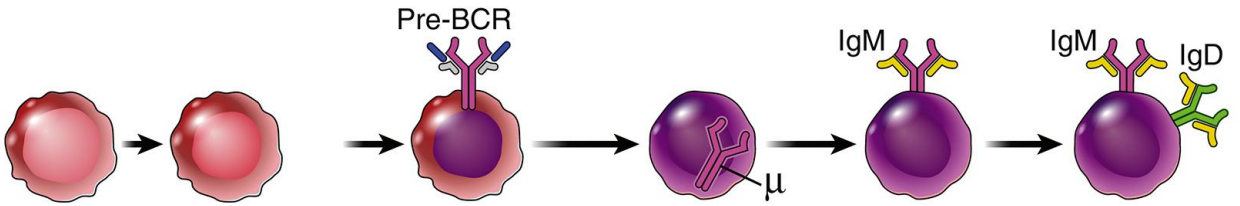
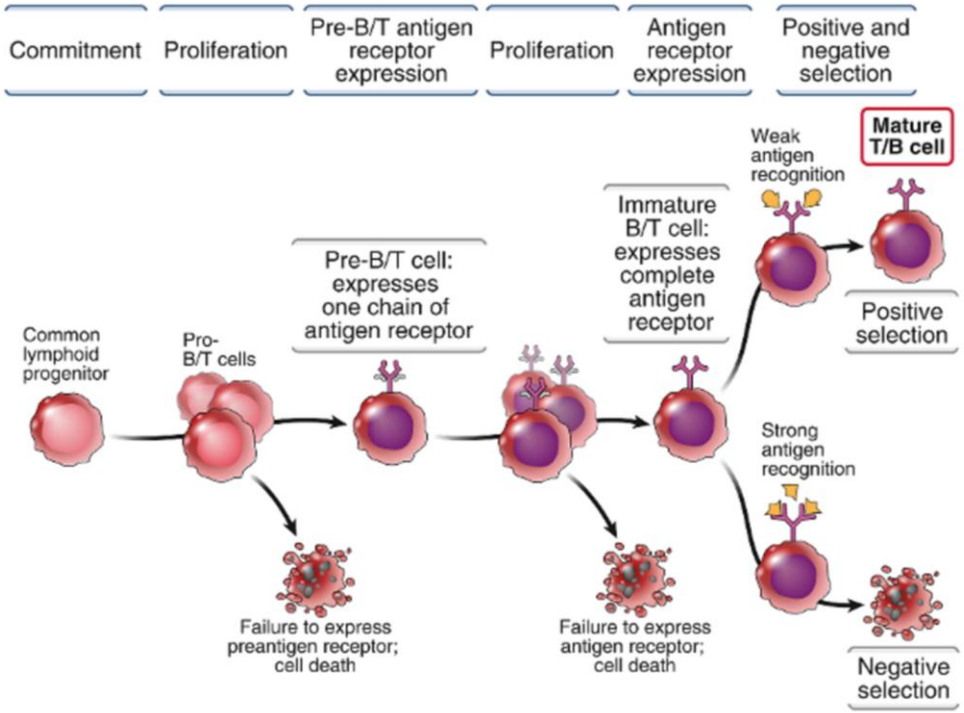
Seminar #5

Chapter #7

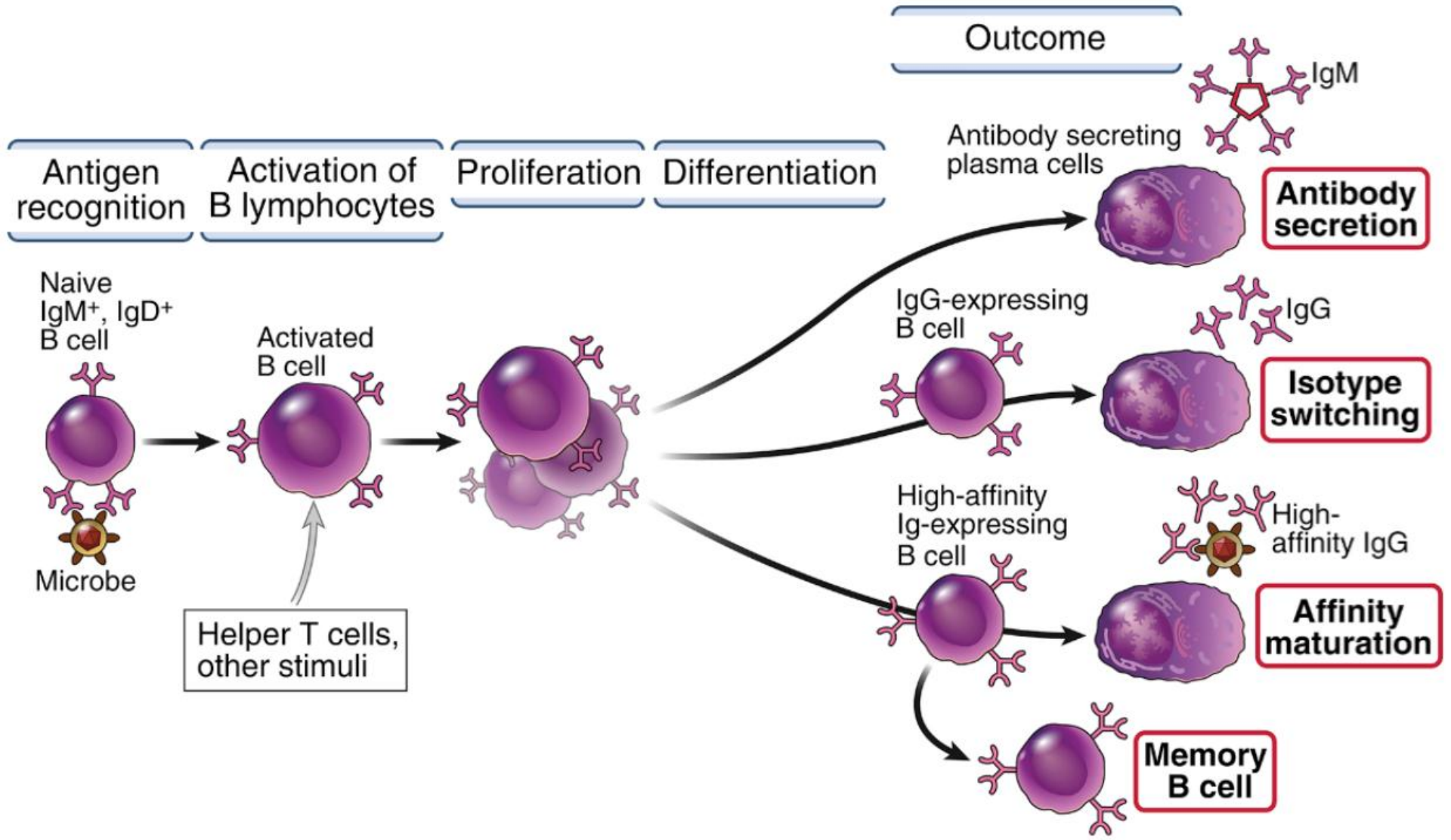
Steps in maturation and selection of B lymphocytes



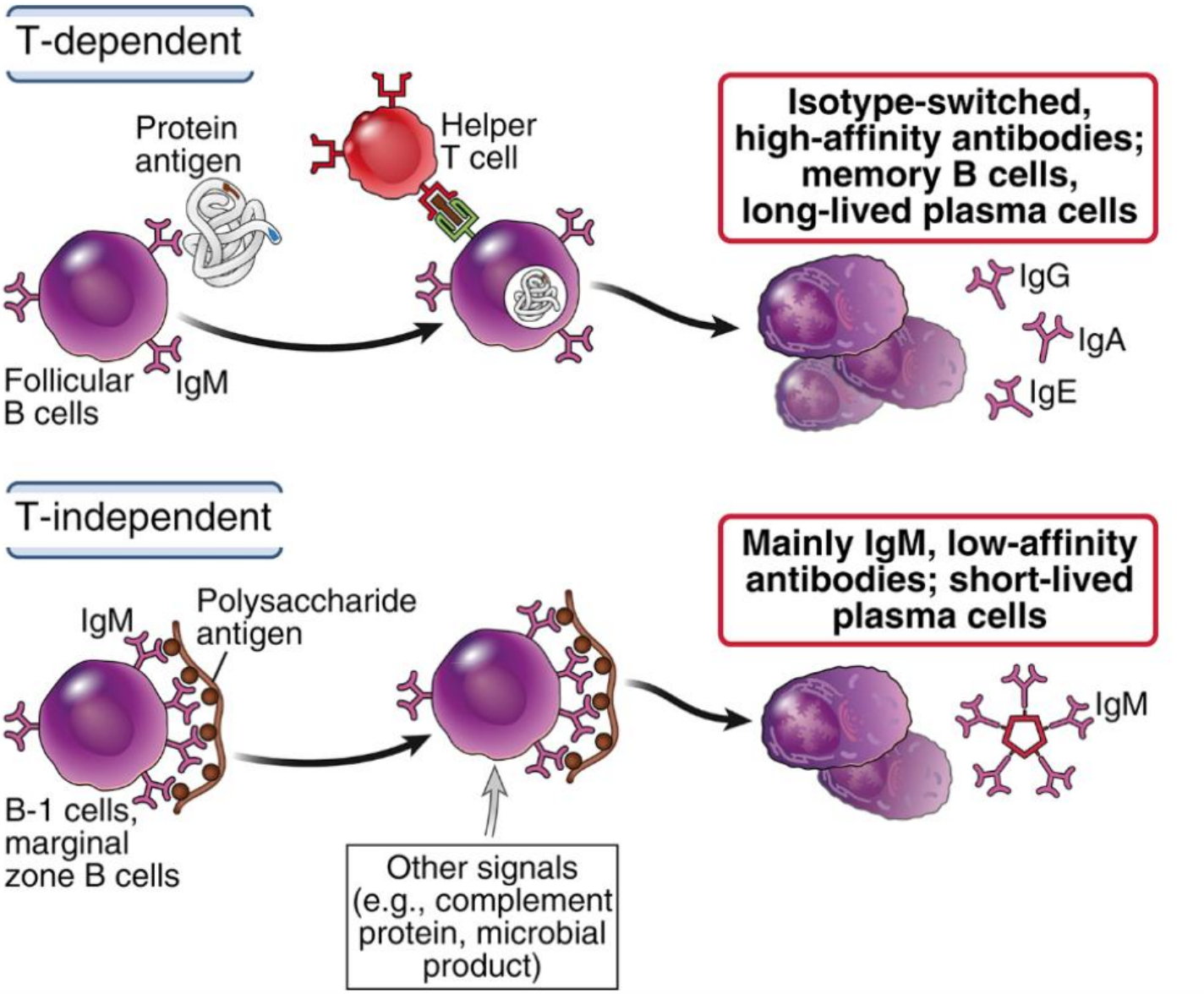
	HSC	Pro-B	Large Pre-B	Small Pre-B	Immature B	Mature B
Ig H chain gene	Germline	D to J rearrangement	V to DJ rearrangement	Rearranged VDJ	Rearranged VDJ	Rearranged VDJ
Ig L chain gene	Germline	Germline	Germline	V to J rearrangement	Rearranged VJ	Rearranged VJ
Ig protein	None	None	pre-BCR	Intracellular μ	IgM	IgM, IgD



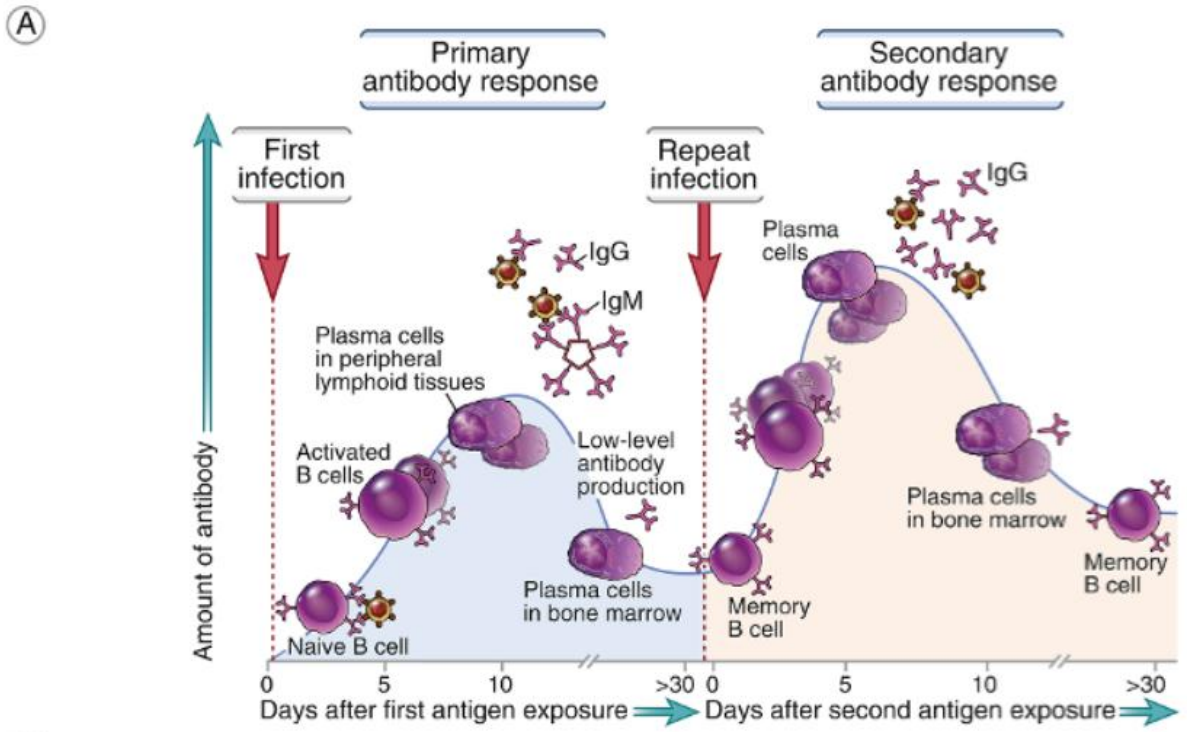
Phases of humoral immune responses.



T-dependent and T-independent antibody responses.



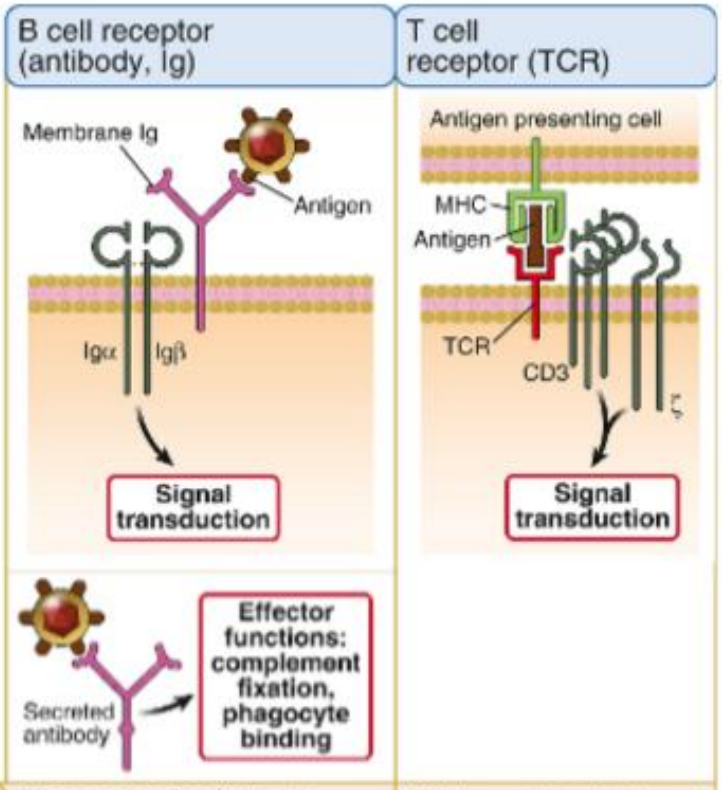
Features of primary and secondary antibody responses.



B

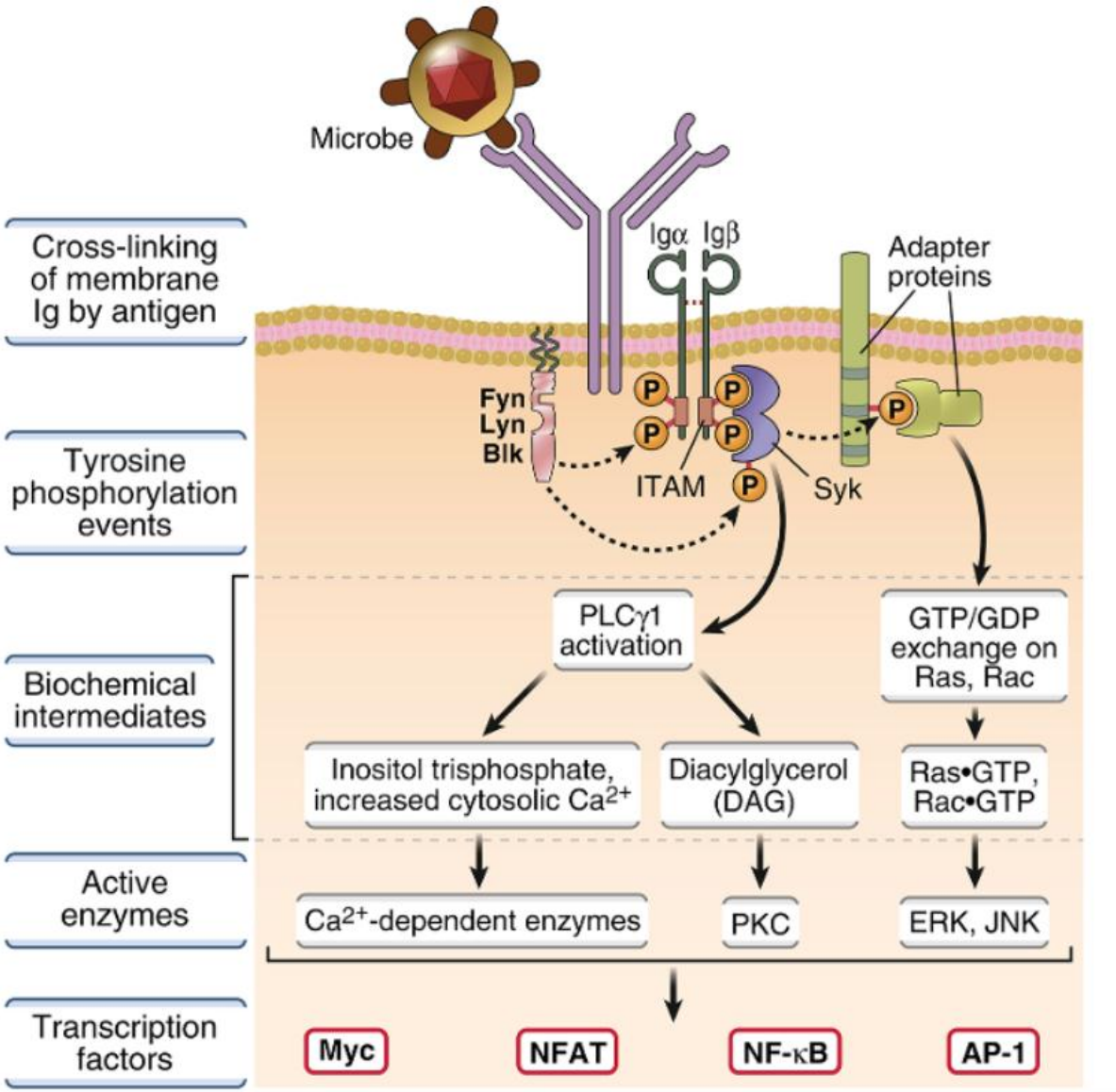
	Primary response	Secondary response
Lag after immunization	Usually 5-10 days	Usually 1-3 days
Peak response	Smaller	Larger
Antibody isotype	Usually IgM>IgG	Relative increase in IgG and, under certain situations, in IgA or IgE (heavy-chain isotype switching)
Antibody affinity	Lower average affinity, more variable	Higher average affinity (affinity maturation)

Properties of antibodies and T cell antigen receptors (TCRs).

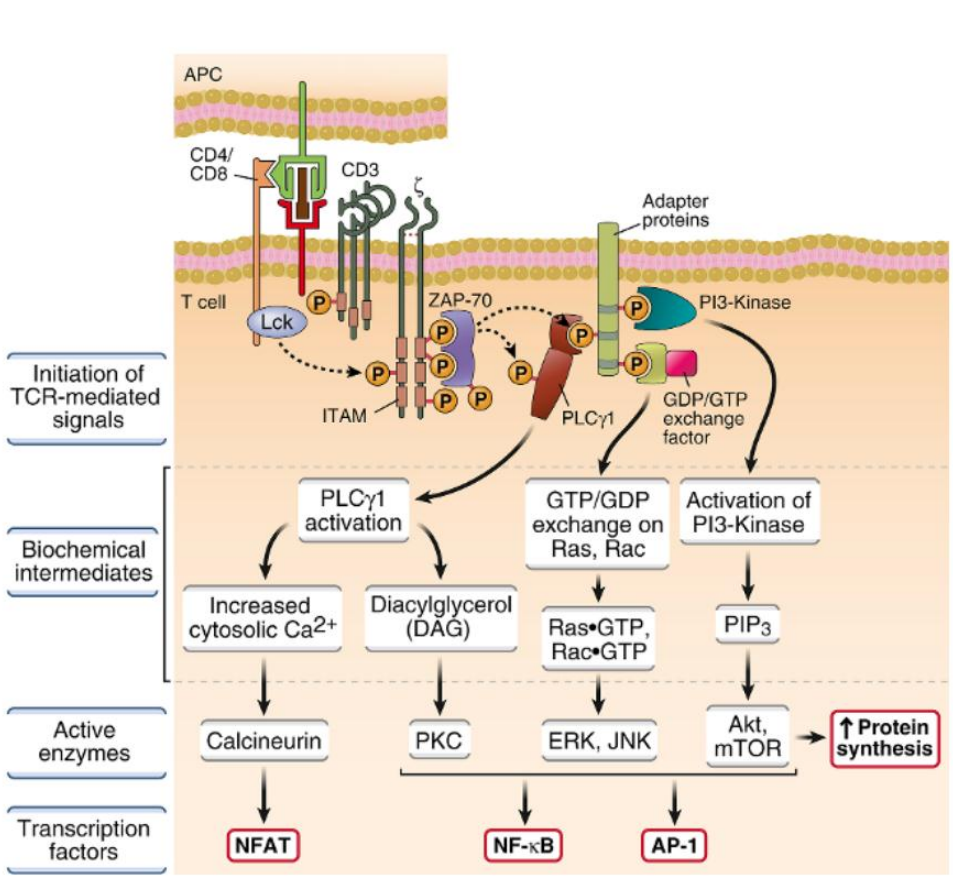


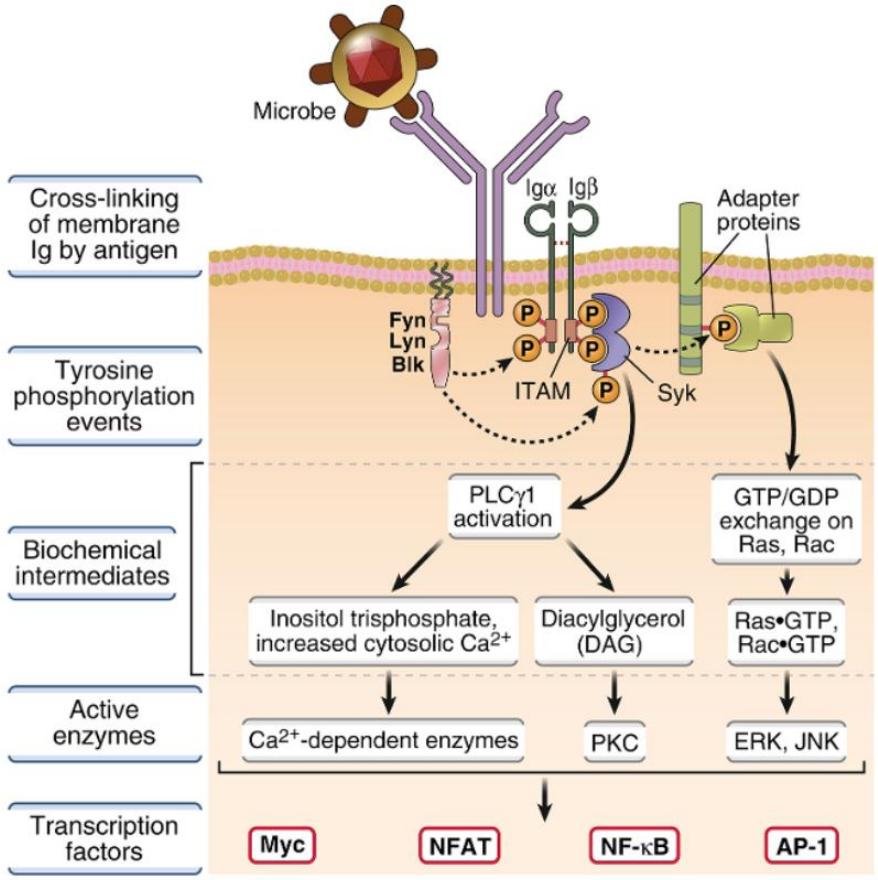
	B cell receptor (antibody, Ig)	T cell receptor (TCR)
Forms of antigens recognized	Macromolecules (proteins, polysaccharides, lipids, nucleic acids), small chemicals Conformational and linear epitopes	Mainly peptides displayed by MHC molecules on APCs Linear epitopes
Diversity	Each clone has a unique specificity; potential for $>10^9$ distinct specificities	Each clone has a unique specificity; potential for $>10^{11}$ distinct specificities
Antigen recognition is mediated by:	Variable (V) regions of heavy and light chains of membrane Ig	Variable (V) regions of α and β chains of the TCR
Signaling functions are mediated by:	Proteins (Igα and Igβ) associated with membrane Ig	Proteins (CD3 and ζ) associated with the TCR
Effector functions are mediated by:	Constant (C) regions of secreted Ig	TCR does not perform effector functions

Antigen receptor–mediated signal transduction in B lymphocytes.

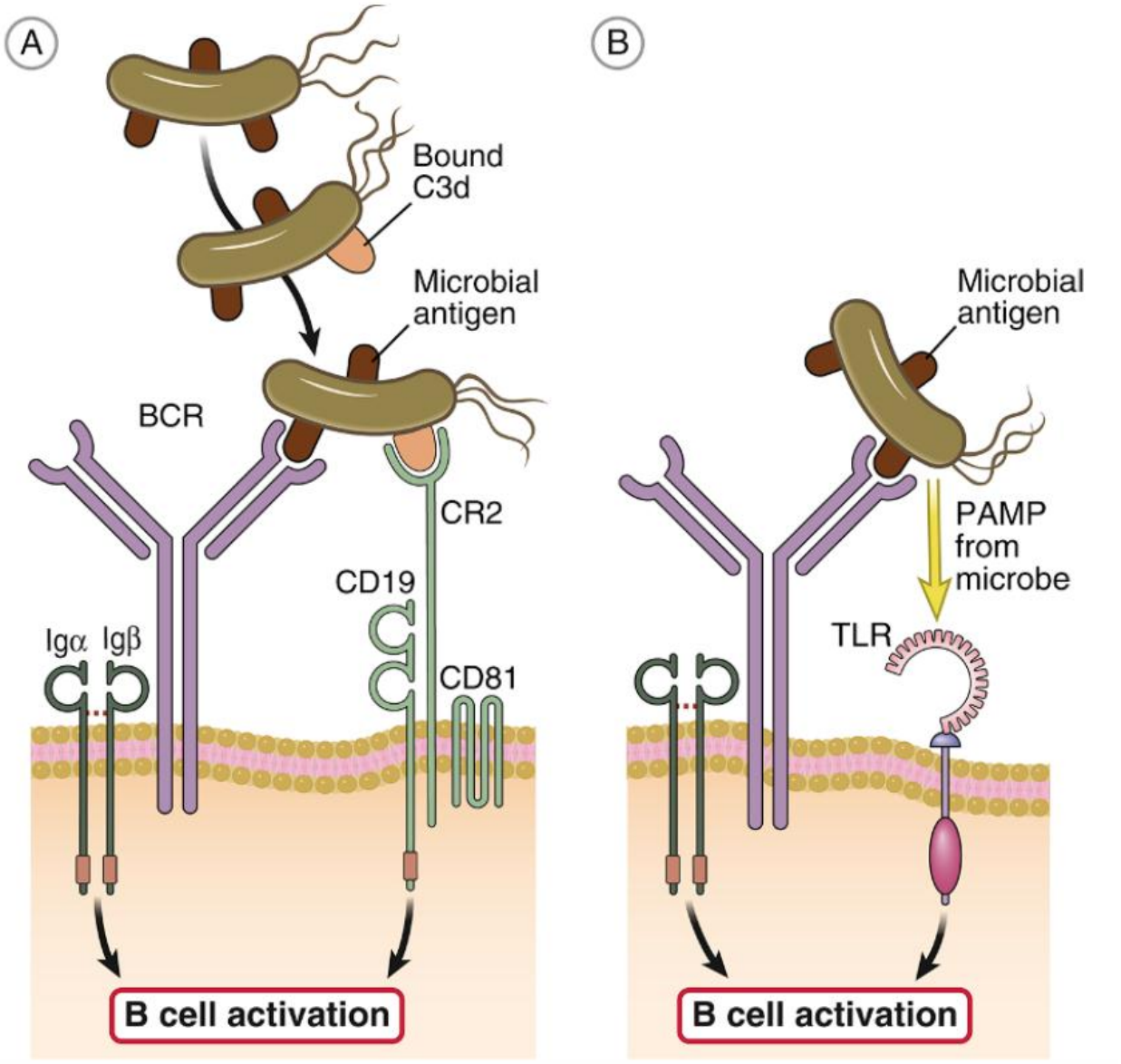


Signal transduction in T and B lymphocytes.

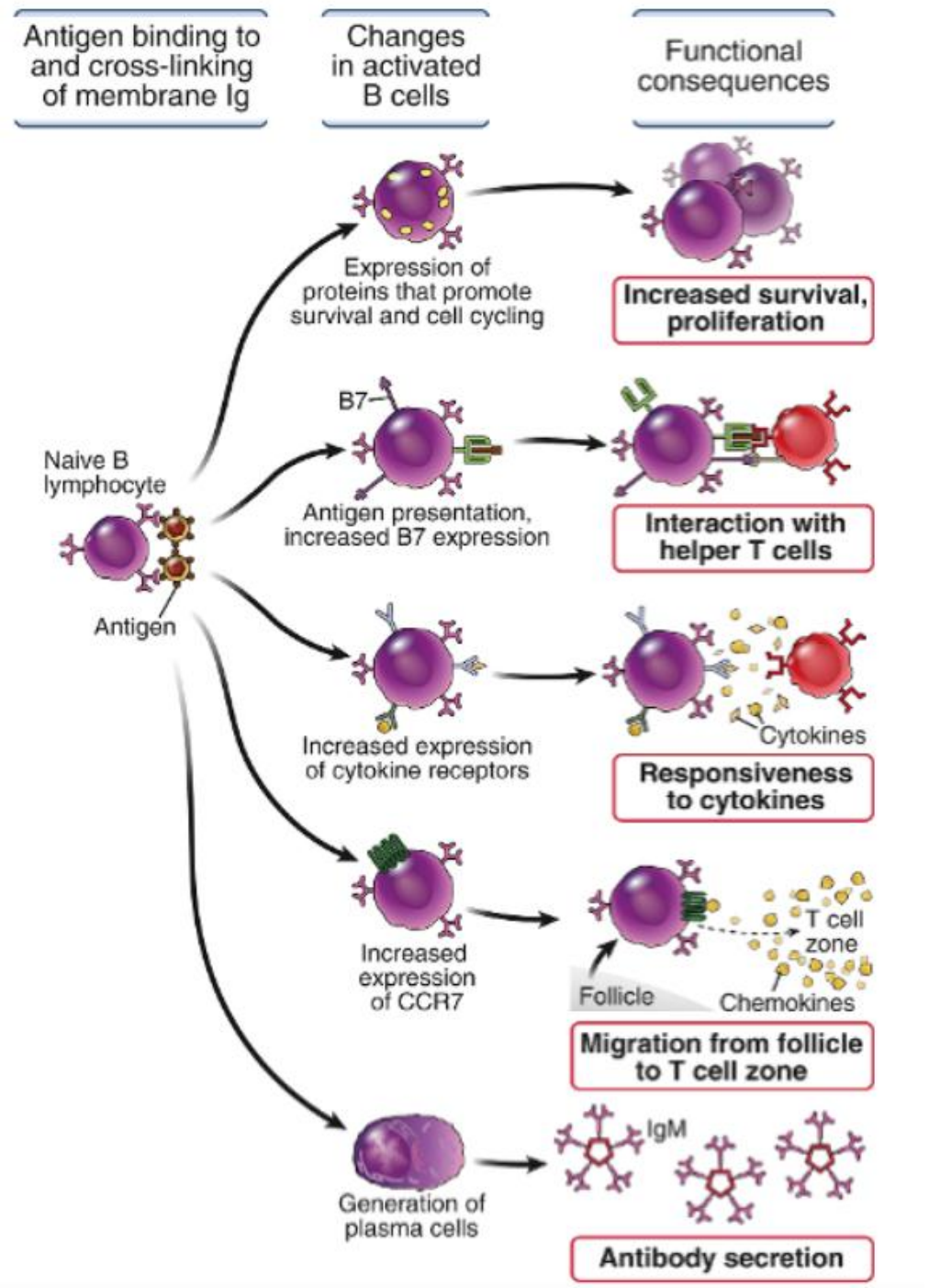




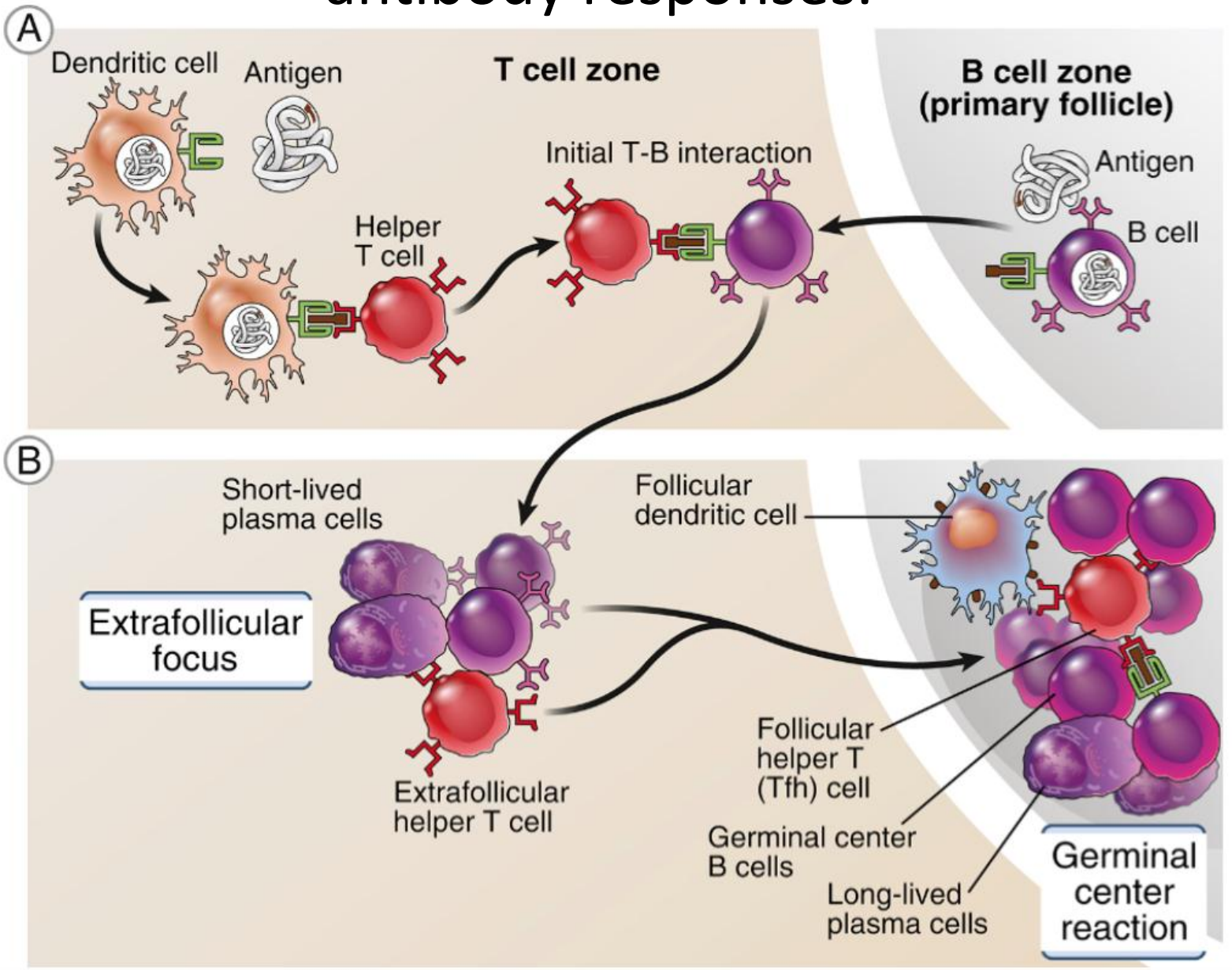
Role of innate immune signals in B cell activation.



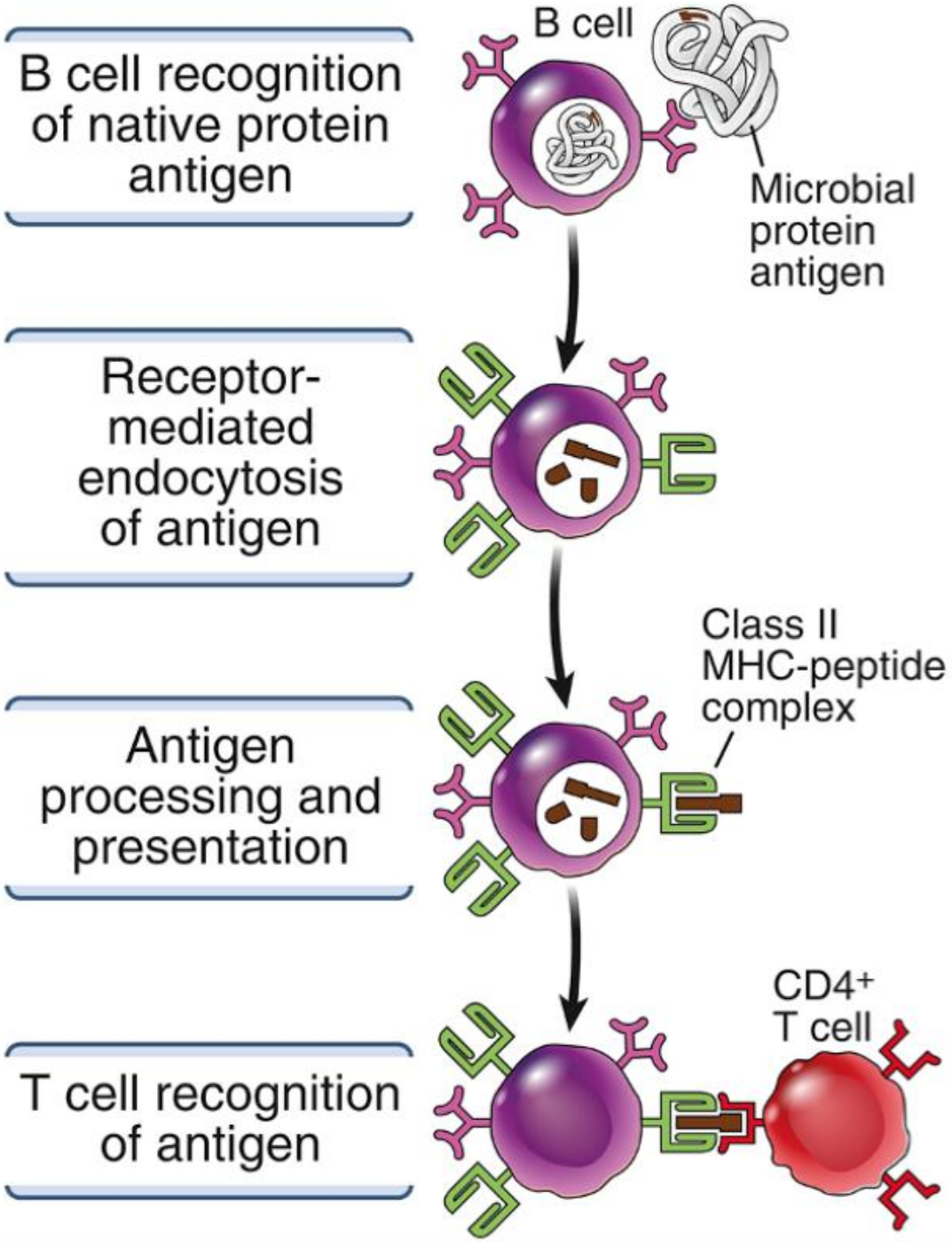
Functional consequences of antigen receptor-mediated B cell activation.



Sequence of events in helper T cell–dependent antibody responses.



Antigen presentation by B lymphocytes to helper T cells.



The principle of conjugate vaccines: the hapten-carrier concept.

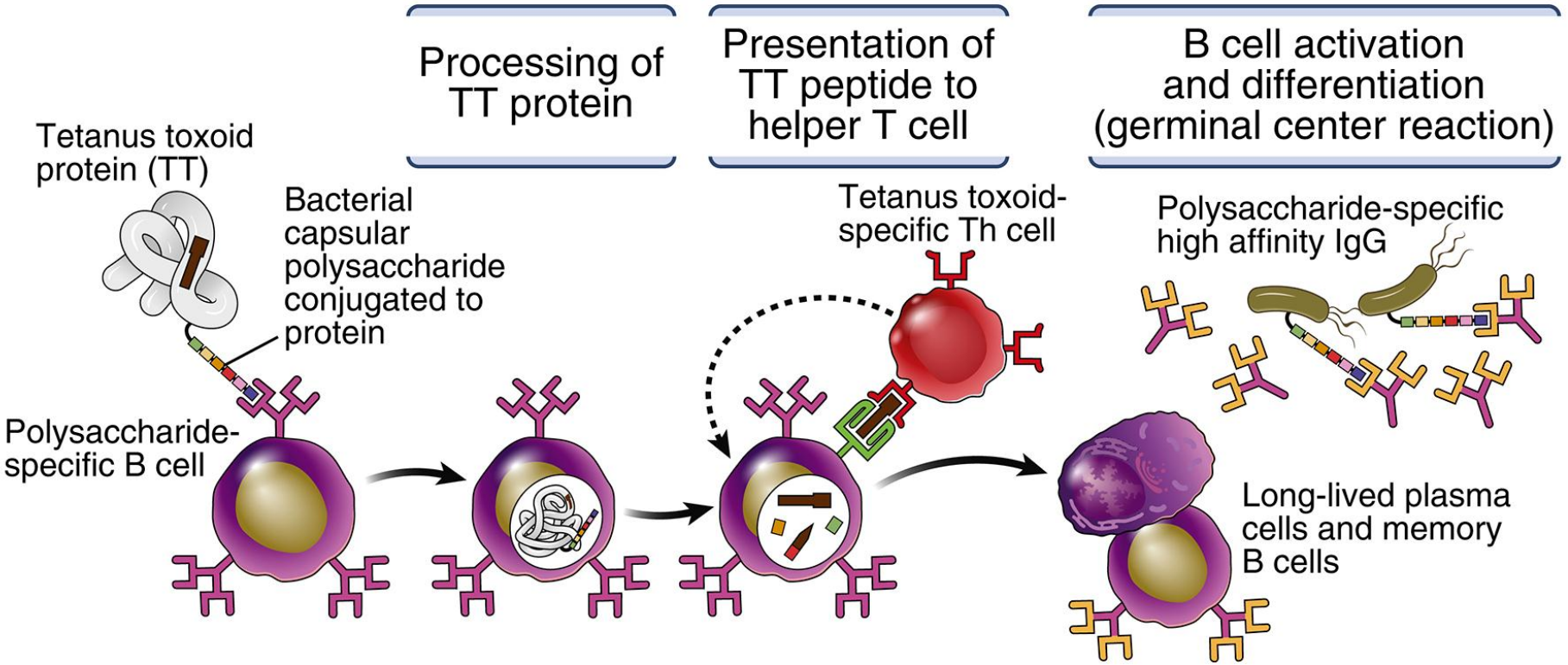
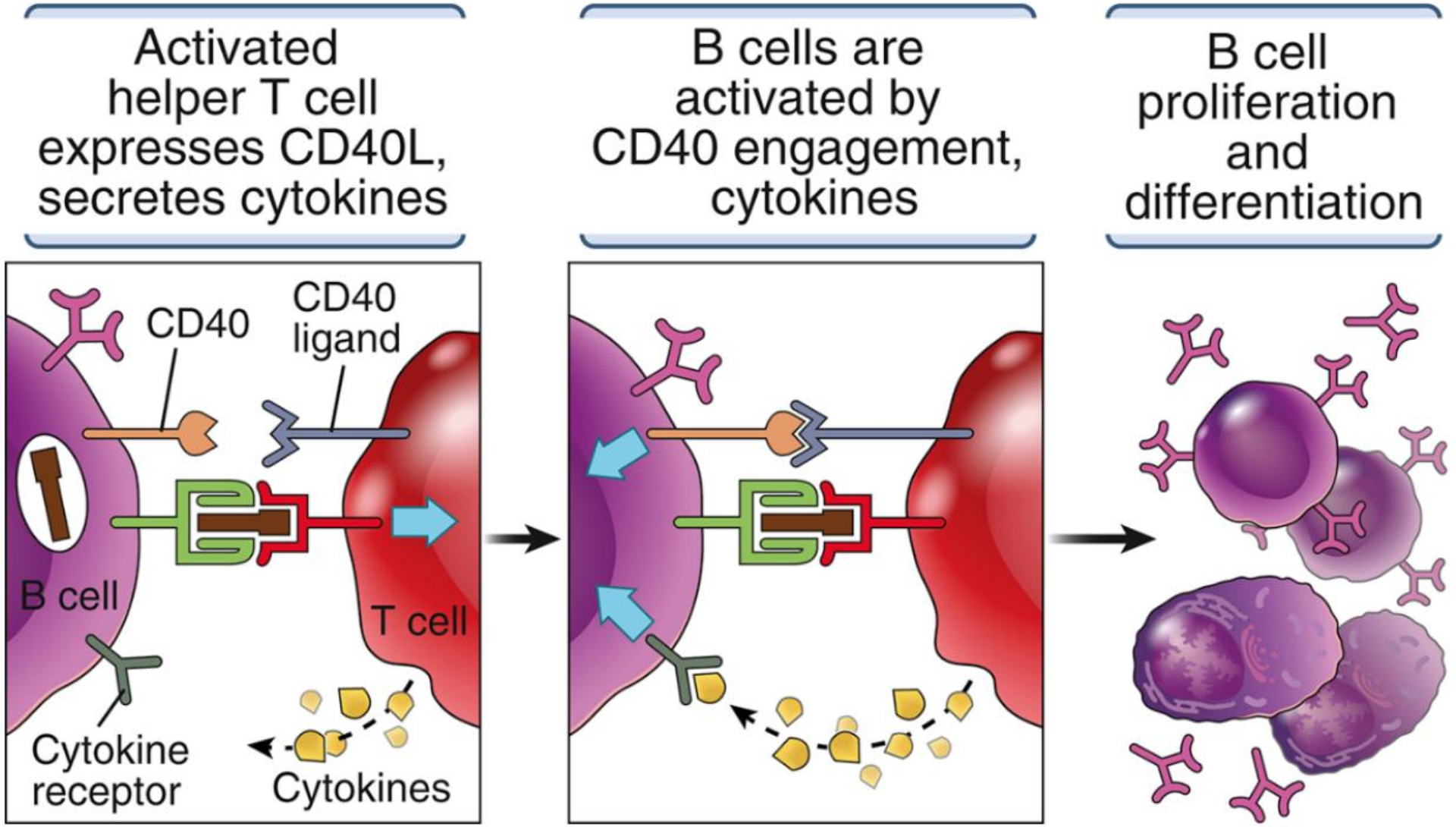


Figure 7.9: The principle of conjugate vaccines: the hapten-carrier concept.
In order to generate strong antibody responses against a microbial polysaccharide, the polysaccharide is coupled to a protein (in this case, tetanus toxoid). B cells that recognize the polysaccharide ingest it and present peptides from the protein to helper T cells, which stimulate the polysaccharide-specific B cells. Thus isotype switching, affinity maturation, and long-lived plasma cells and memory cells (all features of responses to proteins) are induced in a response to polysaccharides. (Note that some B cells will also recognize the tetanus toxoid and antibodies will be produced against the carrier protein, but this has no bearing on the antipolysaccharide response.) Ig, Immunoglobulin.

New figure!

Mechanisms of helper T cell–mediated activation of B lymphocytes.



The germinal center reaction.

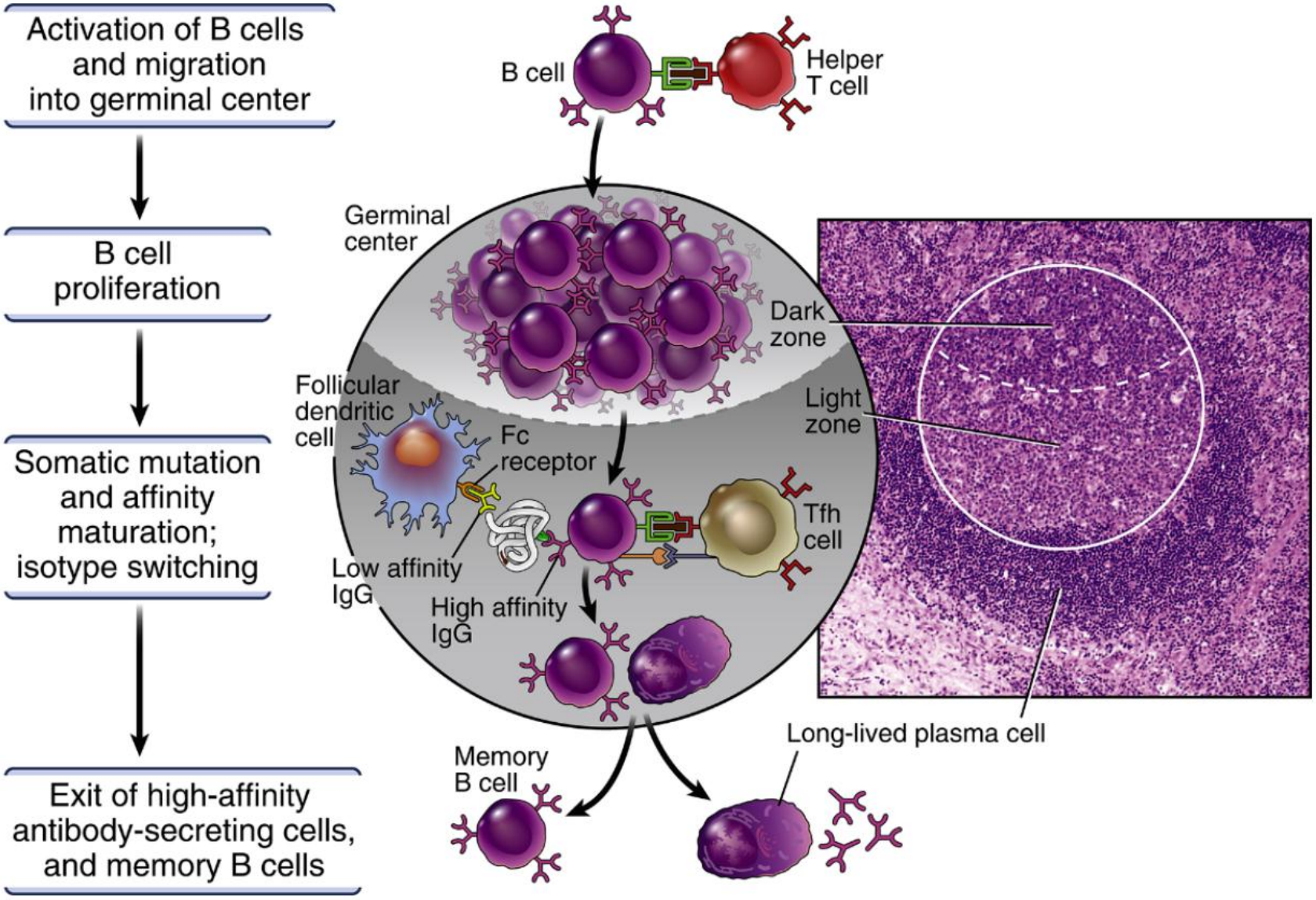
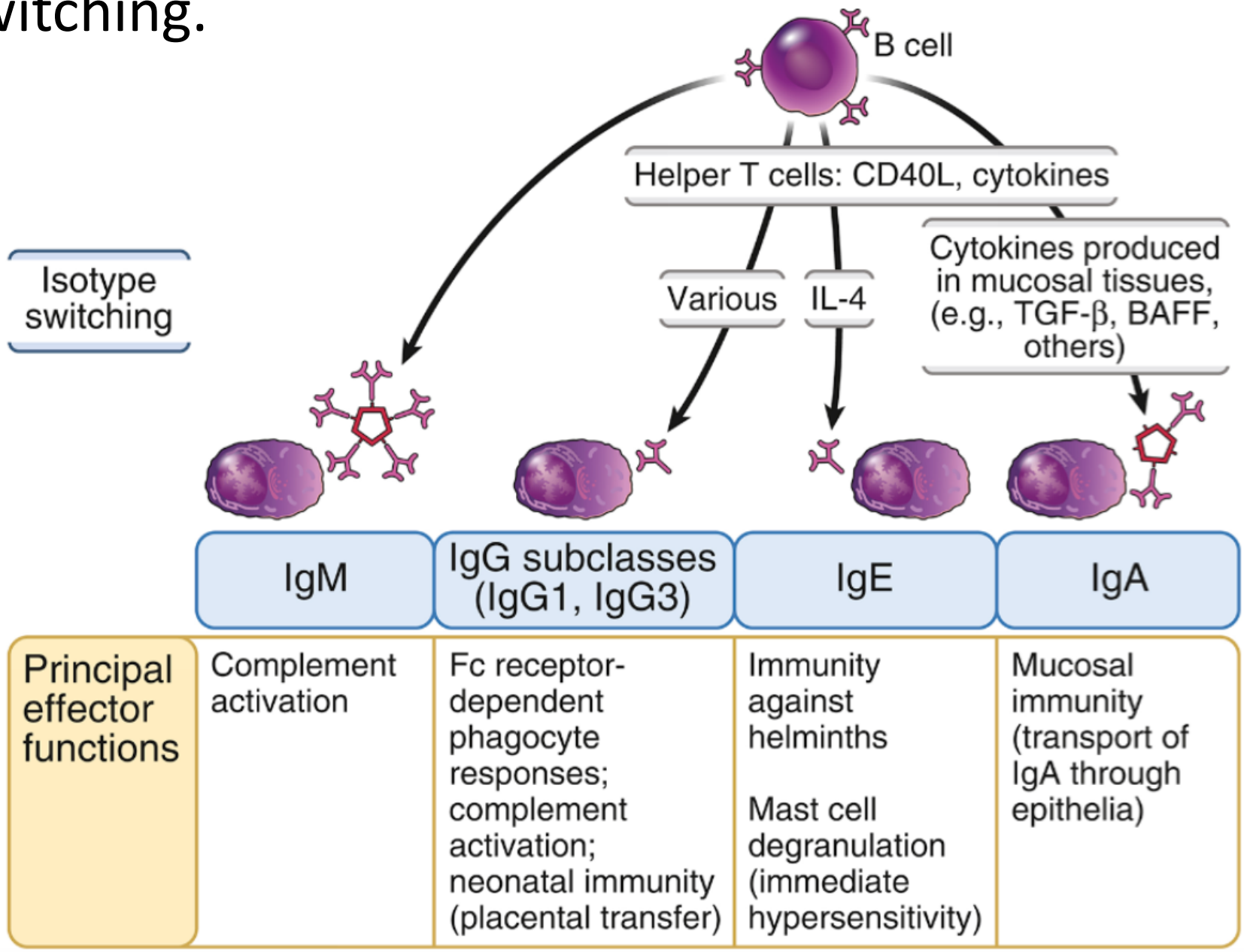
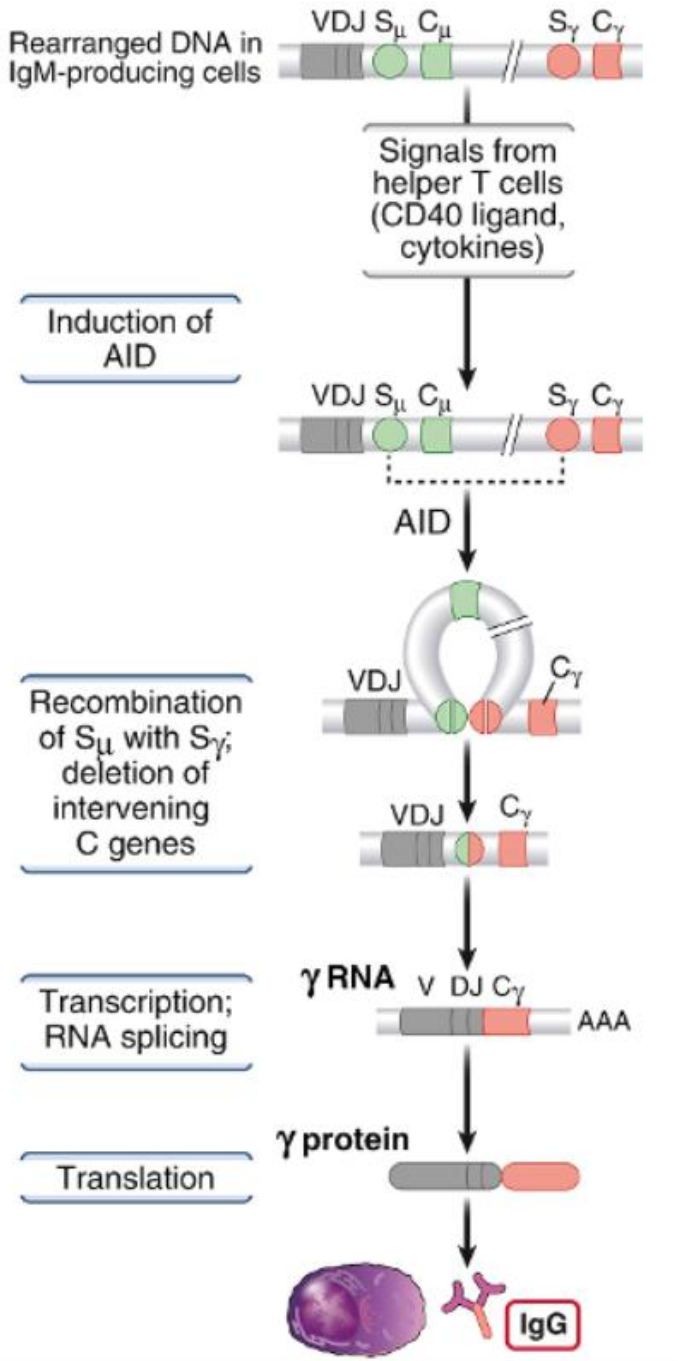


Figure details changed!

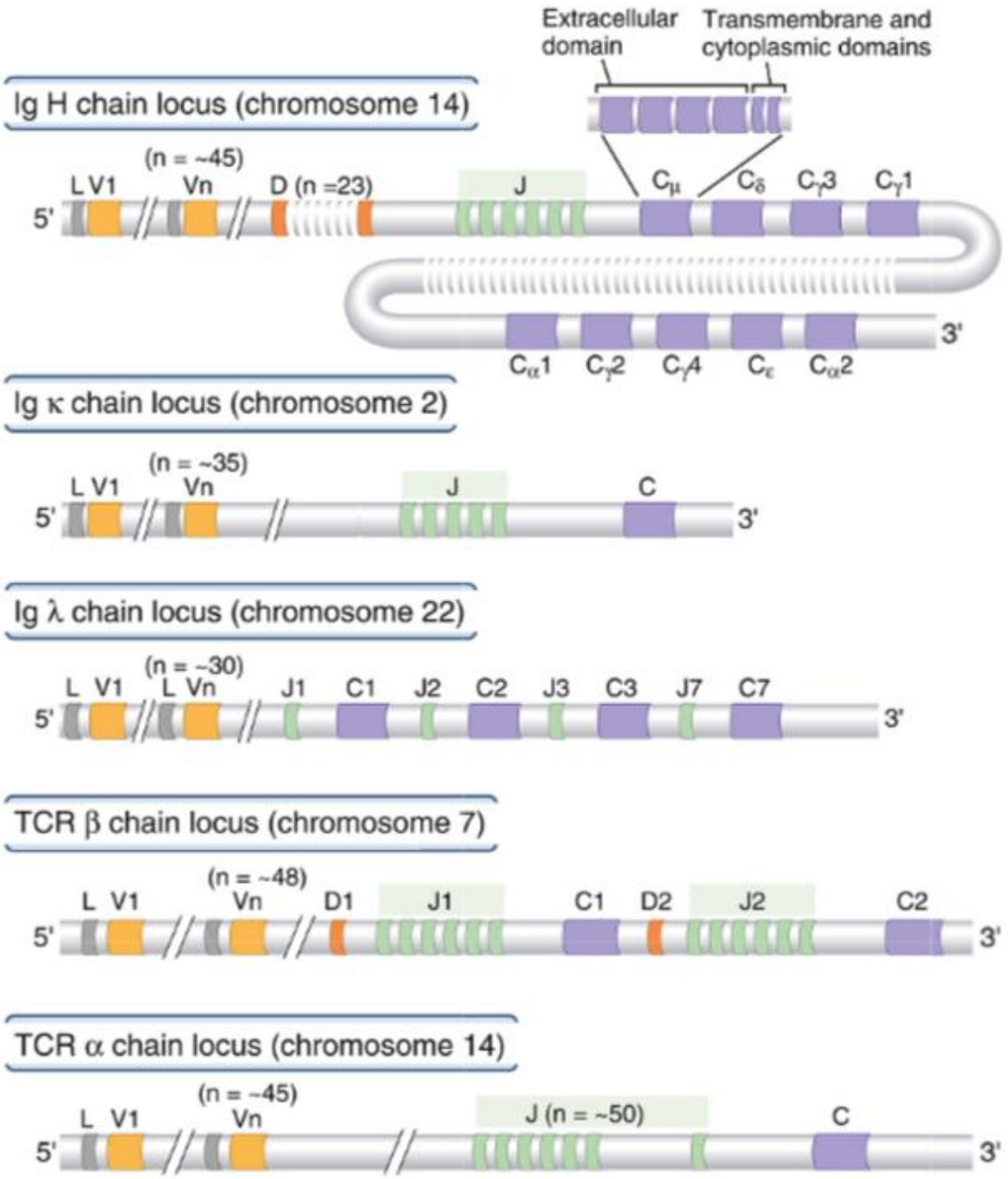
Immunoglobulin (Ig) heavy-chain isotype (class) switching.



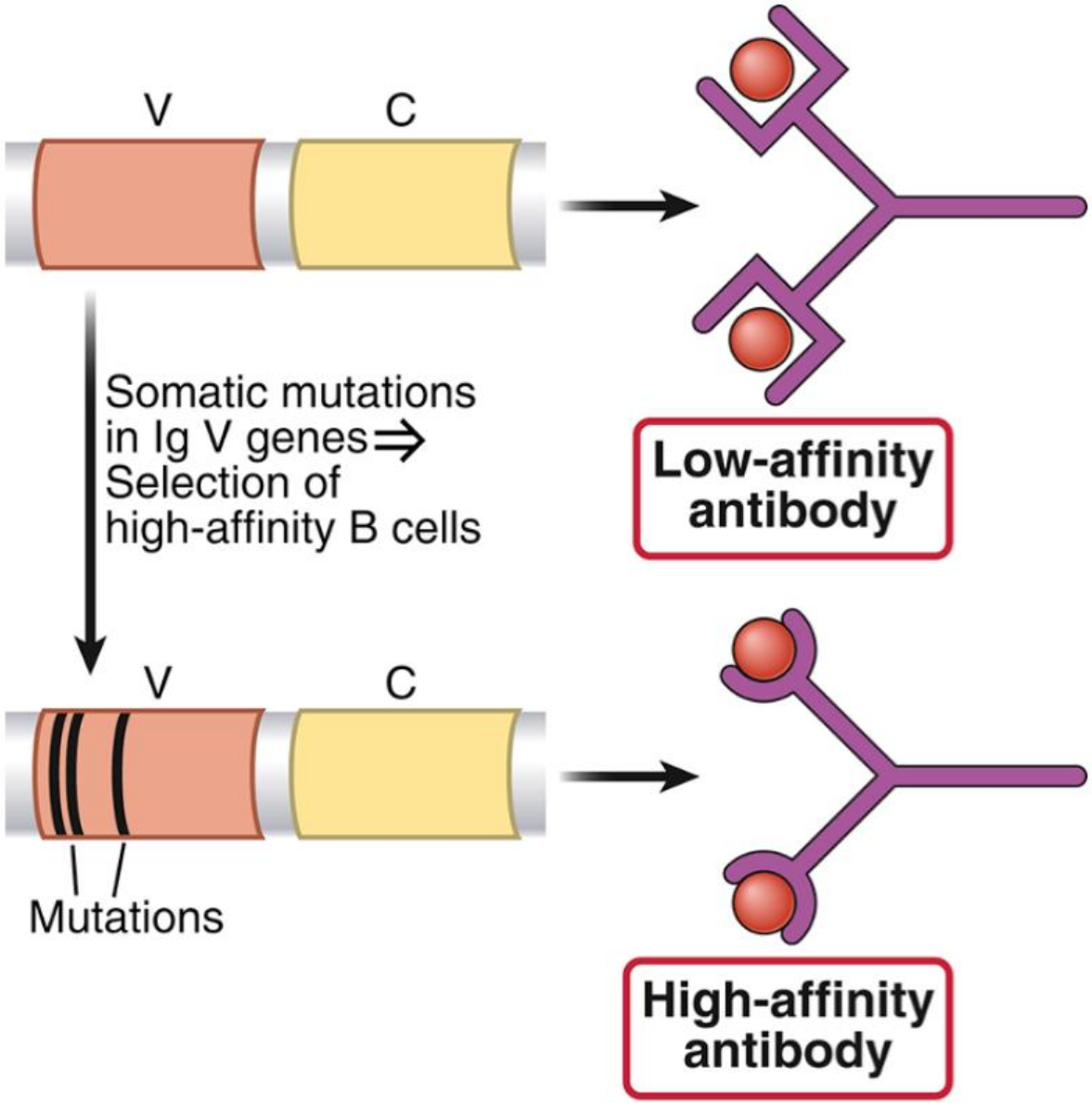
Mechanism of immunoglobulin heavy-chain isotype switching.



Germline organization of antigen receptor gene loci.



Affinity maturation in antibody responses.



Selection of high-affinity B cells in germinal centers.

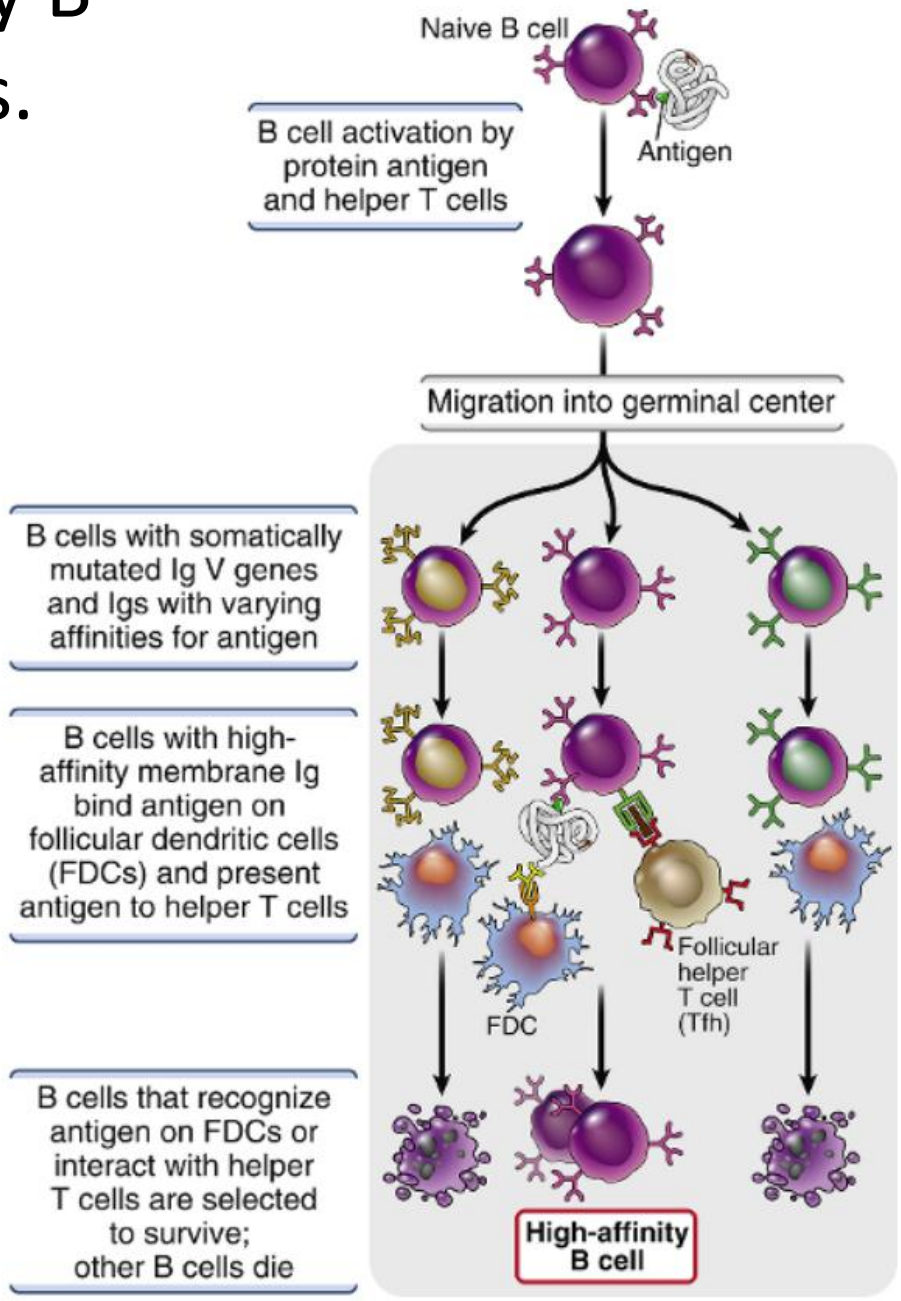
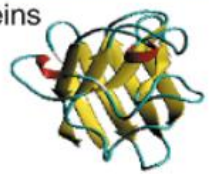
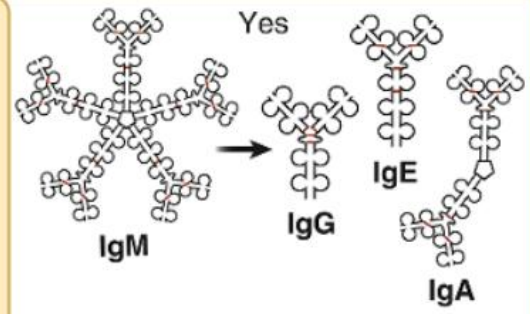
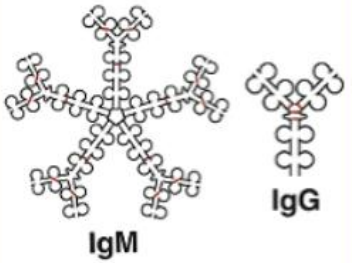


Figure details changed!

Features of Antibody responses to T-dependent and T-independent antigens.

	Thymus-dependent antigen	Thymus-independent antigen
Chemical nature	Proteins 	Polymeric antigens, especially polysaccharides; also glycolipids, nucleic acids 
Features of anitbody response		
Isotype switching		Low level switching to IgG 
Affinity maturation	Yes	Little or no
Plasma cells	Long-lived	Short-lived
Secondary response (memory B cells)	Yes	Only seen with some polysaccharide antigens

Mechanism of antibody feedback.