

Johns Hopkins Engineering

Immunoengineering

Module 2/Lecture 2D

Immune Response to Pathogens: Adaptive Immune System



JOHNS HOPKINS
WHITING SCHOOL
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This is war!

Lymphatics

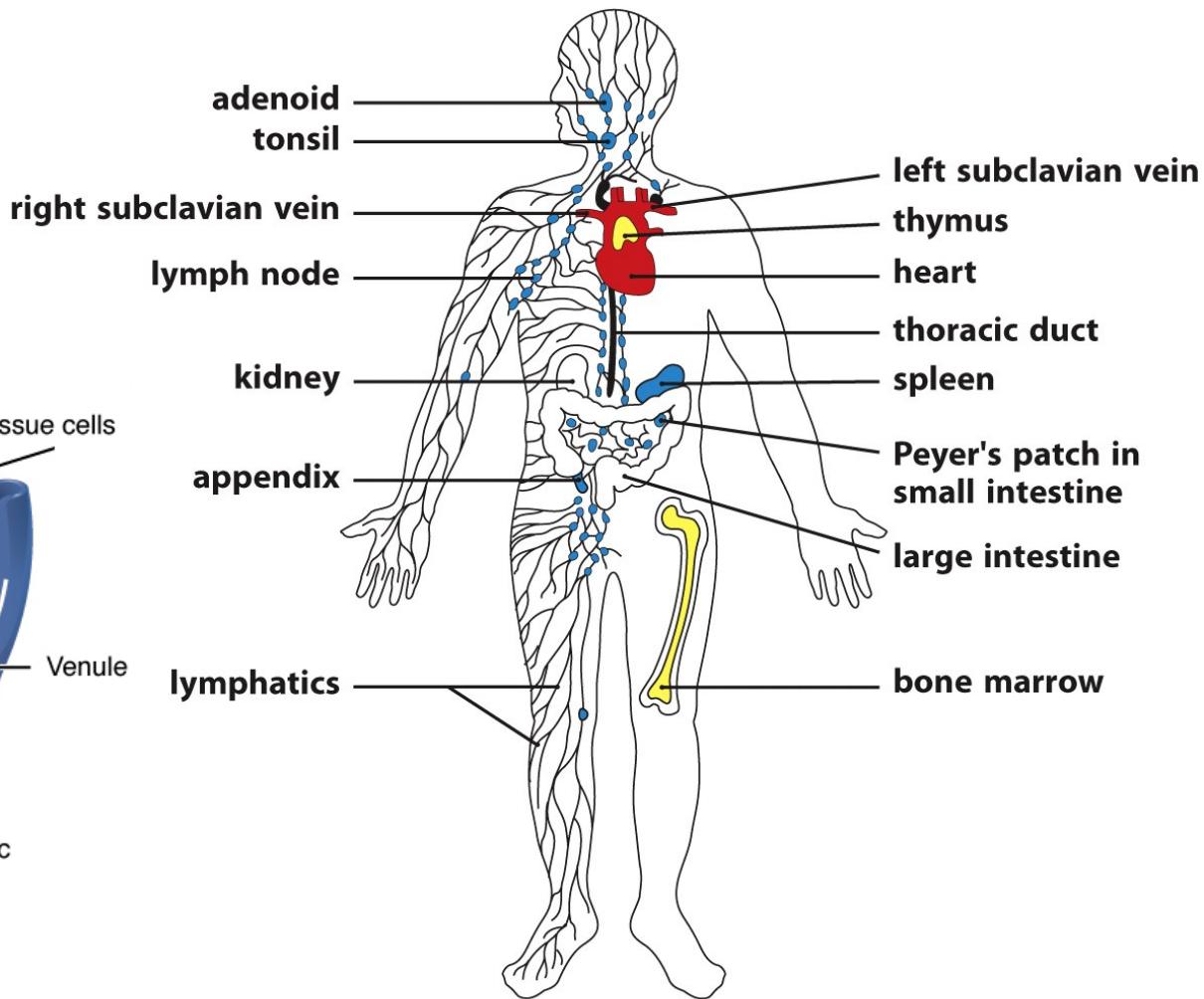
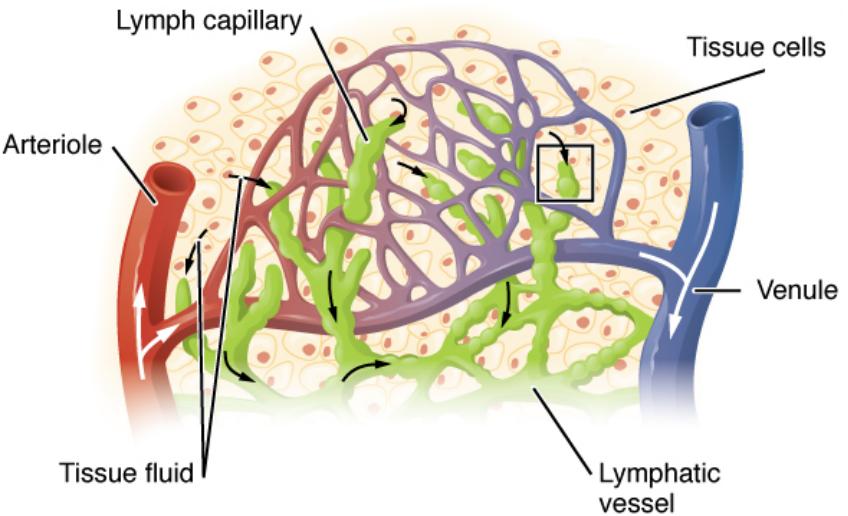


Figure 1.8 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Lymph Node – The base of the immune system

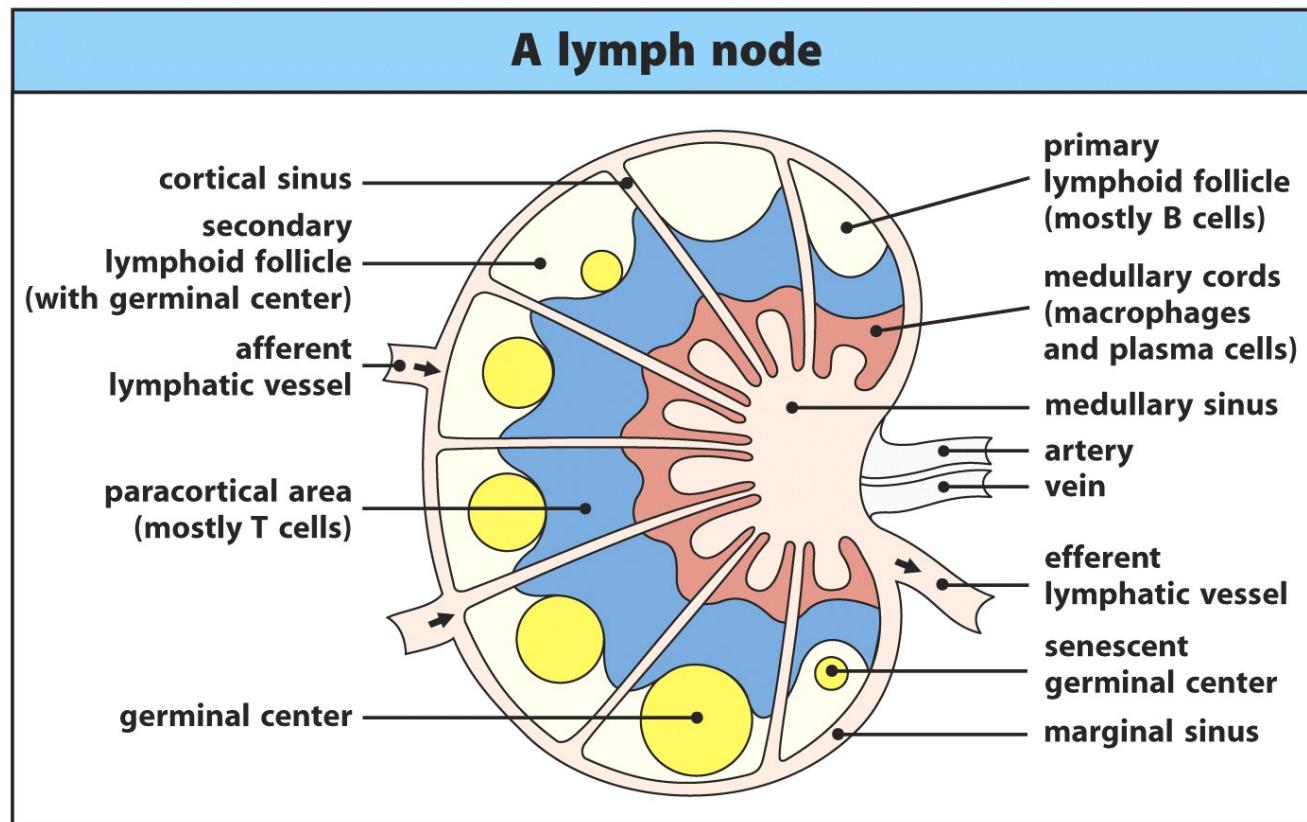


Figure 1.18 part 1 of 2 Janeway's Immunobiology, 8ed. (© Garland Science 2012)



Dendritic cells form the bridge between innate and adaptive immune responses

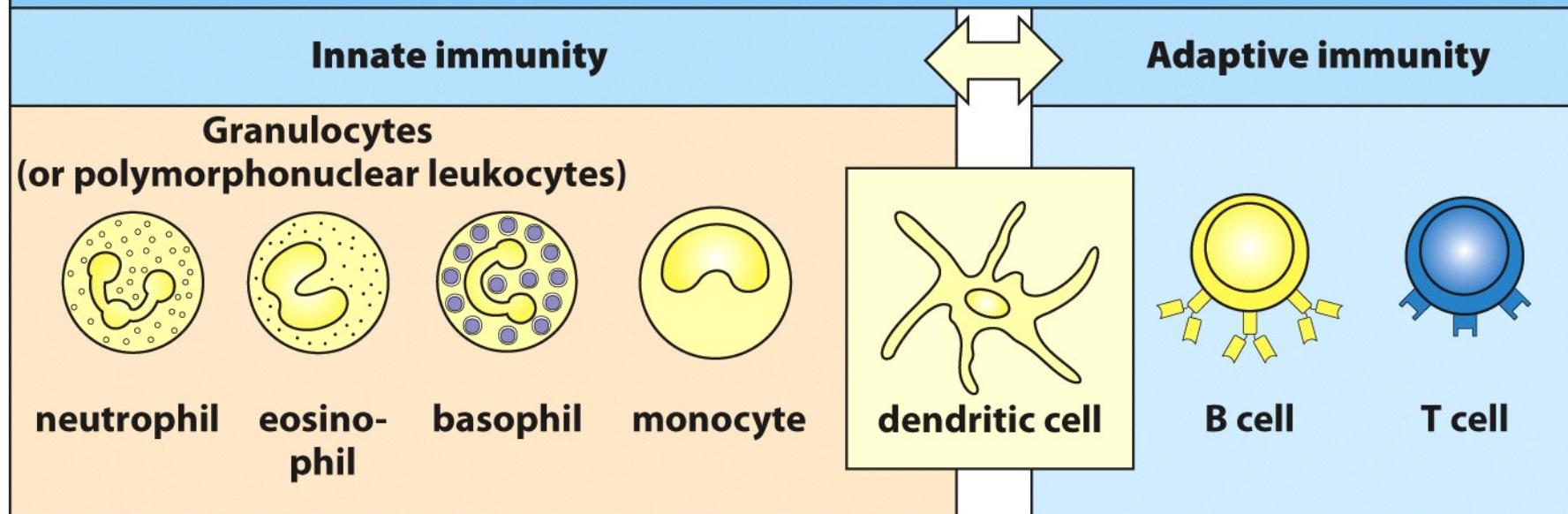


Figure 1.5 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

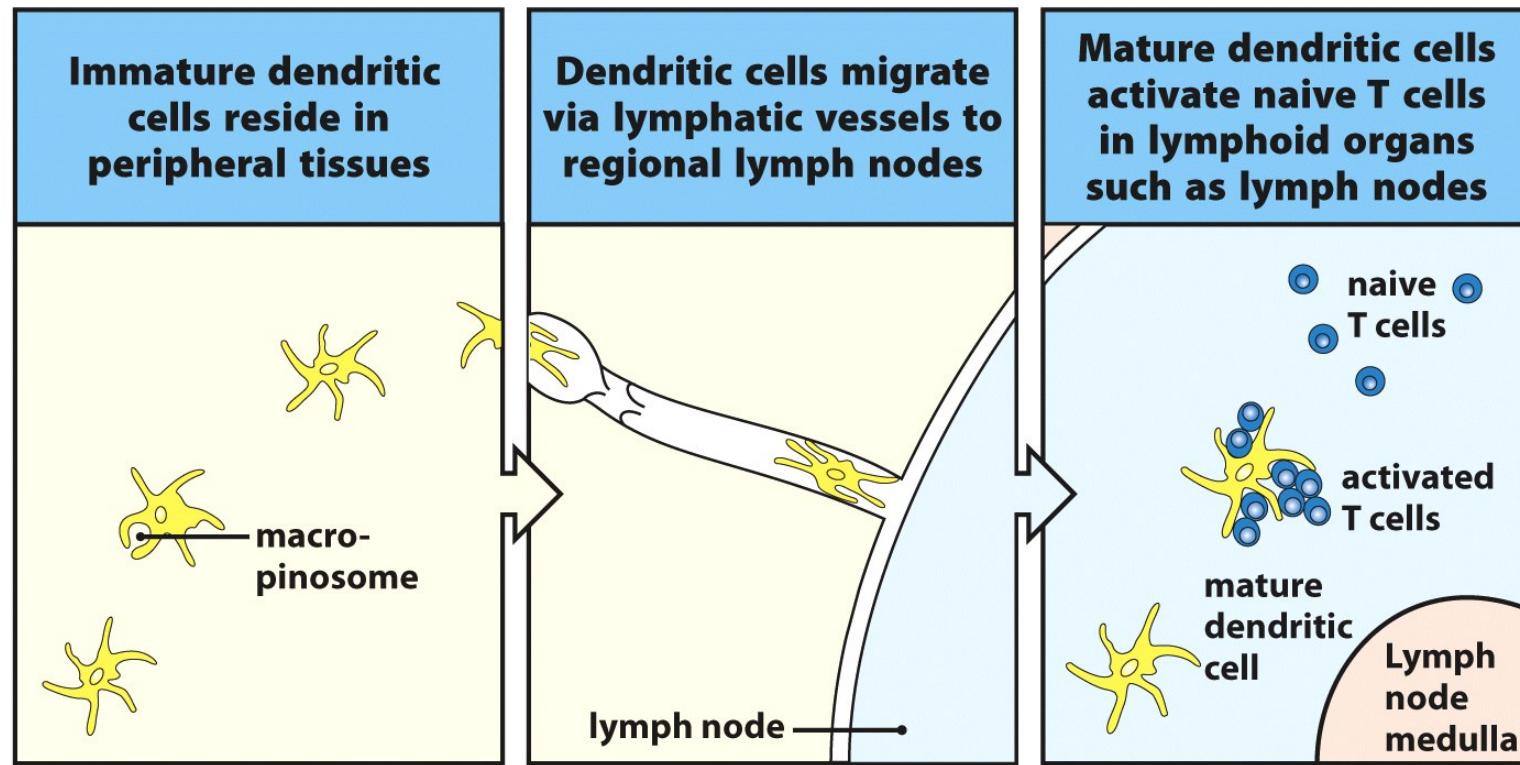


Figure 1.11 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Antigen Processing

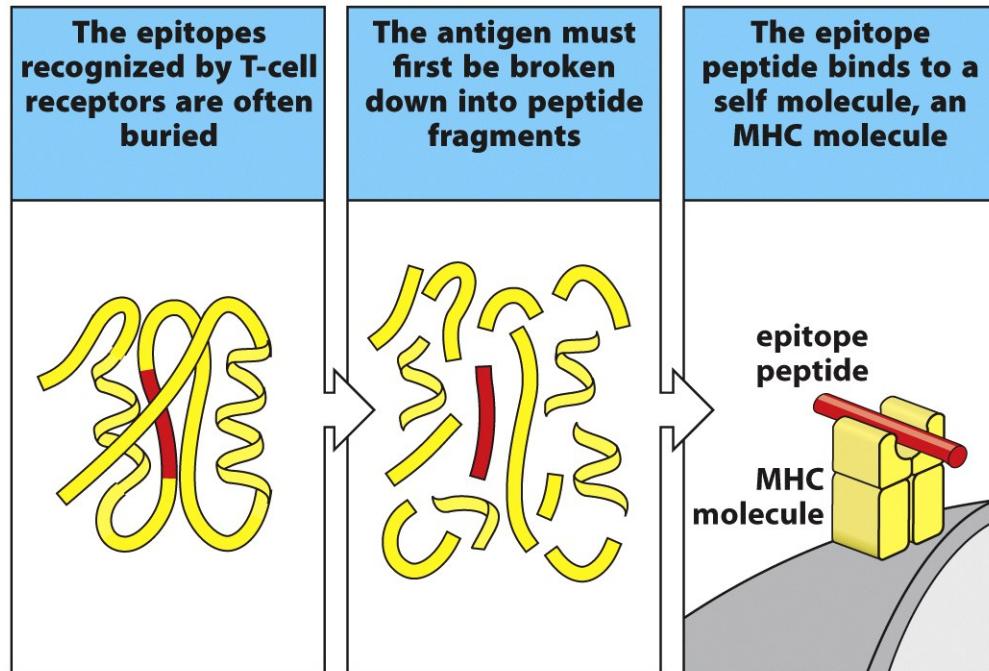


Figure 1.16 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Antigen Processing

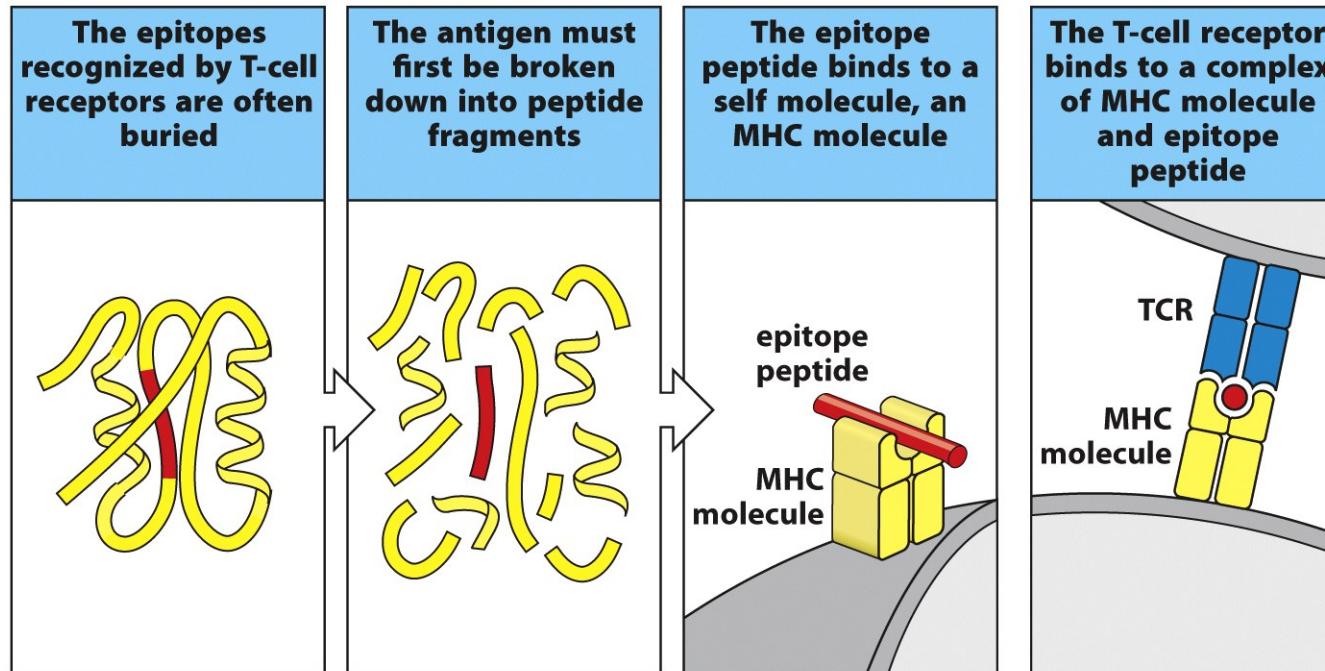
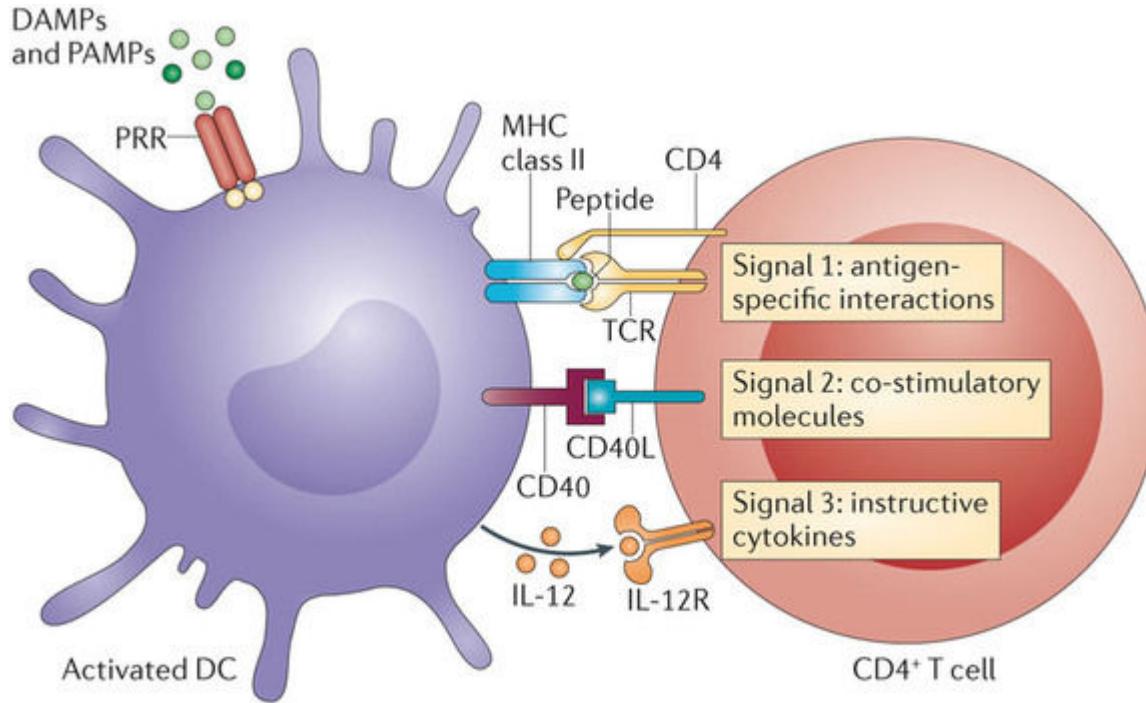


Figure 1.16 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

CD4+ T cell and APC interaction



Nature Reviews | Immunology

Kambayashi, Taku, and Terri M. Laufer. "Atypical MHC class II-expressing antigen-presenting cells: can anything replace a dendritic cell?" *Nature reviews. Immunology* 14.11 (2014): 719.

Receptor diversity

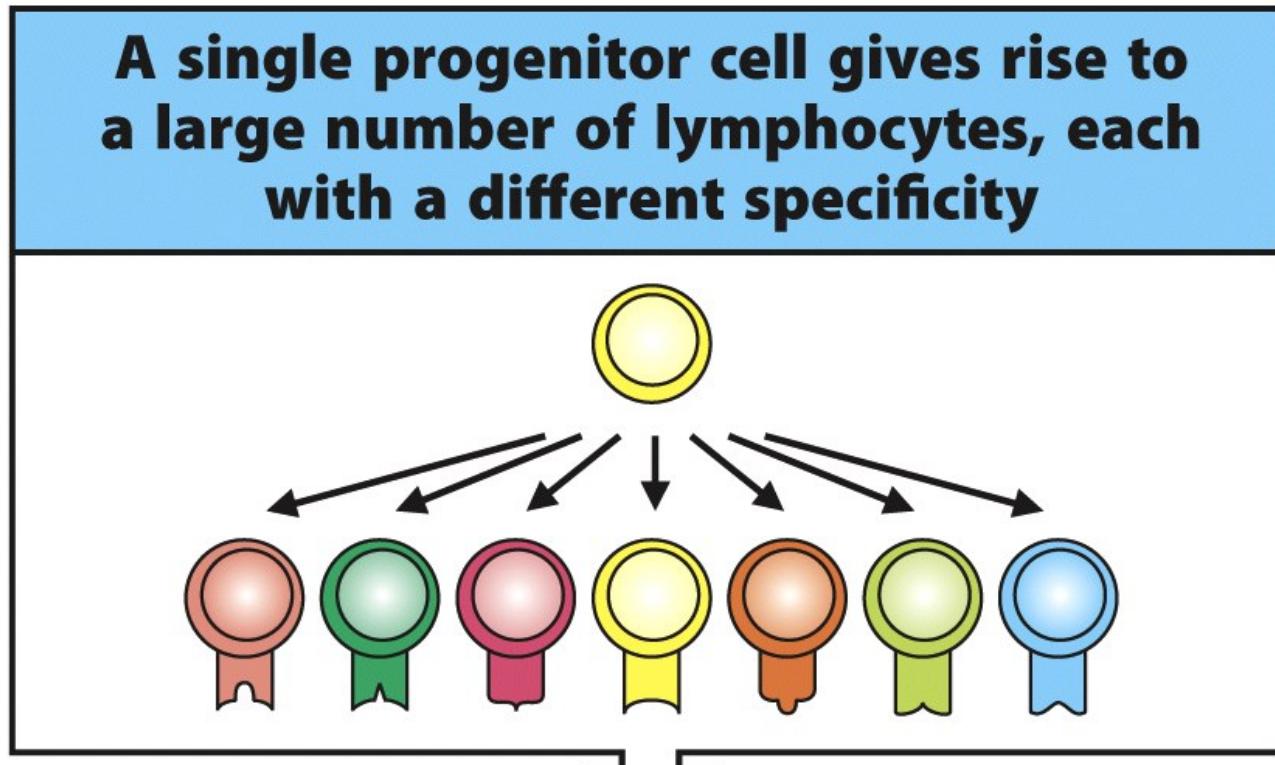
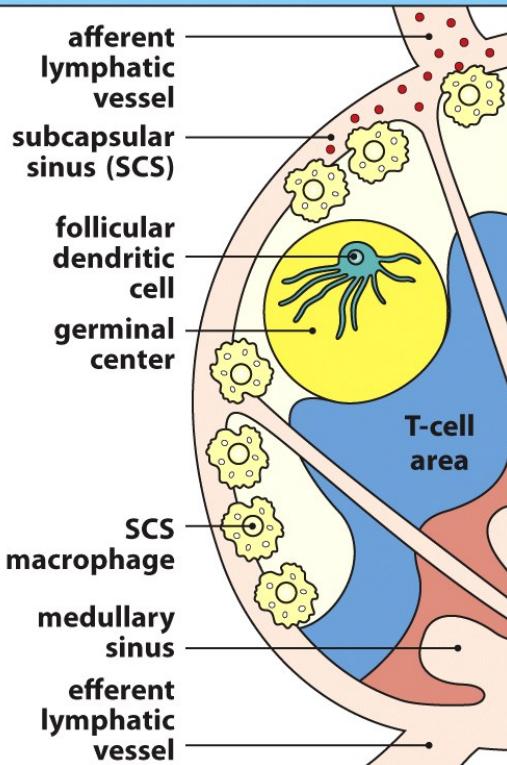
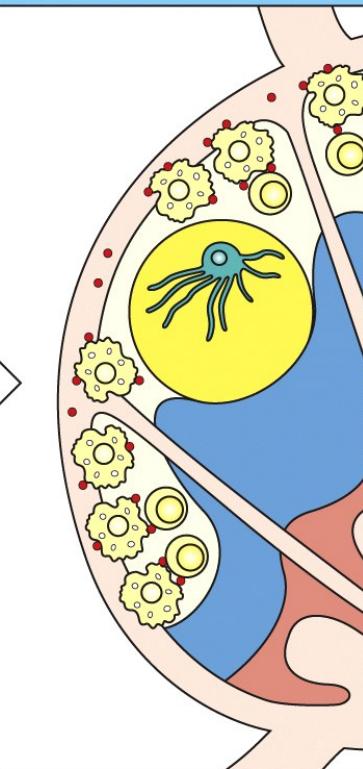


Figure 1.12 part 1 of 3 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

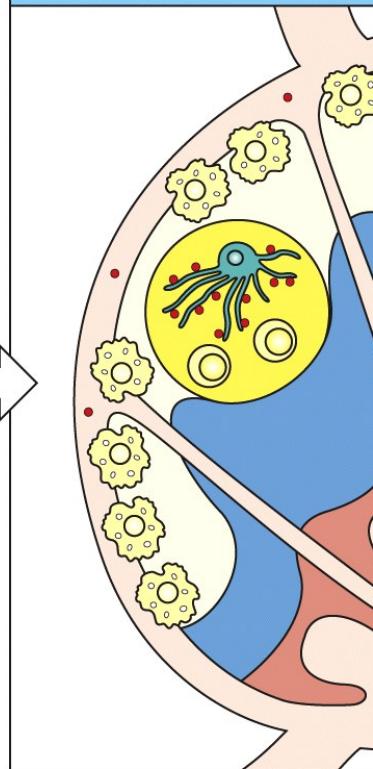
Opsonized antigens entering lymph nodes from afferent lymphatics bind to the complement receptors on the surface of macrophages present in the subcapsular sinus



The low endocytic and degradative activity of subcapsular macrophages preserves the antigens trapped on their surfaces, allowing B cells to encounter them



Antigen preservation by subcapsular macrophages also allows antigen to be transported into the follicle to become localized on the surface of follicular dendritic cells



Follicular Dendritic Cells

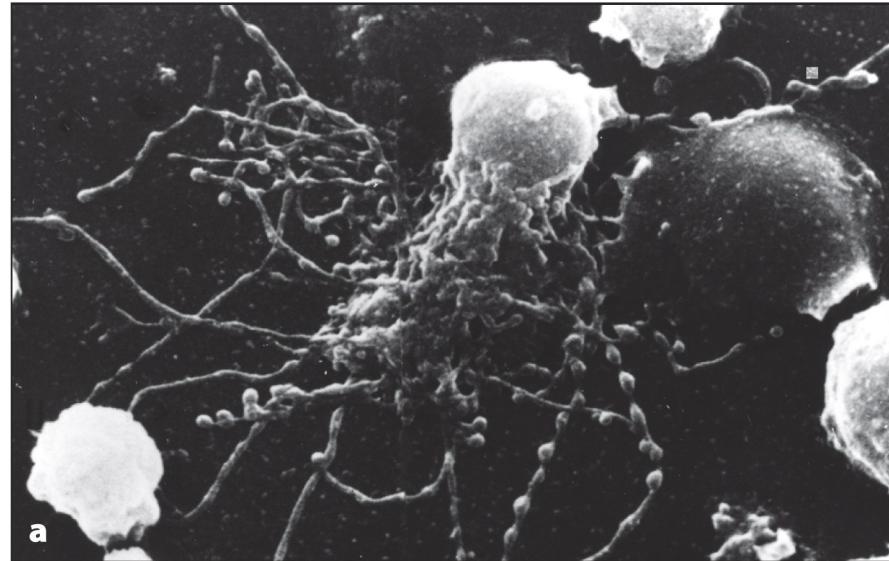


Figure 10.17a Janeway's Immunobiology, 8ed. (© Garland Science 2012)

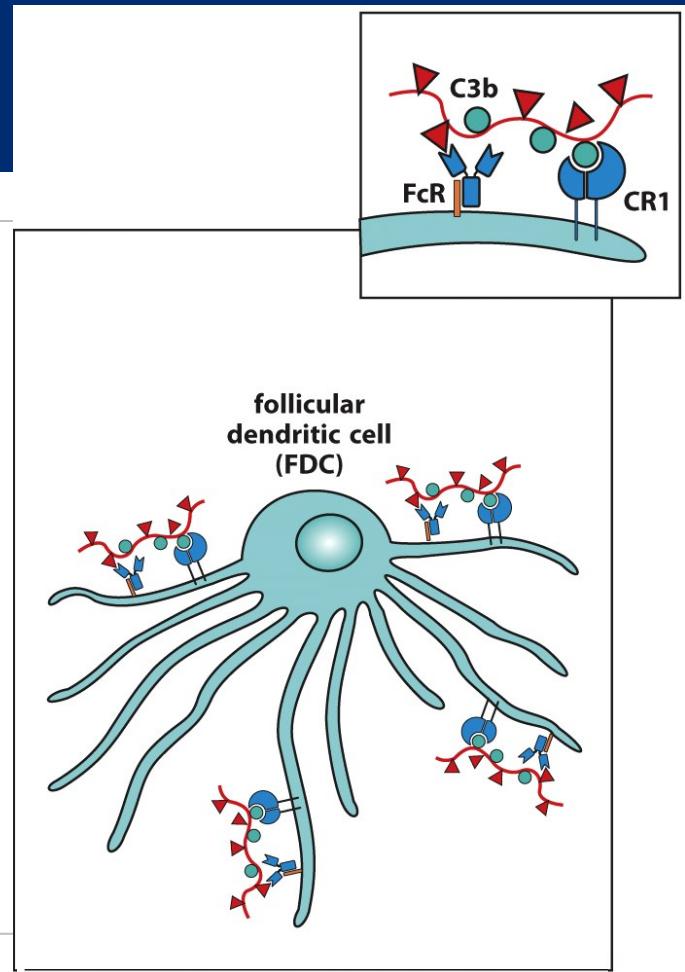


Figure 10.16 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

B cell receptor

B cell binds bacterial polysaccharide epitope linked to tetanus toxoid protein

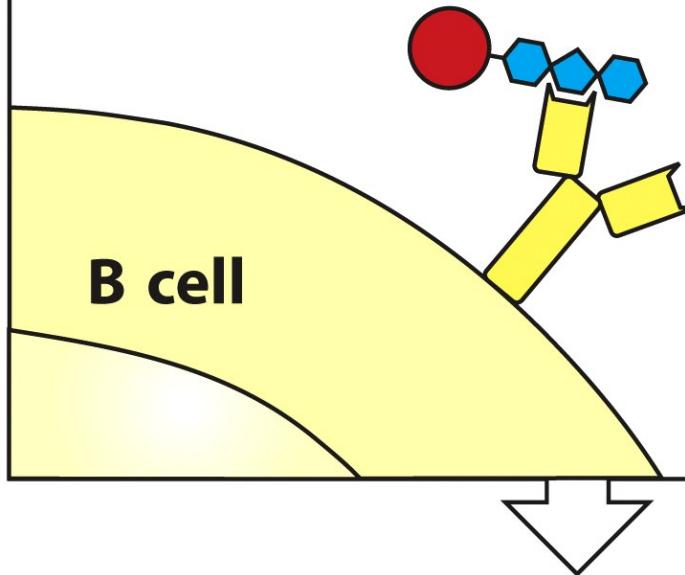
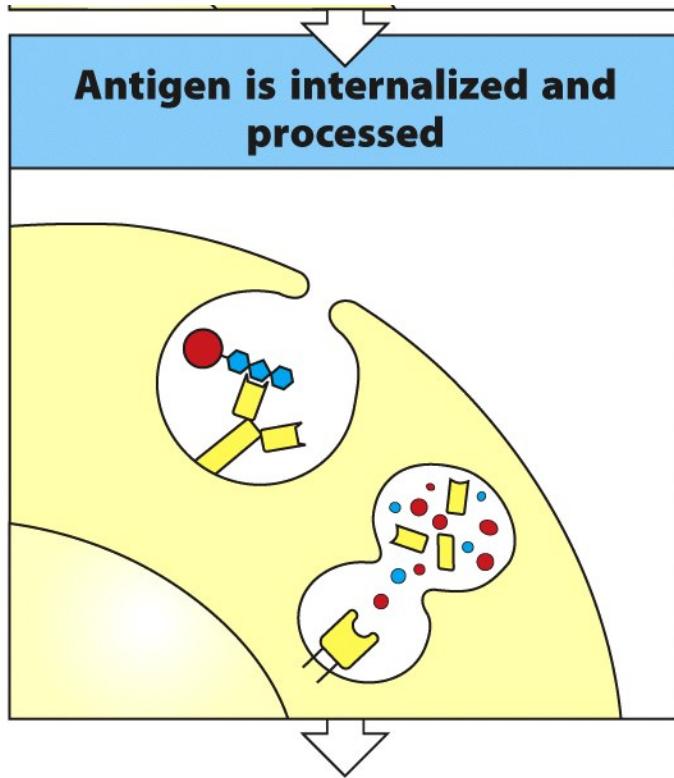


Figure 10.5 part 1 of 4 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

B cell Antigen Processing



CD4+ T cell and B cell Meeting

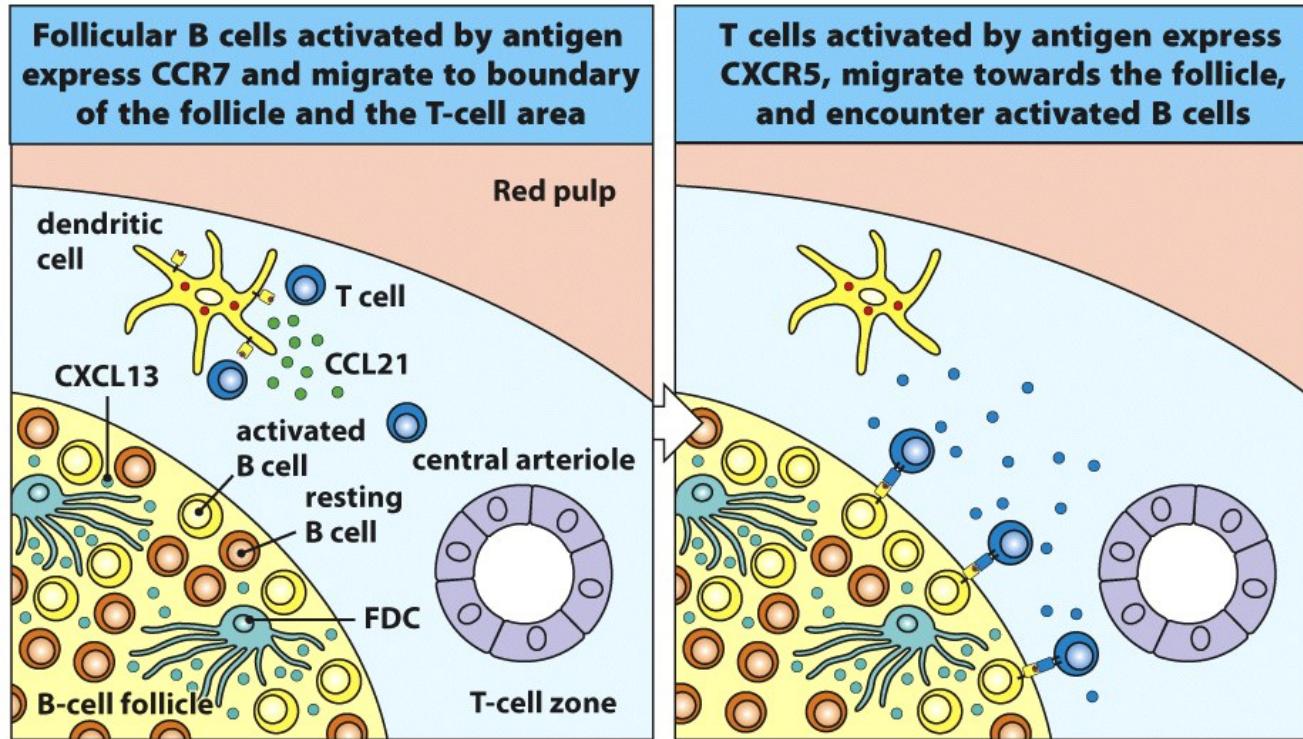
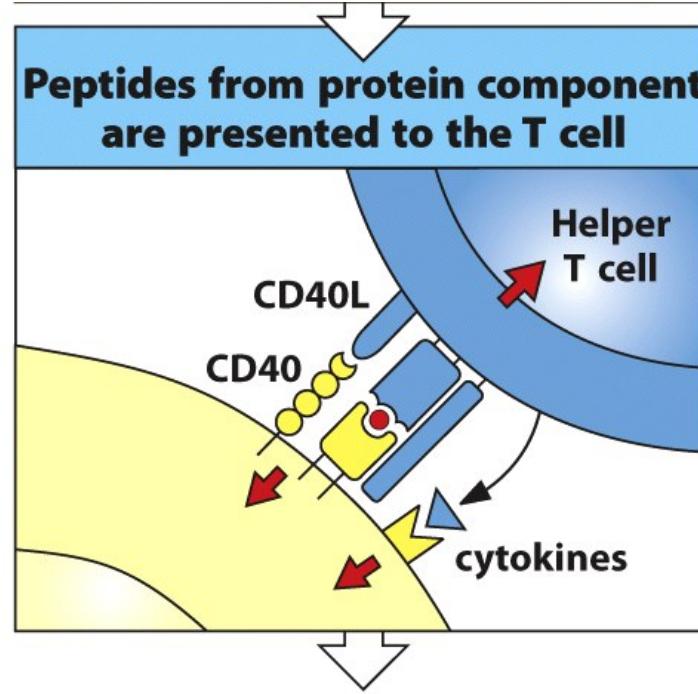
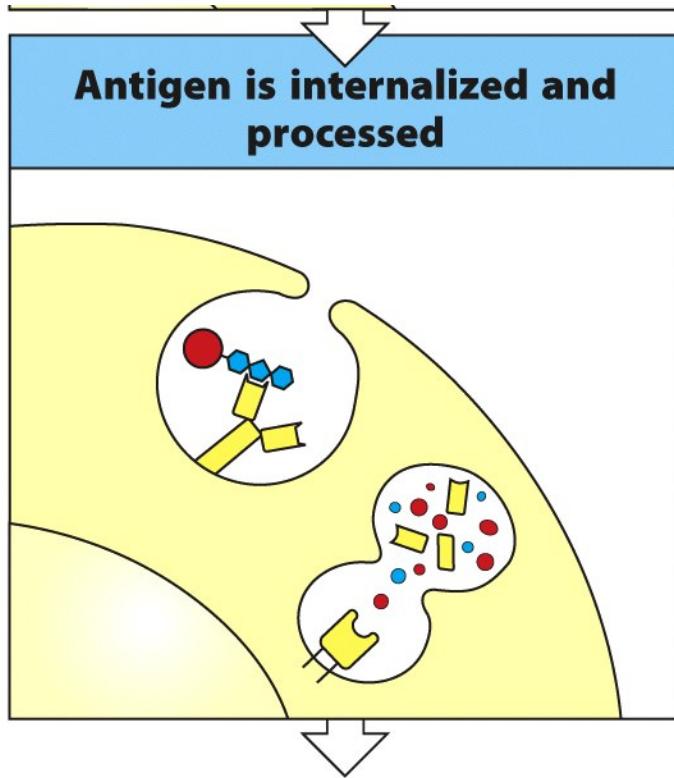


Figure 10.7 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

CD4+ T cell and B cell Interaction



Effects of B cell Activation

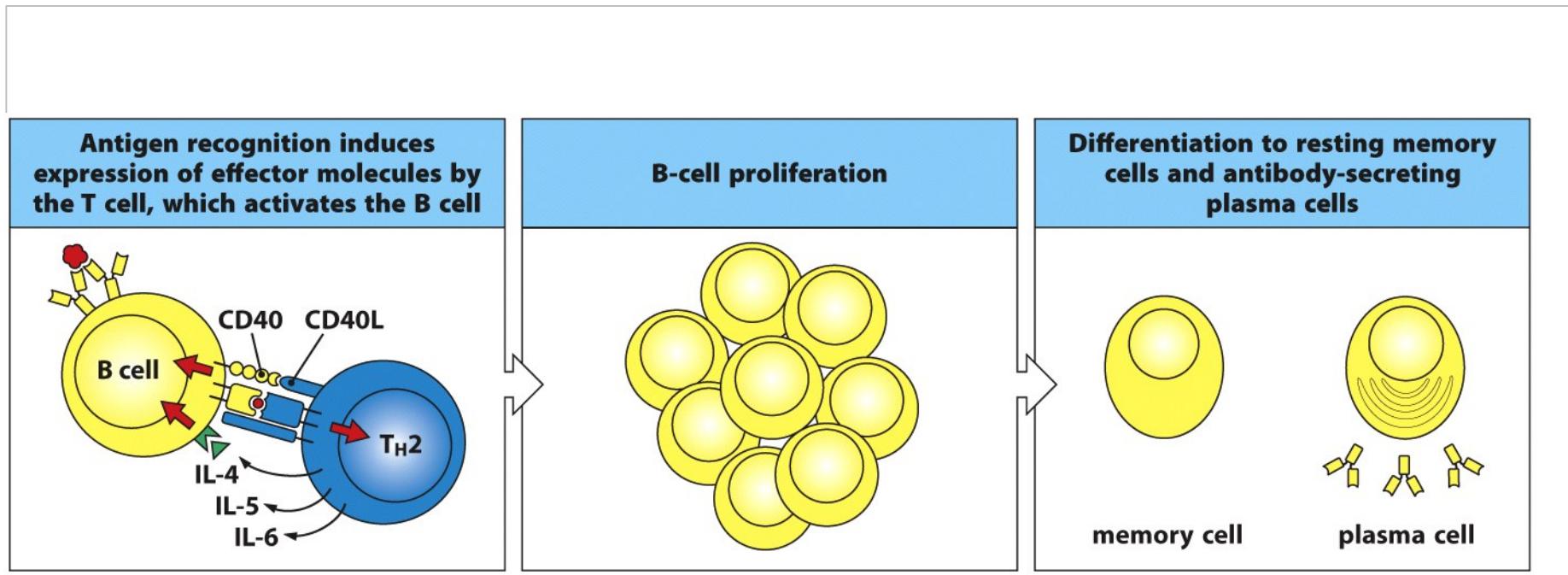


Figure 10.3 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Antibody structure

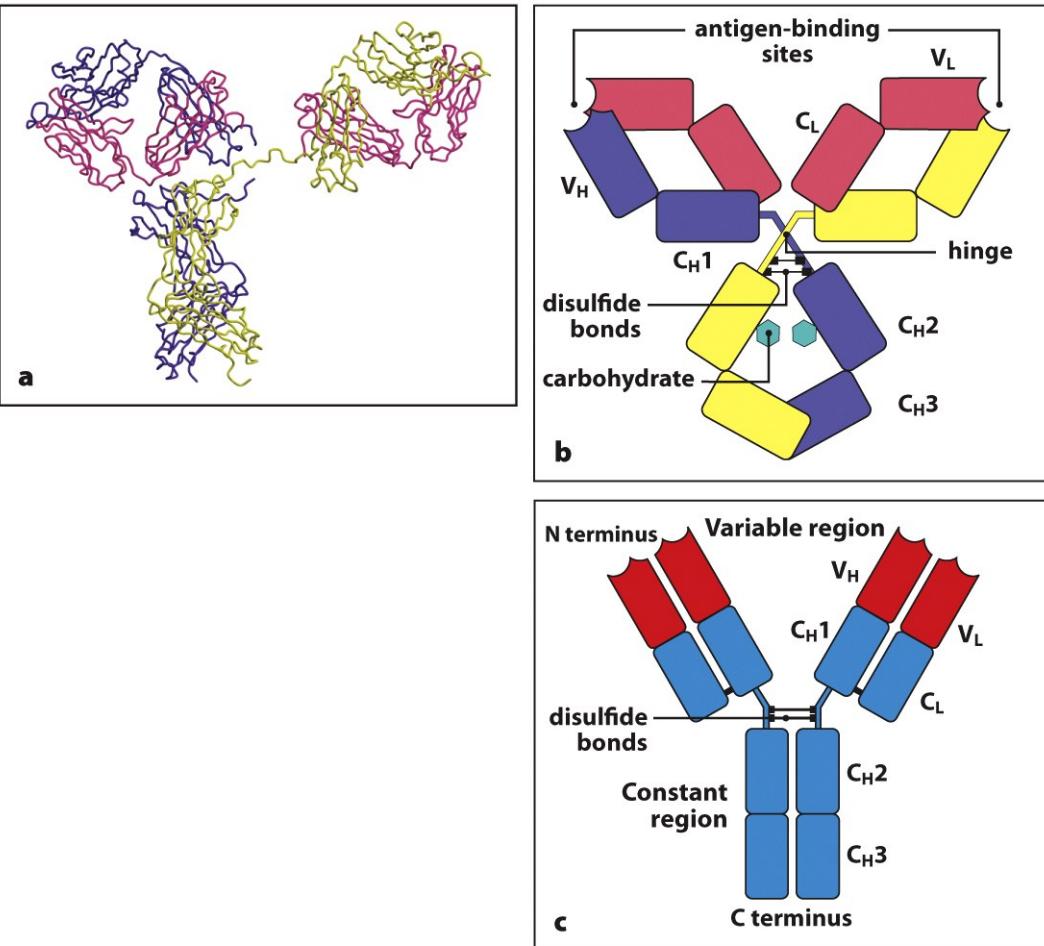
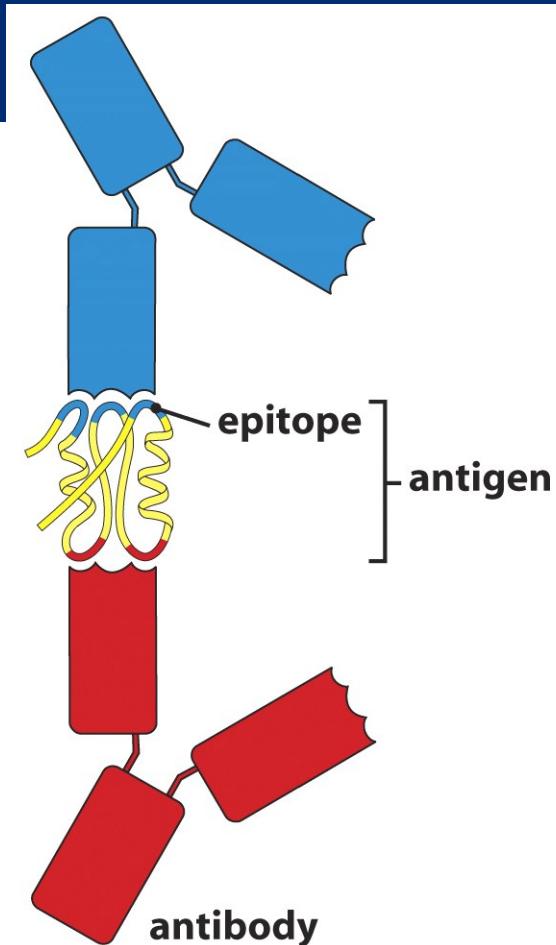


Figure 4.1 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Antibody structure



Antibody Mechanism of Action

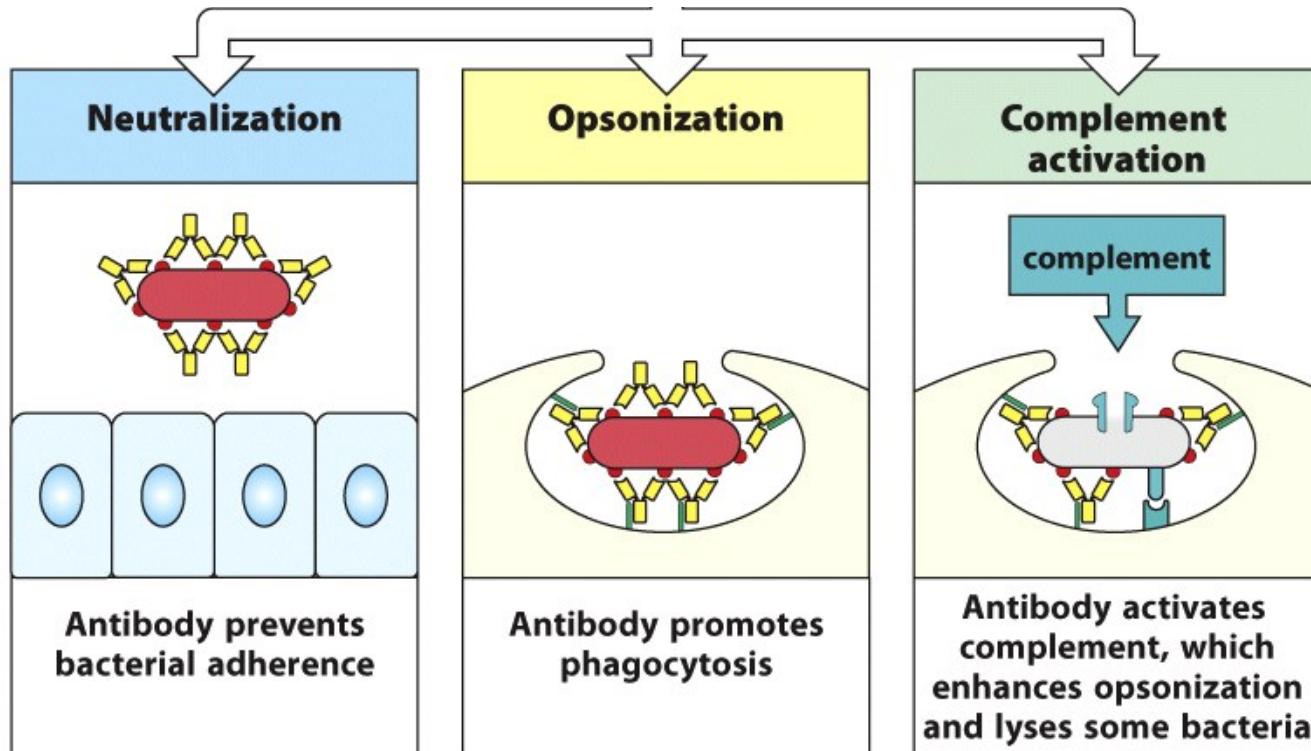


Figure 10.1 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Different types of antibodies

	Immunoglobulin								
	IgG1	IgG2	IgG3	IgG4	IgM	IgA1	IgA2	IgD	IgE
Heavy chain	γ_1	γ_2	γ_3	γ_4	μ	α_1	α_2	δ	ϵ
Molecular weight (kDa)	146	146	165	146	970	160	160	184	188
Serum level (mean adult mg/ml)	9	3	1	0.5	1.5	3.0	0.5	0.03	5×10^{-5}
Half-life in serum (days)	21	20	7	21	10	6	6	3	2
Classical pathway of complement activation	++	+	+++	-	++++	-	-	-	-
Alternative pathway of complement activation	-	-	-	-	-	+	-	-	-
Placental transfer	+++	+	++	-+	-	-	-	-	-
Binding to macrophage and phagocyte Fc receptors	+	-	+	-+	-	+	+	-	+
High-affinity binding to mast cells and basophils	-	-	-	-	-	-	-	-	+++
Reactivity with staphylococcal Protein A	+	+	-+	+	-	-	-	-	-

Figure 5.15 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

Activation of B cells

B-lineage cell	Intrinsic properties			Inducible by antigen stimulation		
	Surface Ig	Surface MHC class II	High-rate Ig secretion	Growth	Somatic hyper-mutation	Class switch
Resting B cell 	High	Yes	No	Yes	Yes	Yes
Plasmablast 	High	Yes	Yes	Yes	Unknown	Yes
Plasma cell 	Low	No	Yes	No	No	No

Figure 10.9 Janeway's Immunobiology, 8ed. (© Garland Science 2012)



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