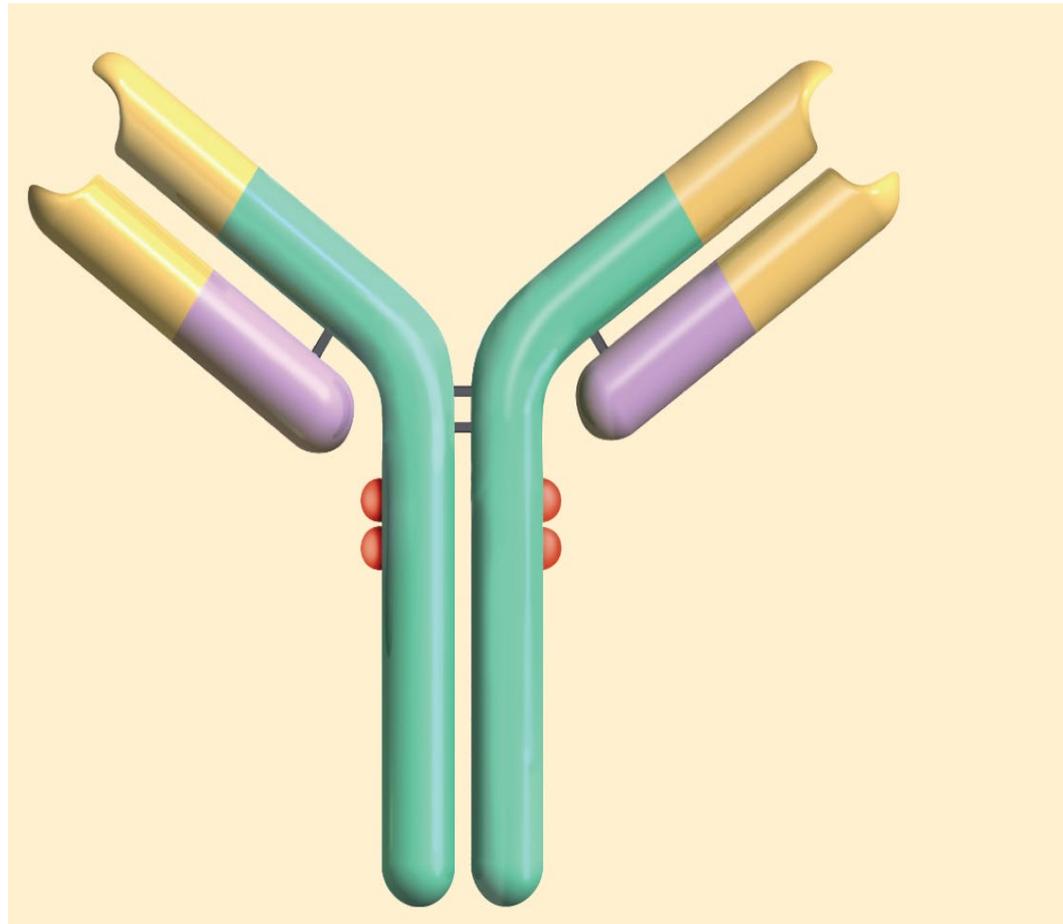


C21.6

Antibodies Structure & Function



Antibodies

Antibodies are also called **Immunoglobulins (Ig)**. They are gamma globulin, a protein made by plasma cells.

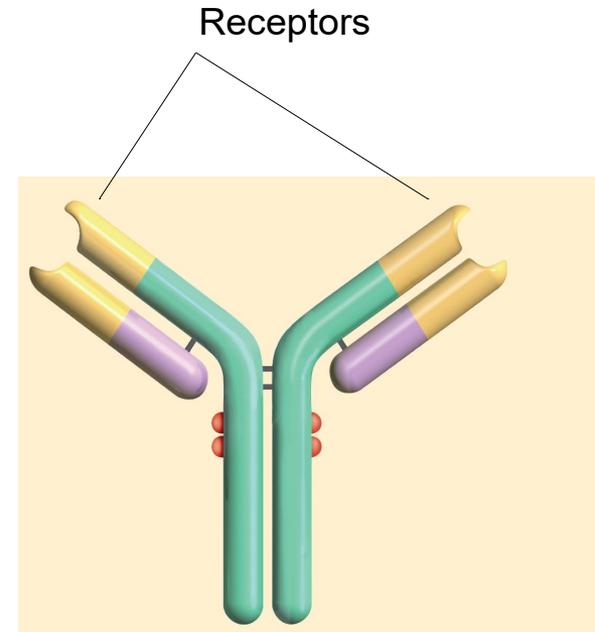
Antibodies maybe found in the blood plasma, tissue fluids, body secretions, inside our small intestine, on some leukocyte membranes. Antibodies have receptors matched to foreign antigen. But antibodies are not inside our cell's cytoplasm.

The basic structural unit of an antibody is composed of four polypeptide chains linked by **disulfide bonds (-S-S-)**

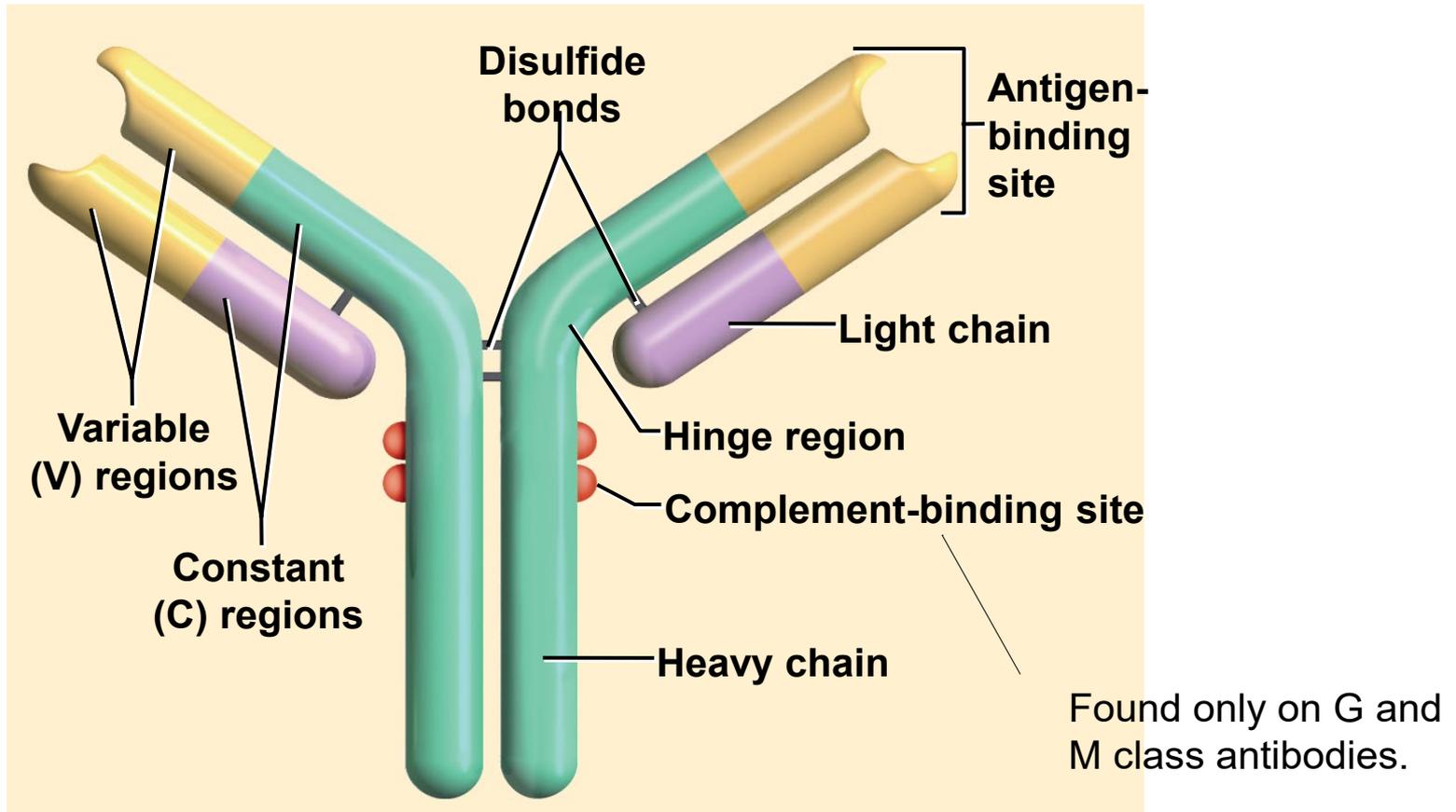
Two larger **heavy chains** about 400 amino acids long // heavy chains have a hinge region where antibody is bent

Two **light chains** about half as long

A variable (V) region in all four chains // gives the antibody its uniqueness



Antibody Structure



Antibodies render pathogens harmless and tag them for destruction.
Antibodies don't kill pathogen, complement kills pathogens.

Five Classes of Antibodies

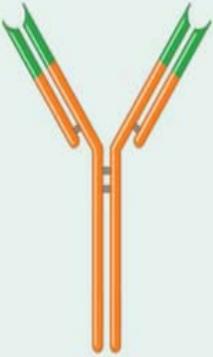
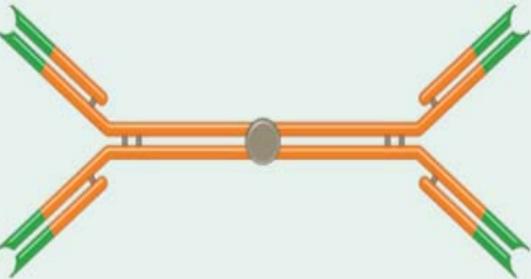
Remember “**MADGE**” (IgM – IgA – IgD – IgG – IgE)

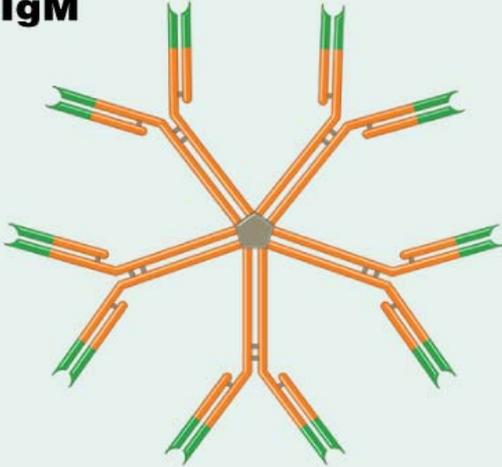
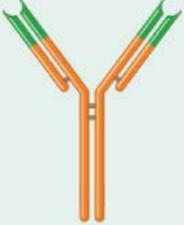
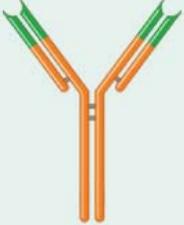
A plasma cell can produce all four classes of antibodies – all with same antigen binding site

A single plasma cell can make 2,000 antibodies per second for 7 days.

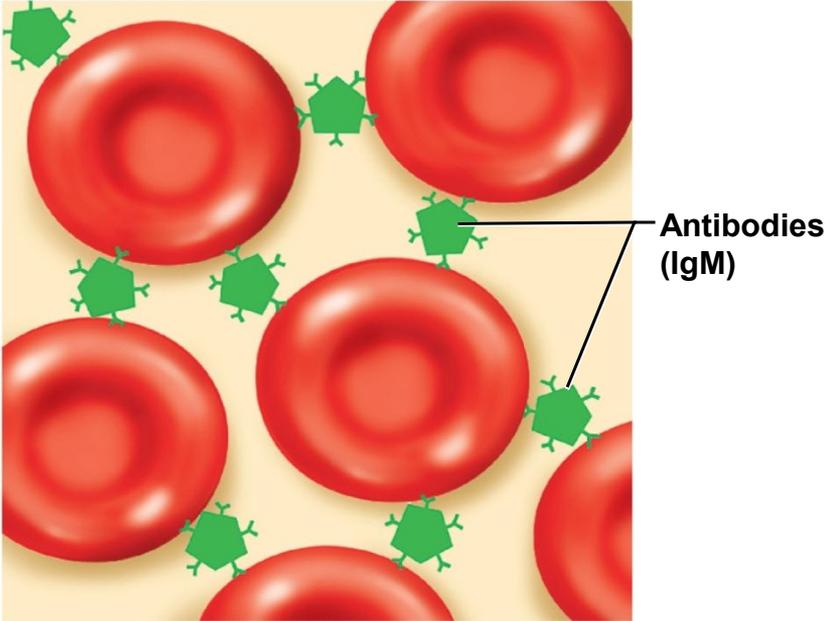
During clonal selection, the immune system produces millions of active plasma cells, all making similar antibodies.

A plasma cells may start by producing IgM antibodies and then later produce IgG during the infection

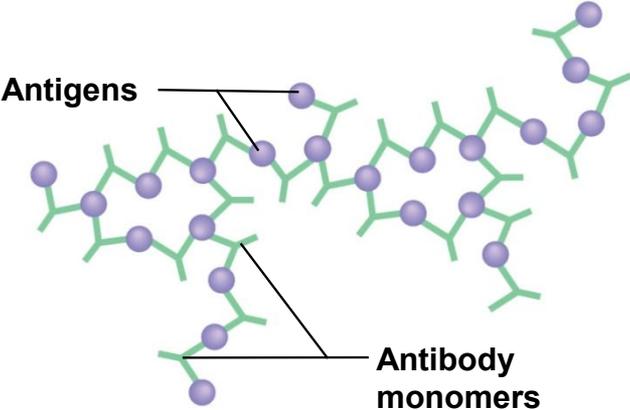
CLASS	FUNCTION
<p data-bbox="241 249 338 307">IgG</p> 	<ul data-bbox="937 249 1709 714" style="list-style-type: none">• Makes up the majority of antibodies in serum• The only antibody that can cross the placenta from mother to fetus• Functions in opsonization, neutralization, and complement fixation
<p data-bbox="241 863 338 921">IgA</p> 	<ul data-bbox="937 863 1632 1342" style="list-style-type: none">• Found in secretions such as breast milk and saliva• Functions in agglutination and neutralization <p data-bbox="937 1163 1632 1342">.M Cells in small intestine secrete IgA into the lumen of the small intestine.</p>

CLASS	FUNCTION
<p data-bbox="324 162 407 201">IgM</p> 	<ul data-bbox="923 162 1528 415" style="list-style-type: none"> • The first antibody secreted on exposure to an antigen • Potent agglutinating and precipitating agent • Functions in complement fixation
<p data-bbox="324 761 397 799">IgE</p> 	<ul data-bbox="923 761 1572 972" style="list-style-type: none"> • Binds mast cells and basophils and triggers their degranulation, facilitating inflammation, particularly in the allergic response
<p data-bbox="324 1118 397 1156">IgD</p> 	<ul data-bbox="923 1118 1566 1279" style="list-style-type: none"> • Antibody found exclusively on the surface of B cells • Has a role in B cell sensitization and activation

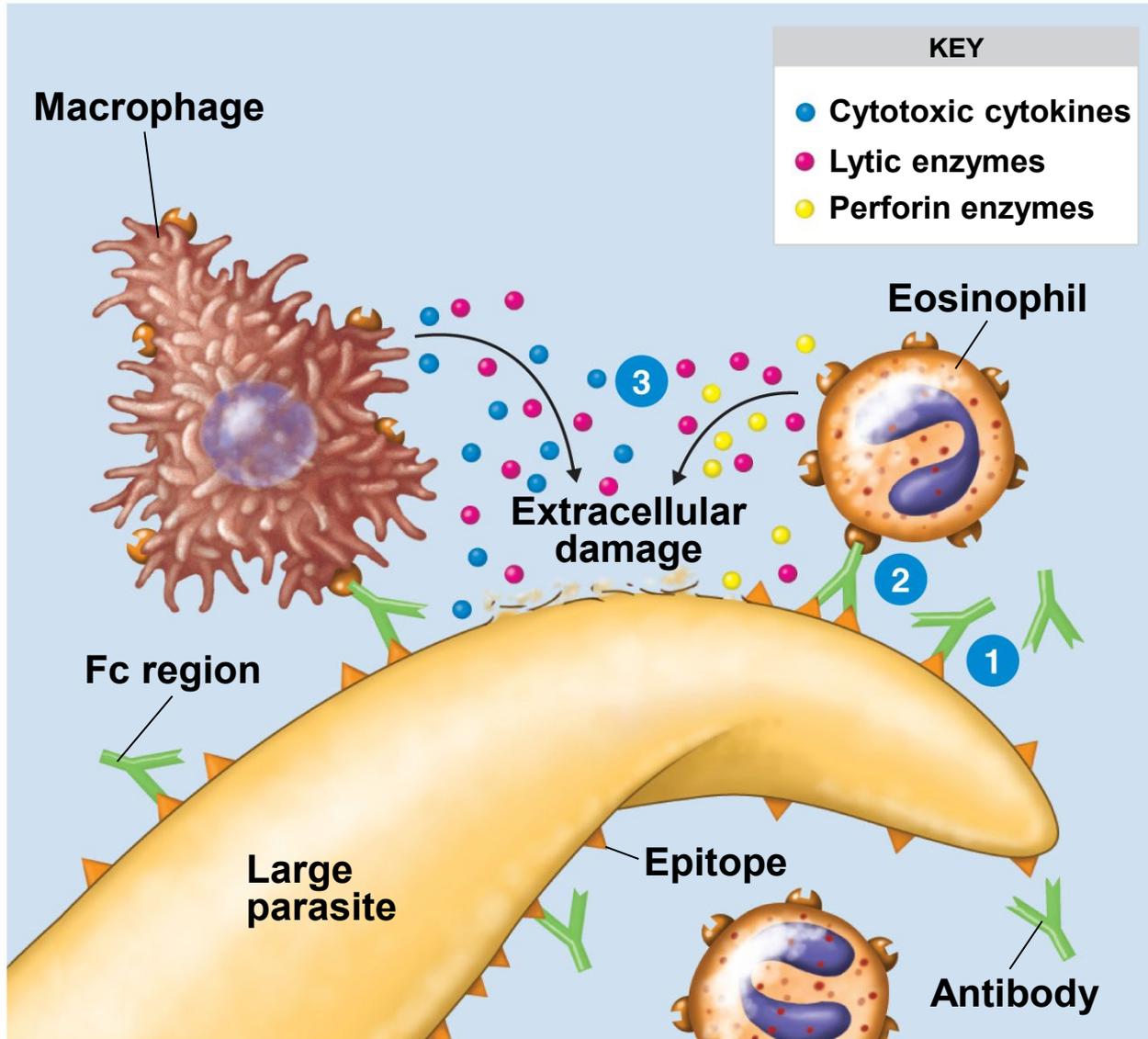
Agglutination



(a)



Antibody-dependent cell-mediated cytotoxicity (ADCC).



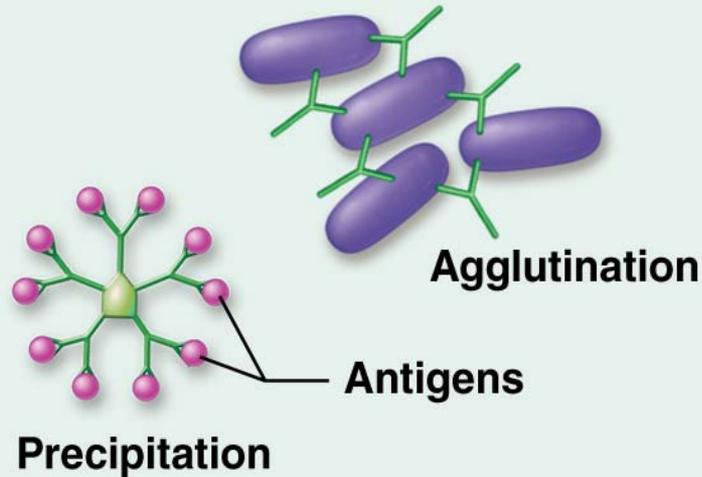
(a) Organisms, such as many parasites, that are too large for ingestion by phagocytic cells must be attacked externally.

FUNCTION

DESCRIPTION

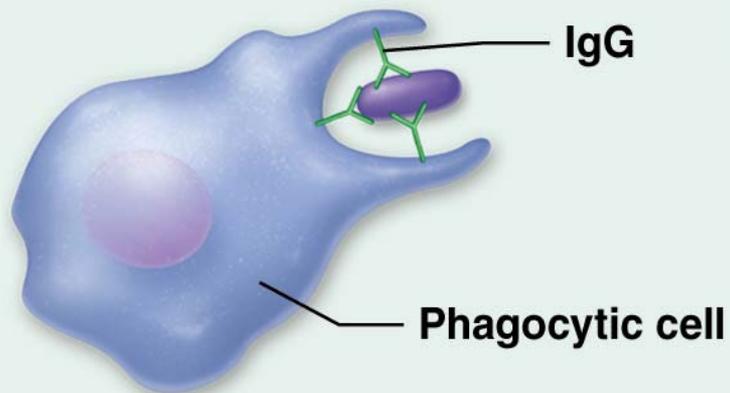
Agglutination/precipitation

Antibodies clump antigens together to enhance phagocytosis.



Opsonization

IgG coats antigens and binds phagocytes, enhancing phagocytosis.



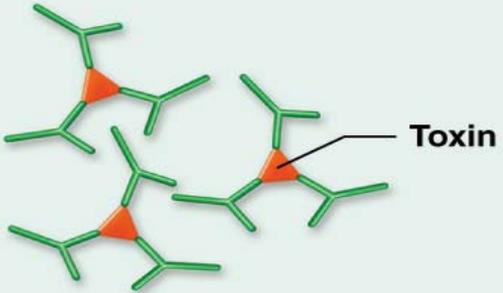
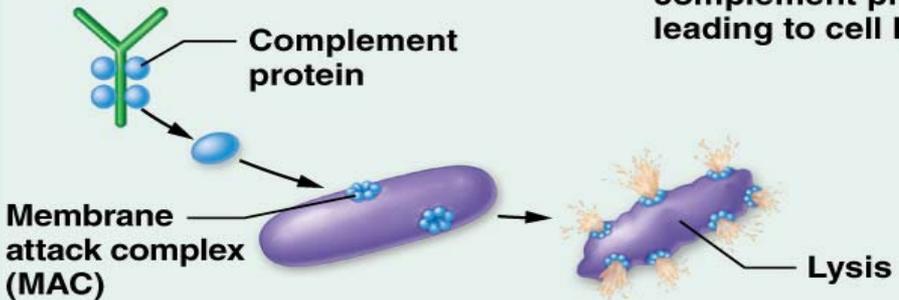
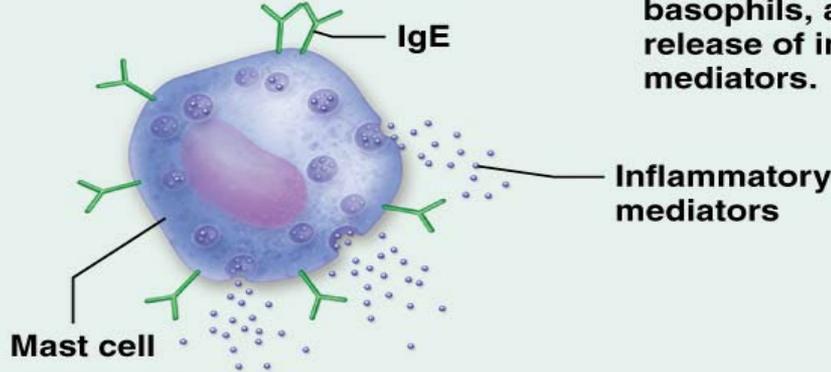
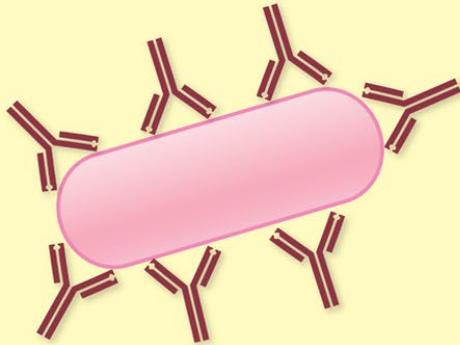
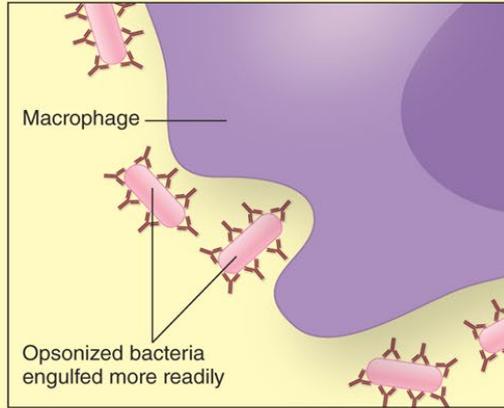
FUNCTION	DESCRIPTION
<p data-bbox="440 139 710 174">Neutralization</p>  <p>The diagram shows several green Y-shaped antibody molecules. Each antibody has two antigen-binding sites. Three of these sites are bound to orange triangular structures labeled 'Toxin'. The antibodies are clustered together, effectively blocking the toxins from interacting with their target receptors.</p>	<p data-bbox="1052 139 1458 274">Antibodies bind pathogenic components of toxins and block toxic effects.</p>
<p data-bbox="440 548 884 582">Complement activation</p>  <p>The diagram illustrates the process of complement activation. On the left, a green Y-shaped antibody is shown with three blue spherical complement proteins bound to its antigen-binding sites. An arrow points to a purple rod-shaped cell (likely a bacterium) where the complement proteins have attached to its membrane. A label 'Membrane attack complex (MAC)' points to these proteins on the cell surface. A second arrow points to the final stage where the cell is being destroyed, labeled 'Lysis', with orange spiky structures protruding from the cell's surface.</p>	<p data-bbox="1052 548 1420 645">Antibodies activate complement proteins, leading to cell lysis.</p>
<p data-bbox="440 976 969 1011">Stimulation of inflammation</p>  <p>The diagram shows a large purple spherical cell labeled 'Mast cell'. It has several green Y-shaped IgE molecules bound to its surface. Small purple granules are visible inside the cell. An arrow points to a cluster of small blue dots being released from the cell, labeled 'Inflammatory mediators'.</p>	<p data-bbox="1052 976 1458 1102">IgE binds mast cells and basophils, and triggers release of inflammatory mediators.</p>

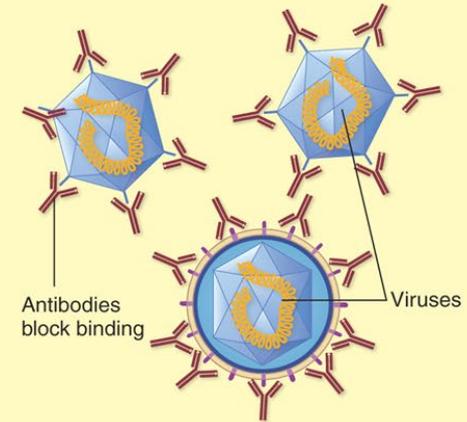
Table 13.7 Summary of Antibody Functions



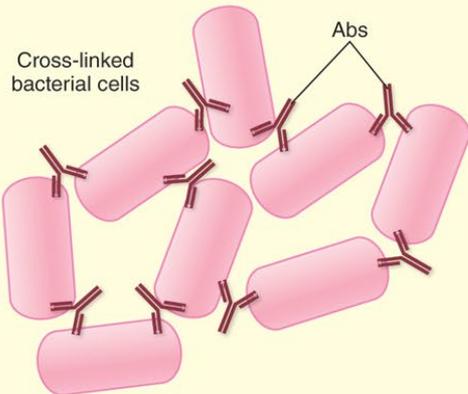
Antibodies coat the surface of a bacterium, preventing its normal function and reproduction in various ways.



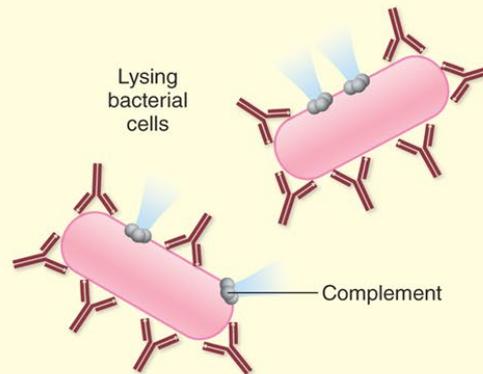
Antibodies called opsonins stimulate **opsonization** (ahp^{oo}-son-uh-zaz'-shun), a process that makes microbes more readily recognized by phagocytes, which dispose of them. Opsonization has been likened to putting handles on a slippery object to provide phagocytes a better grip.



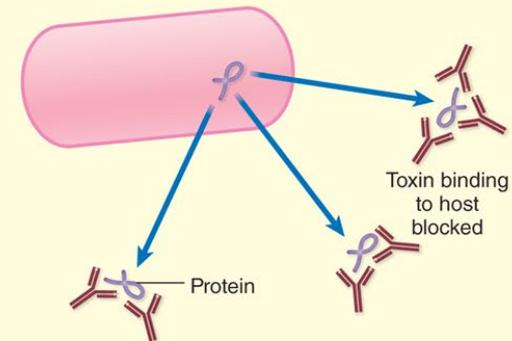
In **neutralization** reactions, antibodies fill the surface receptors on a virus or the active site on a microbial enzyme to prevent it from attaching normally.



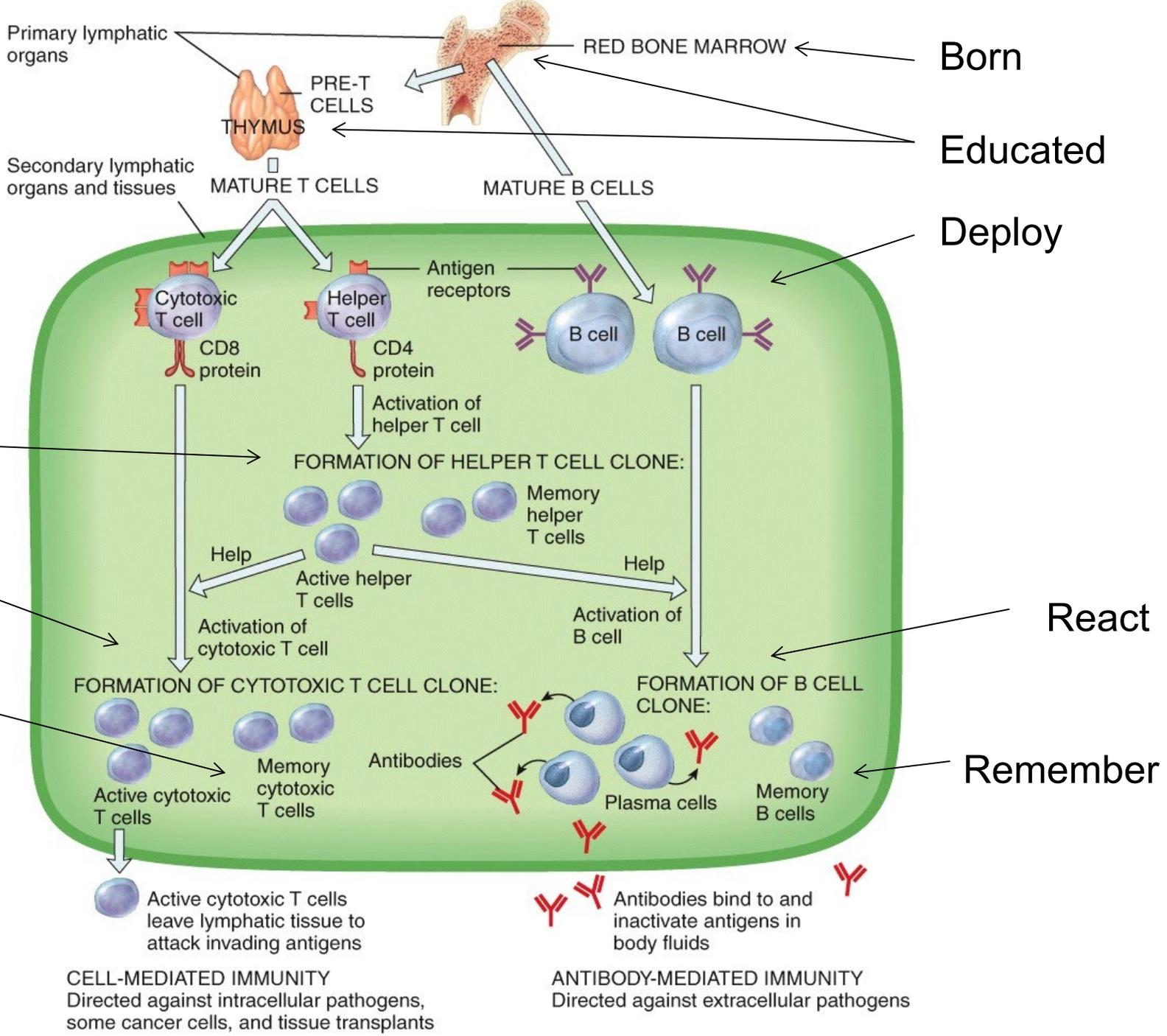
The capacity for antibodies to aggregate, or **agglutinate**, antigens is the consequence of their cross-linking cells or particles into large clumps. Agglutination renders microbes immobile and enhances their phagocytosis. This is a principle behind certain immune tests discussed in chapter 15.



The interaction of an antibody with complement can result in the specific rupturing of cells and some viruses.



An **antitoxin** is a special type of antibody that neutralizes bacterial exotoxins.



Humoral Immunity Responses

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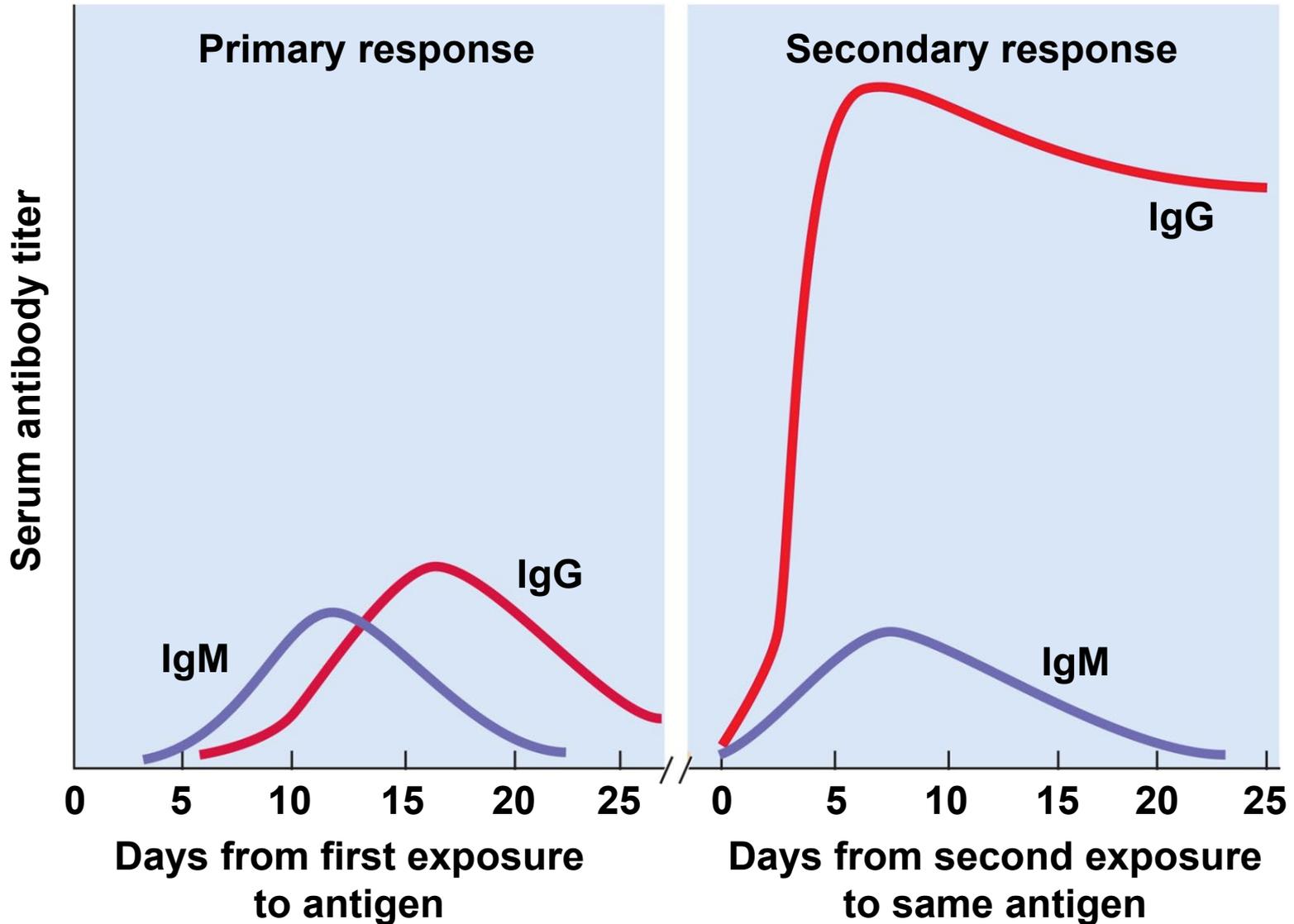
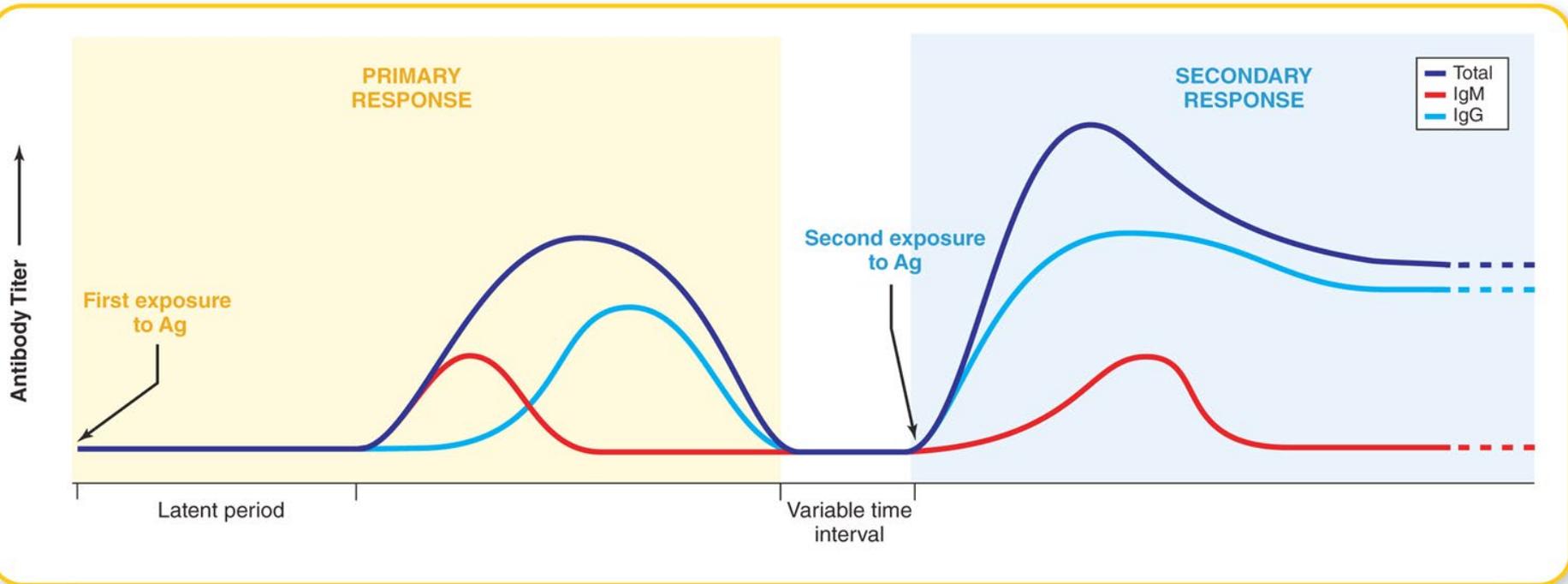


Table 13.9 Primary and Secondary Response to Antigens



Upon the first exposure to an antigen, the system undergoes a **primary response**. The earliest part of this response, the *latent period*, is marked by a lack of antibodies for that antigen, but much activity is occurring. During this time, the antigen is being concentrated in lymphoid tissue and is being processed by the correct clones of B lymphocytes. As plasma cells synthesize antibodies, the serum titer increases to a certain plateau and then tapers off to a low level over a few weeks or months. Early in the primary response, most of the antibodies are the IgM type, which is the first class to be secreted by plasma cells. Later, the class of the antibodies (but not their specificity) is switched to IgG or some other class (IgA or IgE).

After the initial response, there is no activity, but memory cells of the same specificity are seeded throughout the lymphatic system.

When the immune system is exposed again to the same immunogen within weeks, months, or even years, a **secondary response** occurs. The rate of antibody synthesis, the peak titer, and the length of antibody persistence are greatly increased over the primary response. The speed and intensity seen in this response are attributable to the memory B cells that were formed during the primary response. The secondary response is also called the **anamnestic response**. The advantage of this response is evident: It provides a quick and potent strike against subsequent exposures to infectious agents.