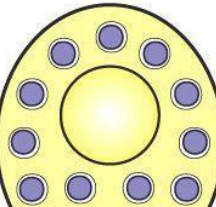
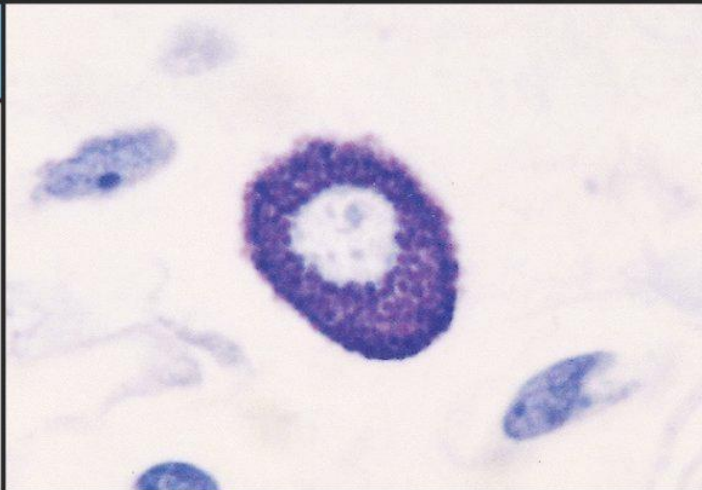
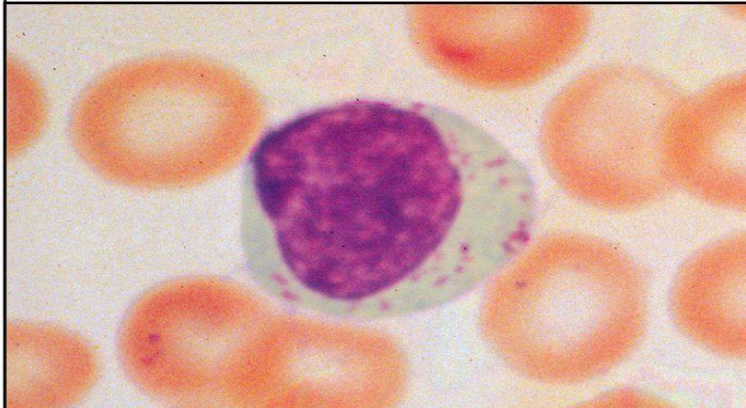
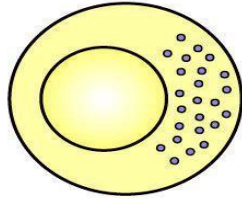
Cell	Activated function	
<p data-bbox="346 302 586 359"><b>Basophil</b></p> 		<p data-bbox="1523 491 1727 548"><b>Unknown</b></p>
<p data-bbox="346 816 586 873"><b>Mast cell</b></p> 		<p data-bbox="1523 848 1880 1219"><b>Release of granules containing histamine and other active agents</b></p>

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



## Natural killer (NK) cell



Releases lytic granules that kill some virus-infected cells

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

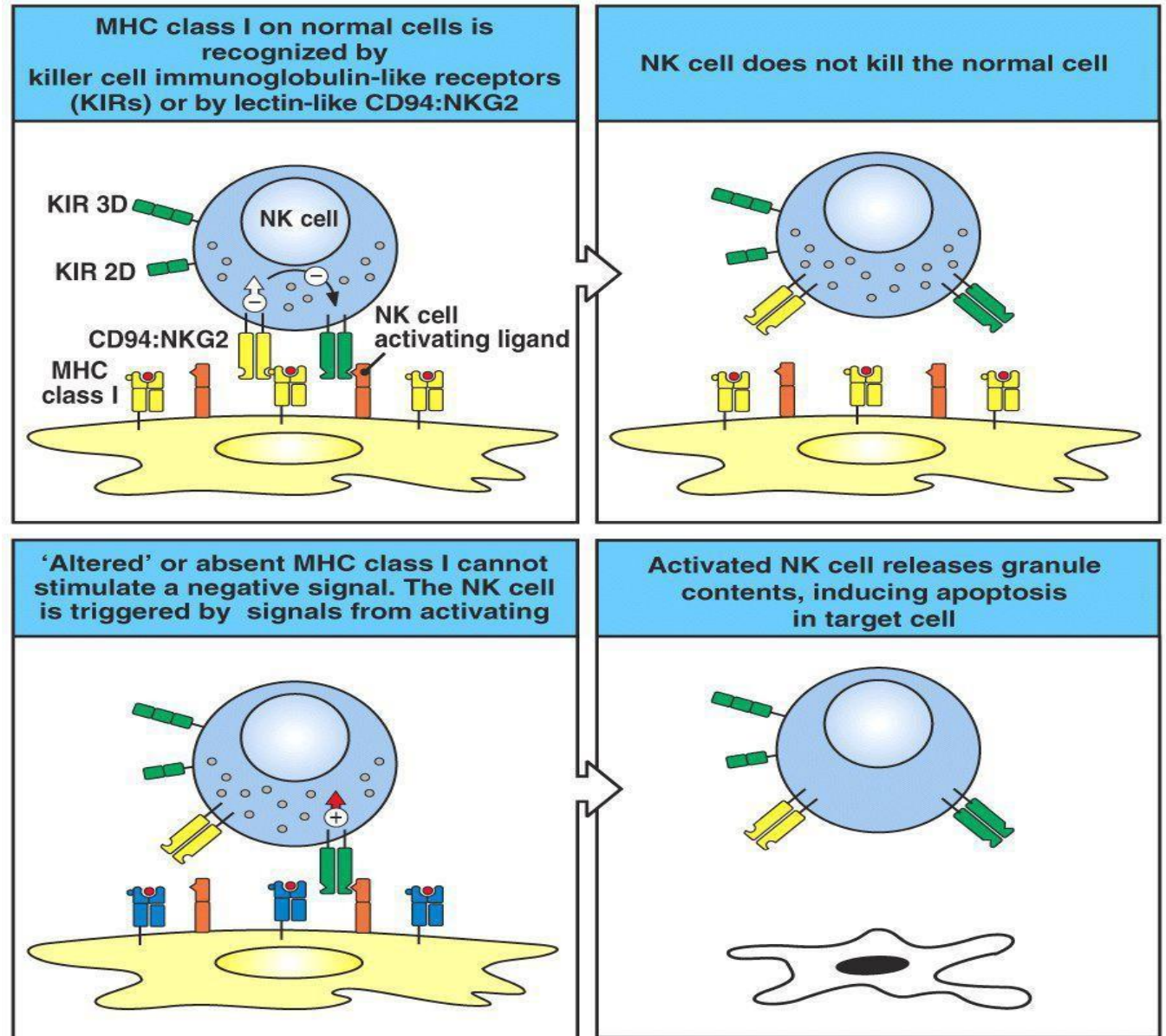
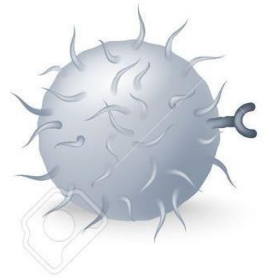
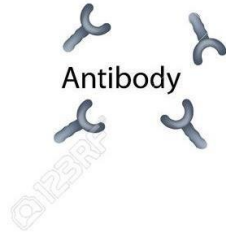


Figure 2-50 Immunobiology, 6/e. (© Garland Science 2005)

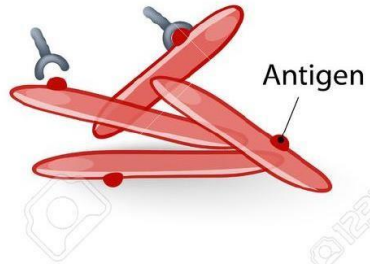
# HUMORAL IMMUNITY



Lymphocyte

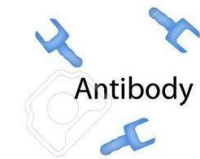
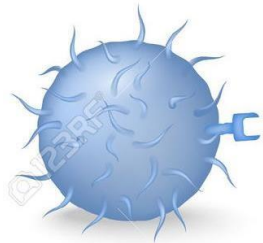


Antibody



Bacteria

Antigen

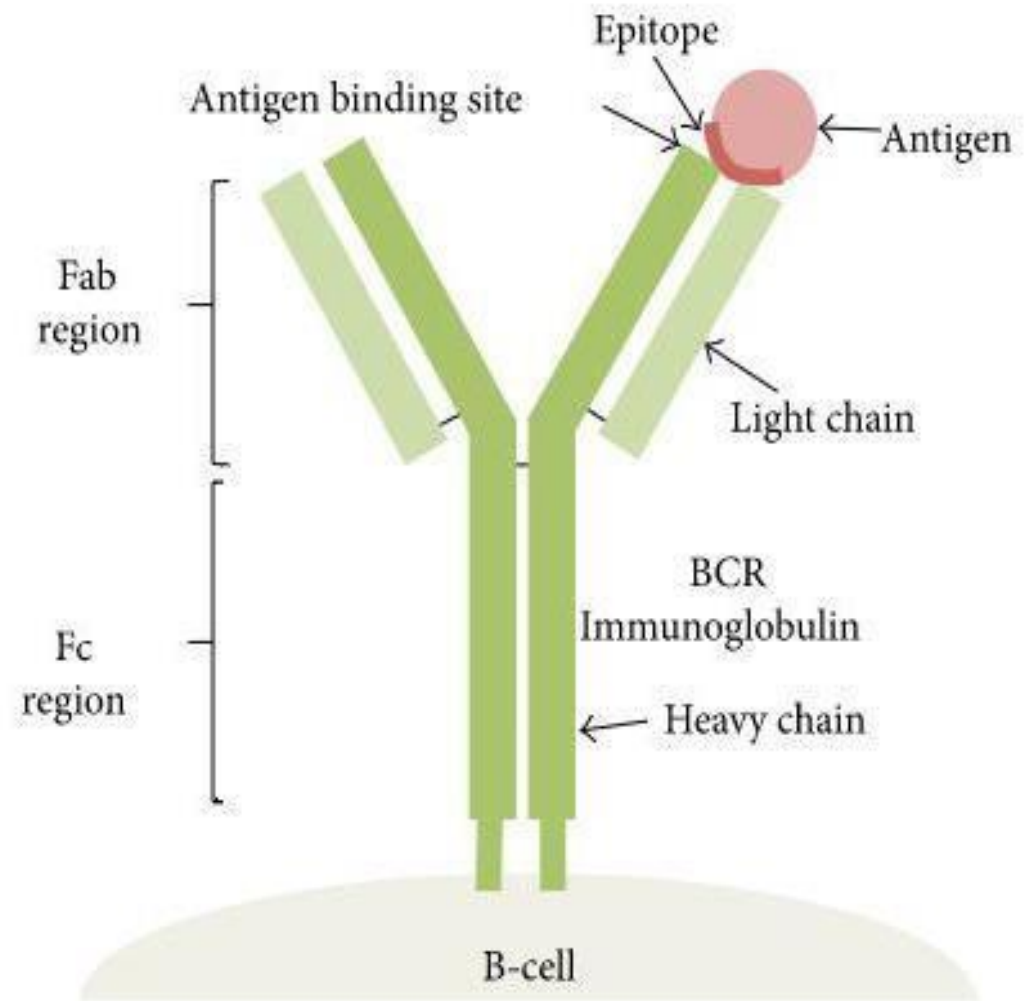


Antibody



Imunitas humoral juga disebut imunitas yang diperantarai antibodi. Dengan bantuan sel T penolong, sel B akan berdiferensiasi menjadi sel B plasma yang dapat menghasilkan antibodi terhadap antigen tertentu. Sistem imun humoral berurusan dengan antigen dari patogen yang beredar bebas, atau di luar sel yang terinfeksi.

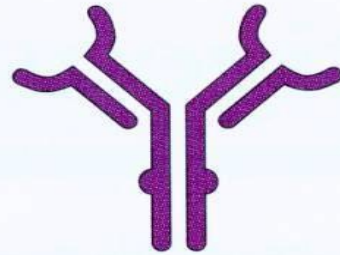
- **Imunogen:** zat yang dapat menginduksi respon imun.
- **Antibodi:** makromolekul protein yang diproduksi oleh sistem imun untuk beraksi mengikat antigen.
- **Antigen:** keseluruhan atau bagian/fragmen dari benda asing (patogen, alergen, etc) yang bersifat menginduksi respon imun.
- **Epitop:** determinan antigen yang secara langsung memiliki afinitas dengan antibodi.
- **Hapten:** molekul kecil yang bersifat antigen jika terikat pada pembawa yang lebih besar, pembawanya juga dapat bersifat imunogen.
- **Cell marker** : protein transmembran/ permukaan membran yang spesifik menjadi ciri khas jenis sel tersebut.



Fab : fragment antigen binding  
 Fc : fragment crystallizable

Antigen-Binding Molecule

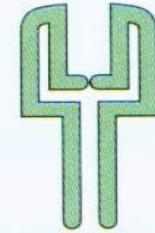
Ig



TCR



MHC molecules\*



Feature	Ig	TCR	MHC molecules*
Antigen-binding site	Made up of three CDRs in $V_H$ and three CDRs in $V_L$	Made up of three CDRs in $V_\alpha$ and three CDRs in $V_\beta$	Peptide-binding cleft made of $\alpha 1$ and $\alpha 2$ (class I) or $\alpha 1$ and $\beta 1$ (class II)
Nature of antigen that may be bound	Macromolecules (proteins, lipids, polysaccharides) and small chemicals	Peptide-MHC complexes	Peptides
Nature of antigenic determinants in macromolecules recognized	Linear and conformational	Linear; only 2 or 3 amino acid residues of a peptide bound to an MHC molecule	Linear; only some amino acid residues of a peptide
Affinity of antigen binding	$K_d$ $10^{-7}$ – $10^{-11}$ M; average affinity of Igs increases during immune response	$K_d$ $10^{-5}$ – $10^{-7}$ M	$K_d$ $10^{-6}$ M
On-rate and off-rate	Rapid on-rate, variable off-rate	Slow on-rate; slow off-rate	Slow on-rate; very slow off-rate

\* The structure and function of MHC and TCR molecules are discussed in Chapters 4 and 6, respectively.

*Abbreviations:* CDR, complementarity-determining region; Ig, immunoglobulin;  $K_d$ , dissociation constant; MHC, major histocompatibility complex; TCR, T cell receptor;  $V_H$ , variable domain of heavy chain Ig;  $V_L$ , variable domain of light chain Ig.

# FUNCTIONS OF ANTIBODY IN GENERAL

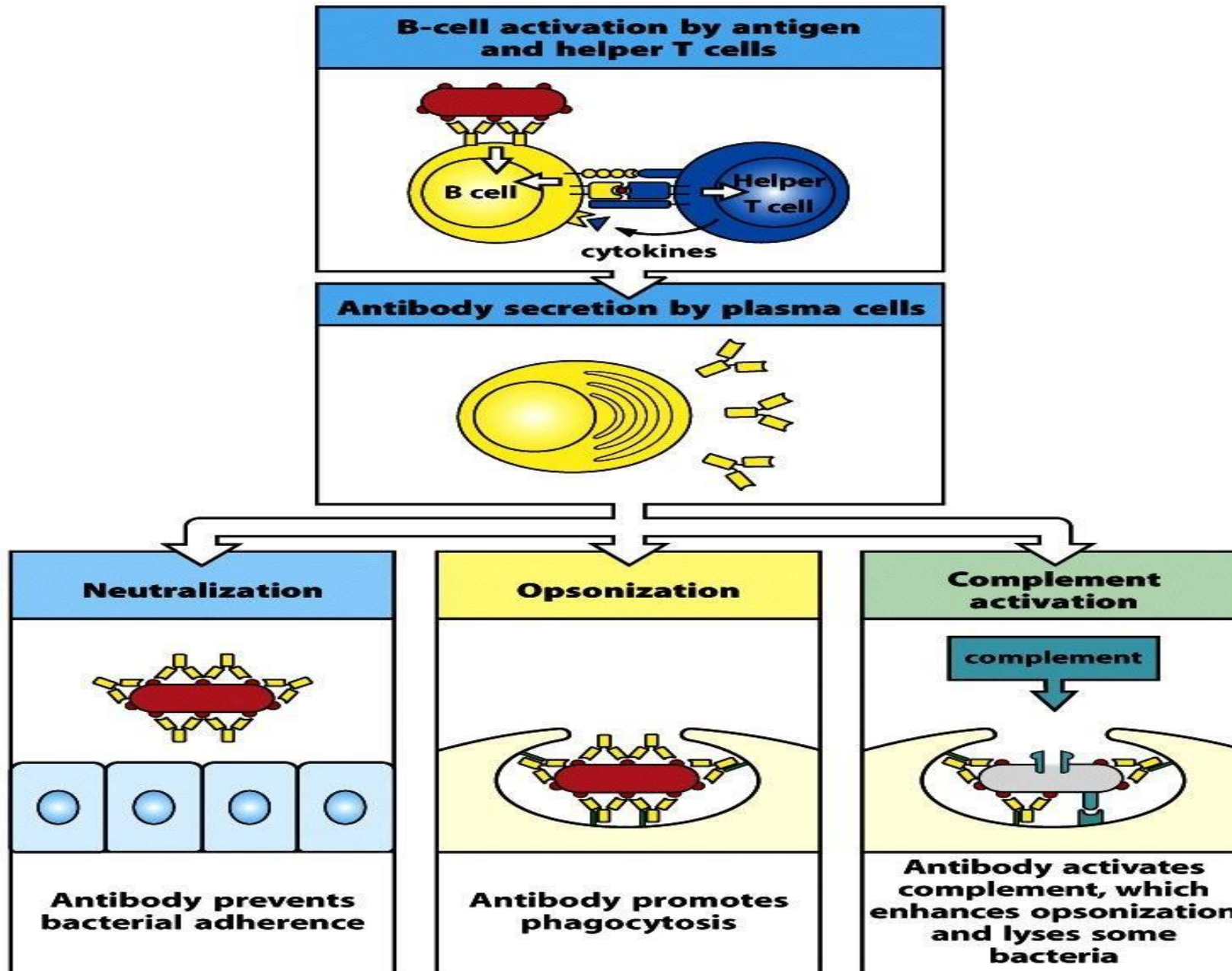
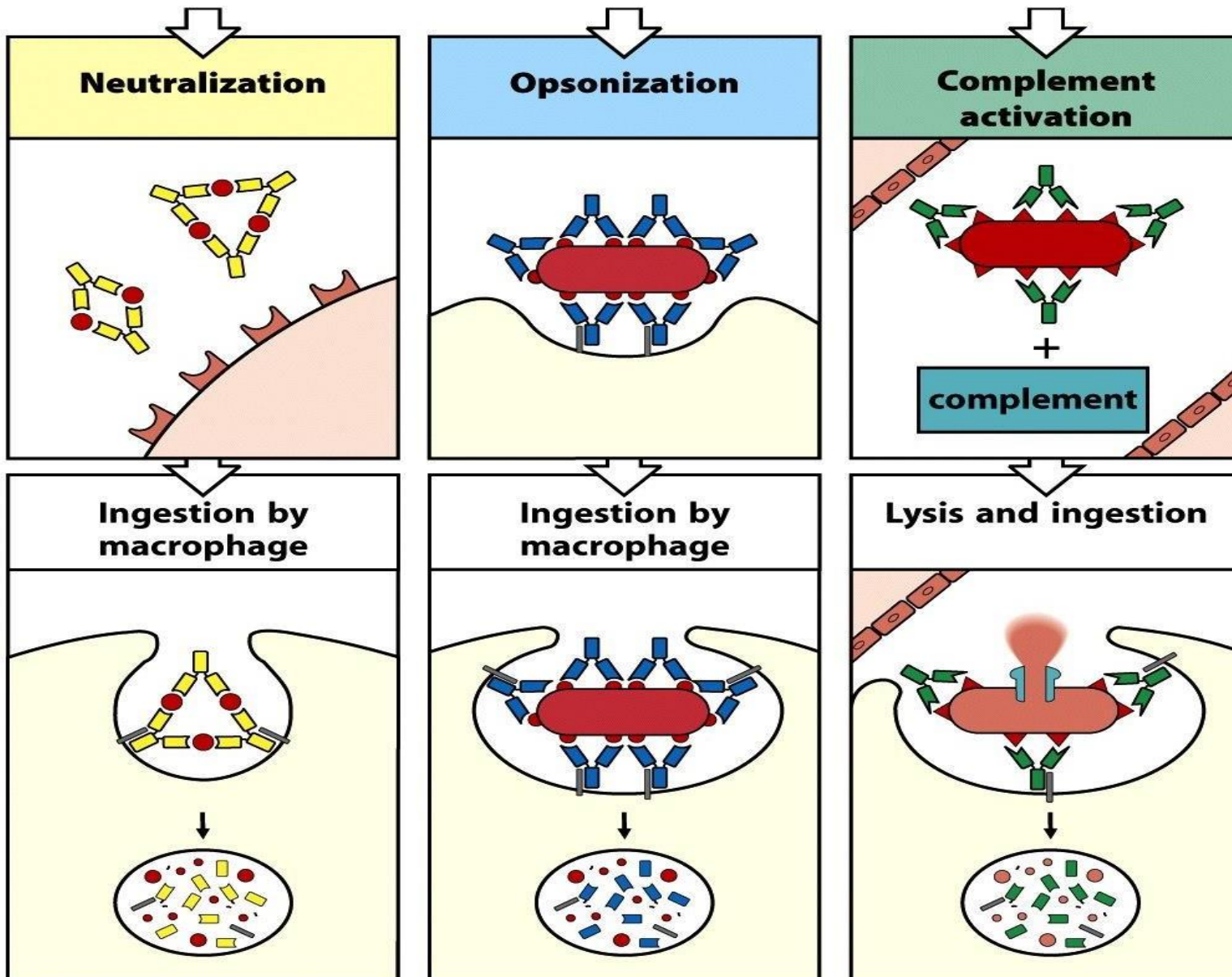


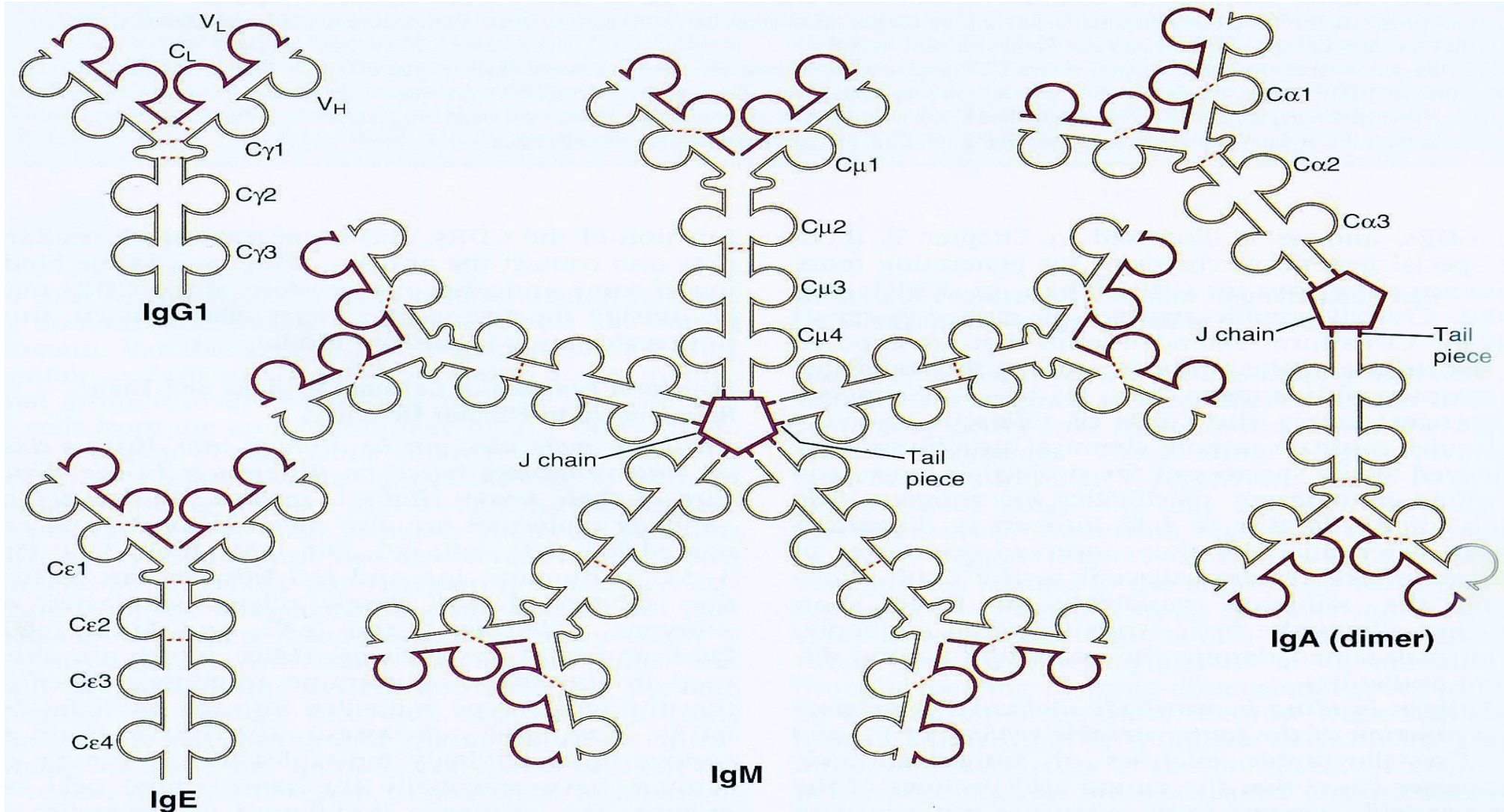
Figure 9-1 Immunobiology, 7ed. (© Garland Science 2008)



# FUNCTIONS OF ANTIBODY IN GENERAL

Figure 1-26 part 3 of 3 Immunobiology, 7ed. (© Garland Science 2008)

# IMUNOGLOBULIN



## Physicochemical properties of human immunoglobulin classes

property	immunoglobulin type									
	IgG1	IgG2	IgG3	IgG4	IgM	IgA1	IgA2	sIgA	IgD	IgE
heavy chain	$\gamma_1$	$\gamma_2$	$\gamma_3$	$\gamma_4$	$\mu$	$\alpha_1$	$\alpha_2$	$\alpha_1/\alpha_2$	$\delta$	$\epsilon$
mean serum conc. (mg/ml)	9	3	1	0.5	1.5	3.0	0.5	0.05	0.03	0.00005
sedimentation constant	7s	7s	7s	7s	19s	7s	7s	11s	7s	8s
mol. wt ( $\times 10^3$ )	146	146	170	146	970	160	160	385	184	188
half-life (days)	21	20	7	21	10	6	6	?	3	2
% intravascular distribution	45	45	45	45	80	42	42	trace	75	50
carbohydrate (%)	2-3	2-3	2-3	2-3	12	7-11	7-11	7-11	9-14	12



## Differences between Humoral and cell Mediated Immunity

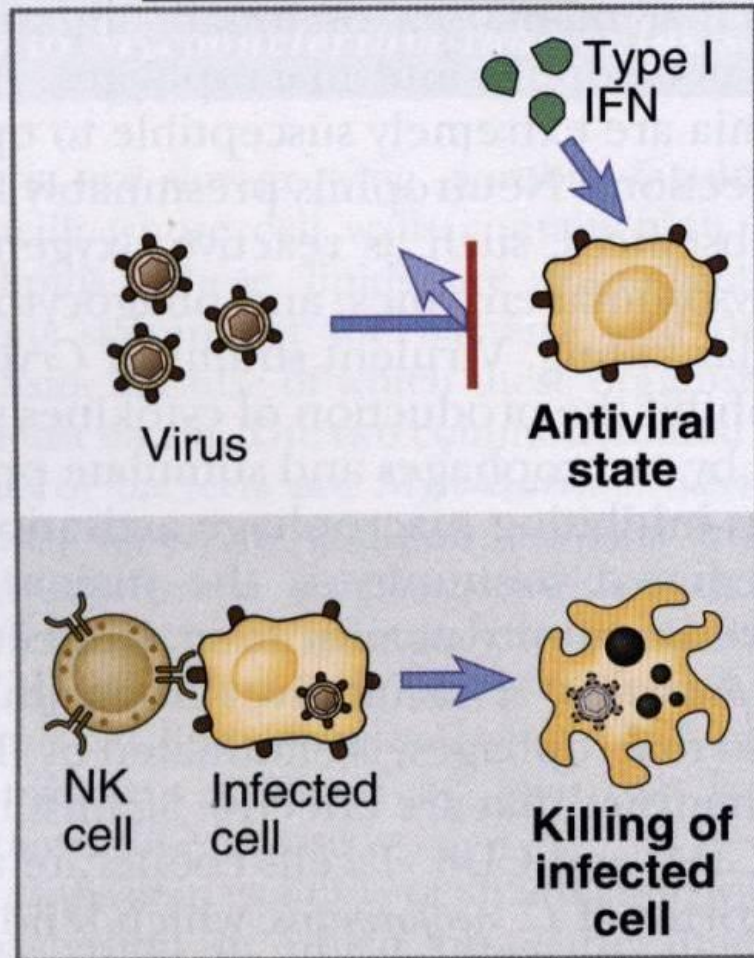
	<b>Humoral Immunity</b>	<b>Cell Mediated Immunity</b>
Main cells involved	B lymphocytes	T lymphocytes
Where do cells develop?	Produced and mature in the bone marrow	Produced in the bone marrow, mature in the thymus gland
Antibodies?	Involves production of antibodies	Does not involve production of antibodies
How are pathogens identified?	Via antigens floating in the blood	Via antigens on the surface of infected cells.
How are pathogens killed?	By antibodies	By specialised 'killer T cells'
How do cells divide once they are stimulated?	cells divide into either plasma cells or memory cells	cells divide into different types of specialist T cells

# RESPON IMUN

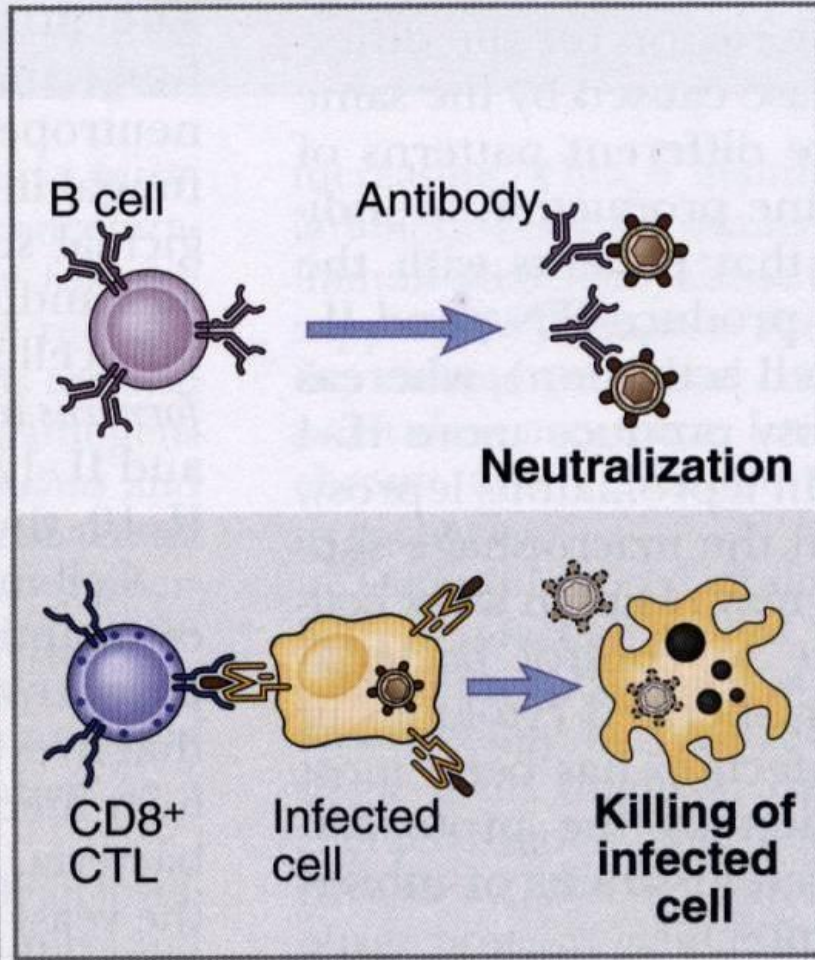
Antigen	Effect of response to antigen	
	Normal response	Deficient response
Infectious agent	Protective immunity	Recurrent infection
Innocuous substance	Allergy	No response
Grafted organ	Rejection	Acceptance
Self organ	Autoimmunity	Self tolerance
Tumor	Tumor immunity	Cancer

Figure 1-32 Immunobiology, 6/e. (© Garland Science 2005)

## Innate immunity



## Adaptive immunity



**Protection  
against  
infection**

**Eradication  
of established  
infection**

