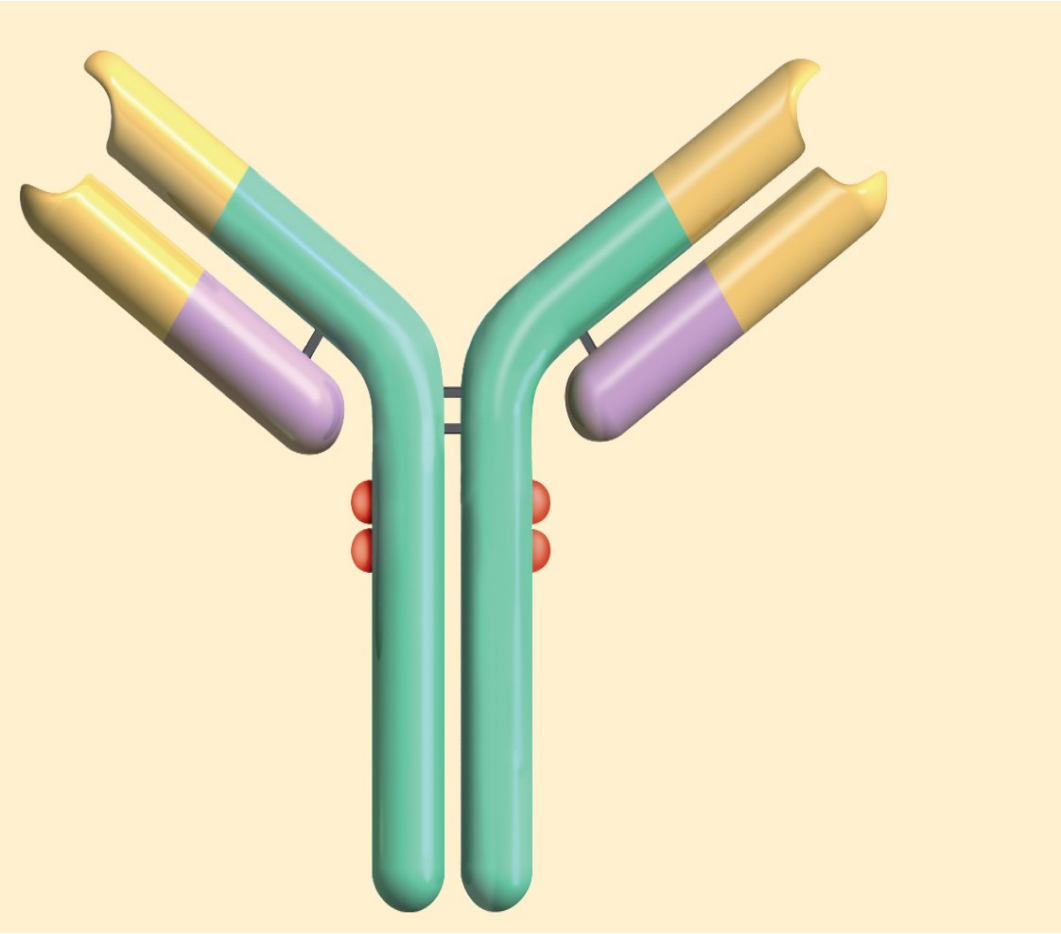
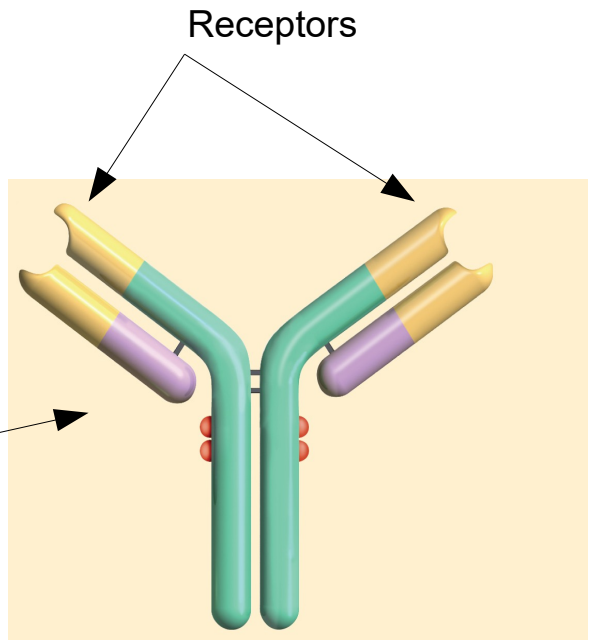
C21.6

Antibodies
Structure & Function



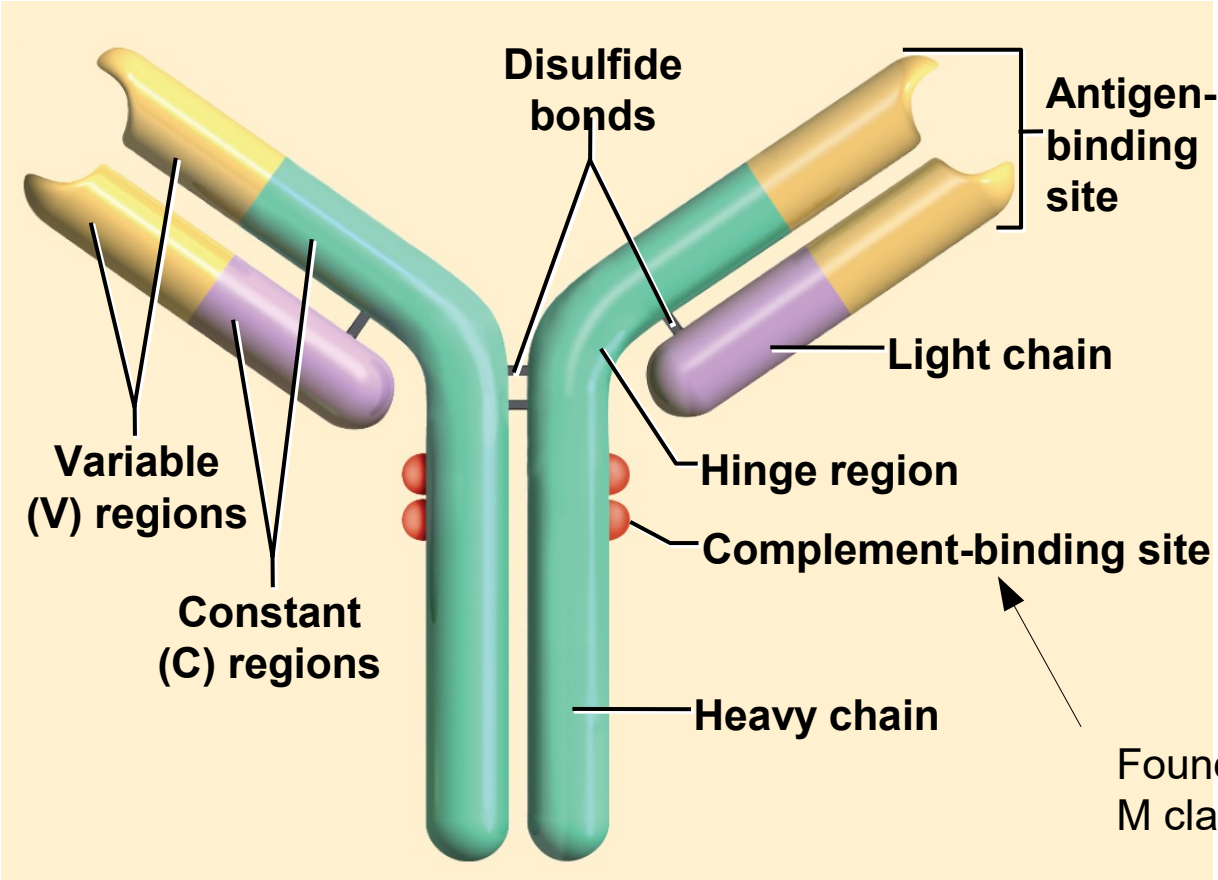
Antibodies

- Immunoglobulin (Ig) is a gama globulin, a protein made by plasma cells. These proteins are our antibodies. They are in the blood plasma, tissue fluids, body secretions, inside our small intestine, on some leukocyte membranes but not inside our cell's cytoplasm. Antibodies have receptors matched to foreign antigen.



- the basic structural unit of an antibody.....
- composed of four polypeptide chains linked by **disulfide (-S-S-) bonds**
- 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
- **variable (V) region** in all four chains // gives the antibody its uniqueness

Antibody Structure

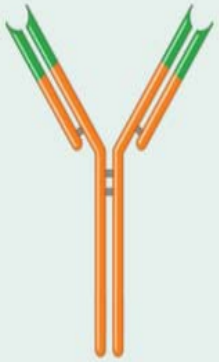
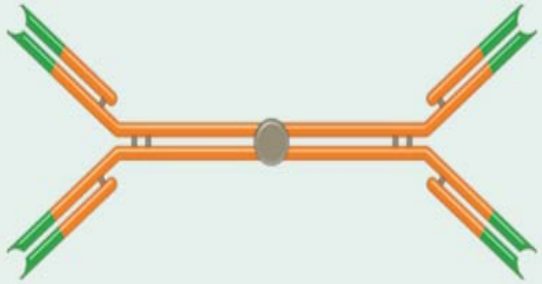


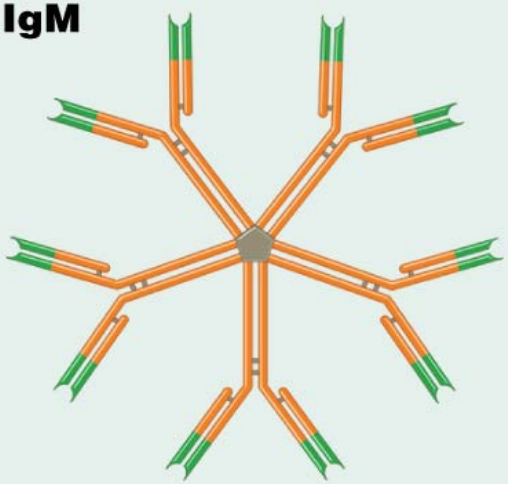
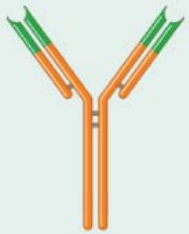
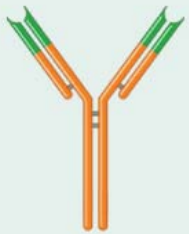
Antibodies render pathogens harmless and tag them for destruction.

Antibodies don't kill pathogen, complement kills pathogens.

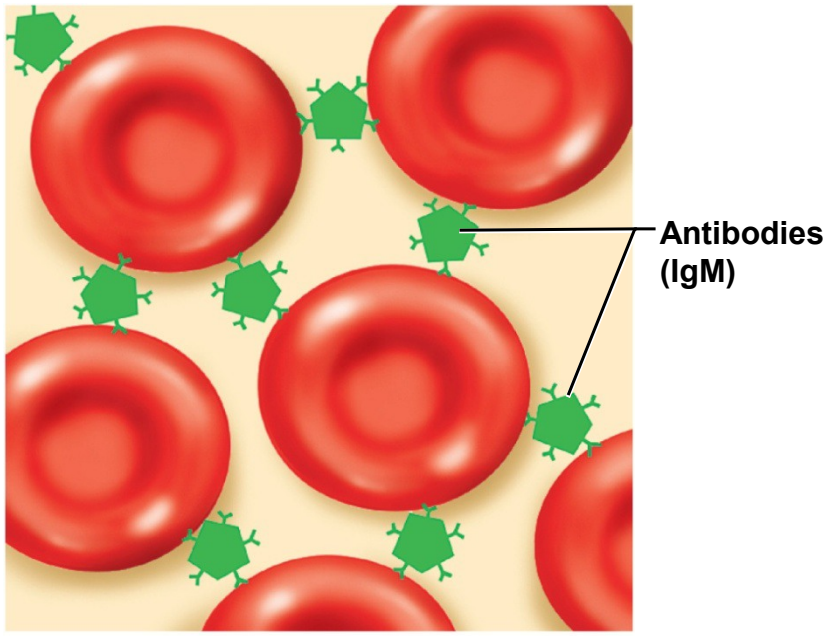
Five Classes of Antibodies

- Remember **"MADGE"** (IgM – IgA – IgD – IgG – IgE)
  - A plasma cell is able to produce all four classes of antibodies – all with same antigen binding site
  - A single plasma cell may 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

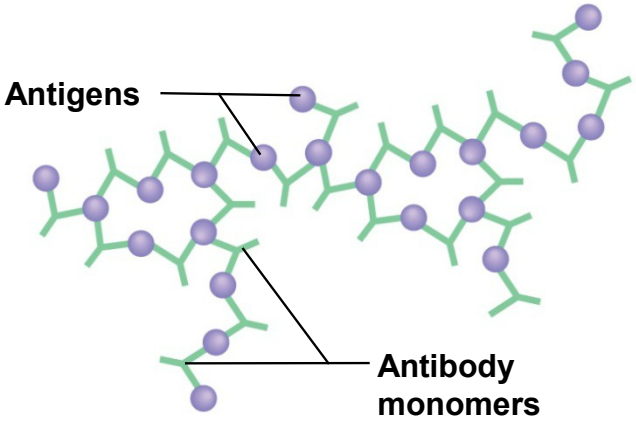
CLASS	FUNCTION
IgG 	• Makes up the majority of antibodies in serum • The only antibody that can cross the placenta from mother to fetus • Functions in opsonization, neutralization, and complement fixation
IgA 	• Found in secretions such as breast milk and saliva • Functions in agglutination and neutralization • M Cells in small intestine secrete IgA into the lumen of the small intestine.

CLASS	FUNCTION
IgM 	• The first antibody secreted on exposure to an antigen • Potent agglutinating and precipitating agent • Functions in complement fixation
IgE 	• Binds mast cells and basophils and triggers their degranulation, facilitating inflammation, particularly in the allergic response
IgD 	• Antibody found exclusively on the surface of B cells • Has a role in B cell sensitization and activation

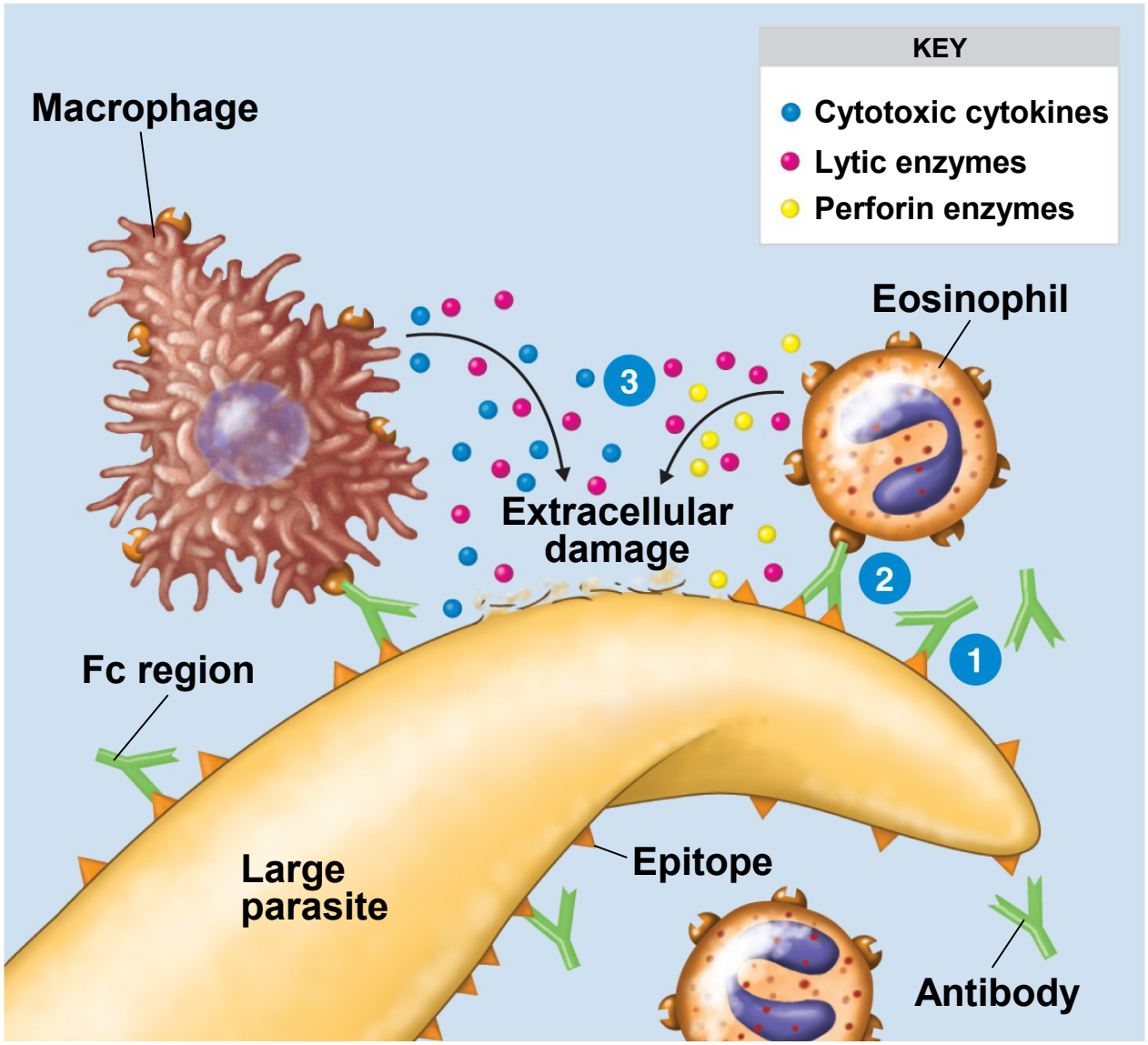
Agglutination



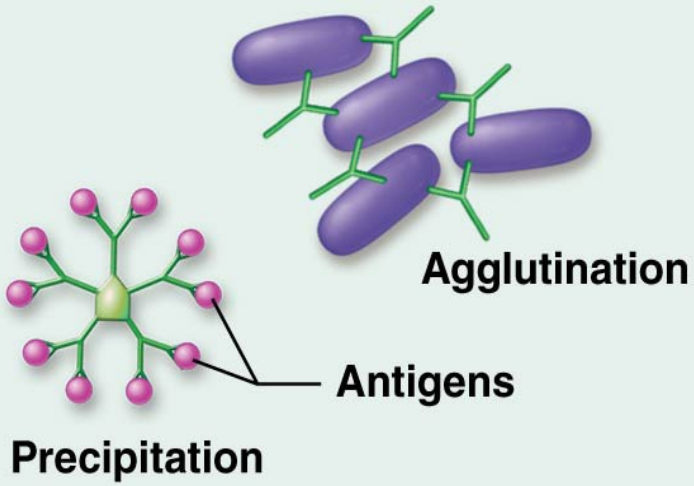
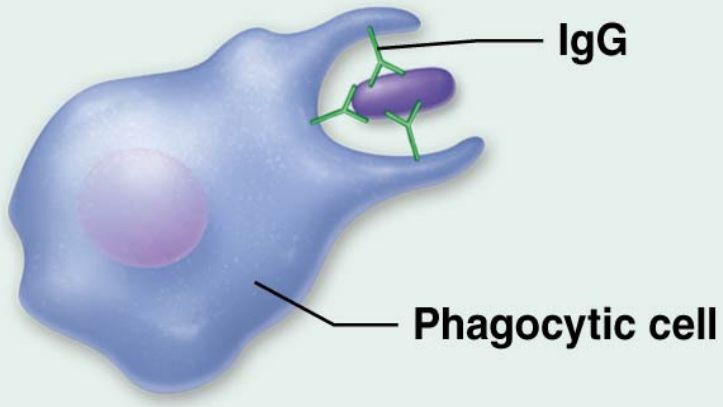
(a)



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.

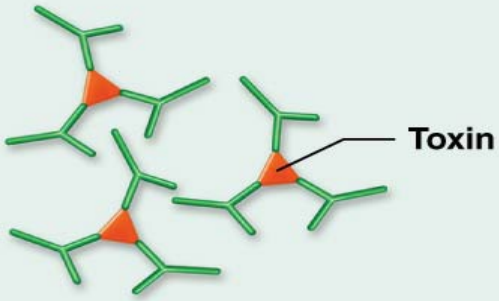
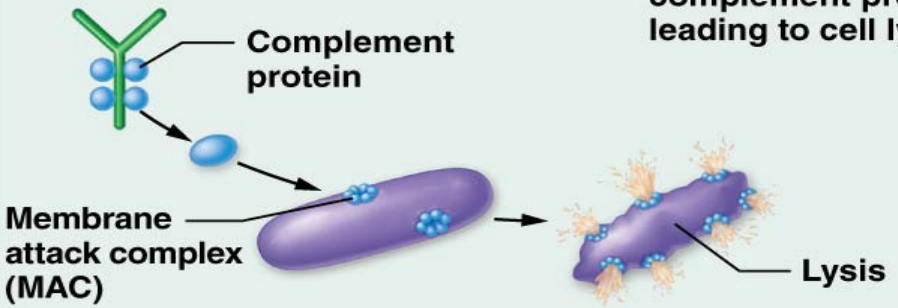
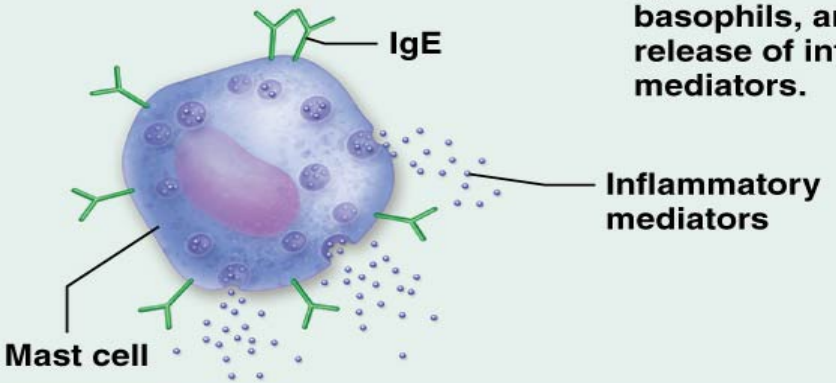
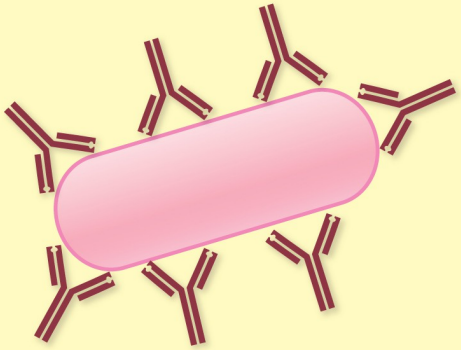
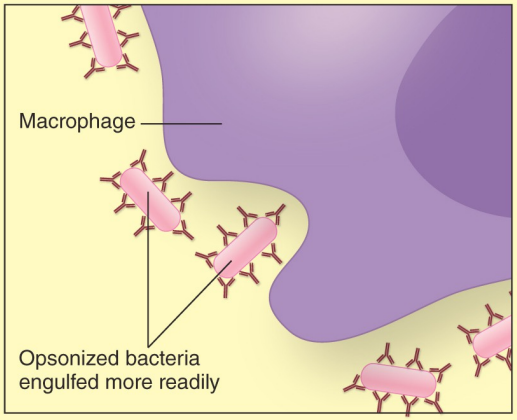
FUNCTION	DESCRIPTION
Neutralization 	Antibodies bind pathogenic components of toxins and block toxic effects.
Complement activation 	Antibodies activate complement proteins, leading to cell lysis.
Stimulation of inflammation 	IgE binds mast cells and basophils, and triggers release of inflammatory mediators.

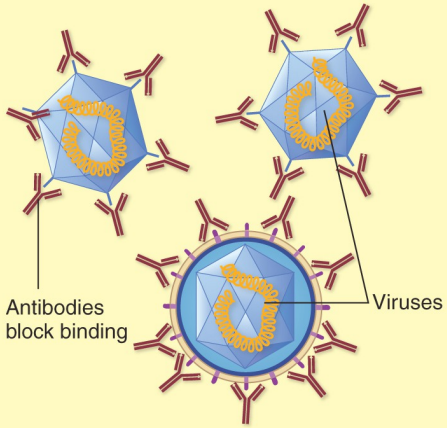
Table 13.7 Summary of Antibody Functions



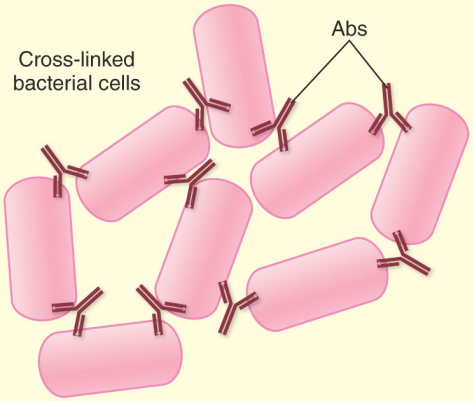
Antibodies coat the surface of a bacterium, preventing its normal function and reproduction in various ways.



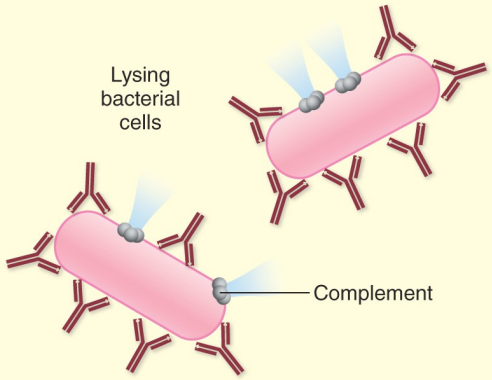
Antibodies called opsonins stimulate **opsonization** (ahp″-son-uh-zaz′-shun), a process that makes microbes more readily recognized by phagocytes, which dispose of them. Opsonization has been likened to putting handles on a slippery object to provide phagocytes a better grip.



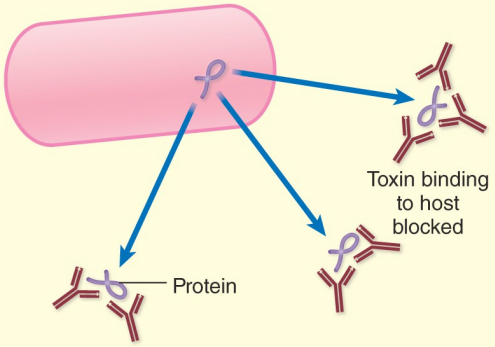
In **neutralization** reactions, antibodies fill the surface receptors on a virus or the active site on a microbial enzyme to prevent it from attaching normally.



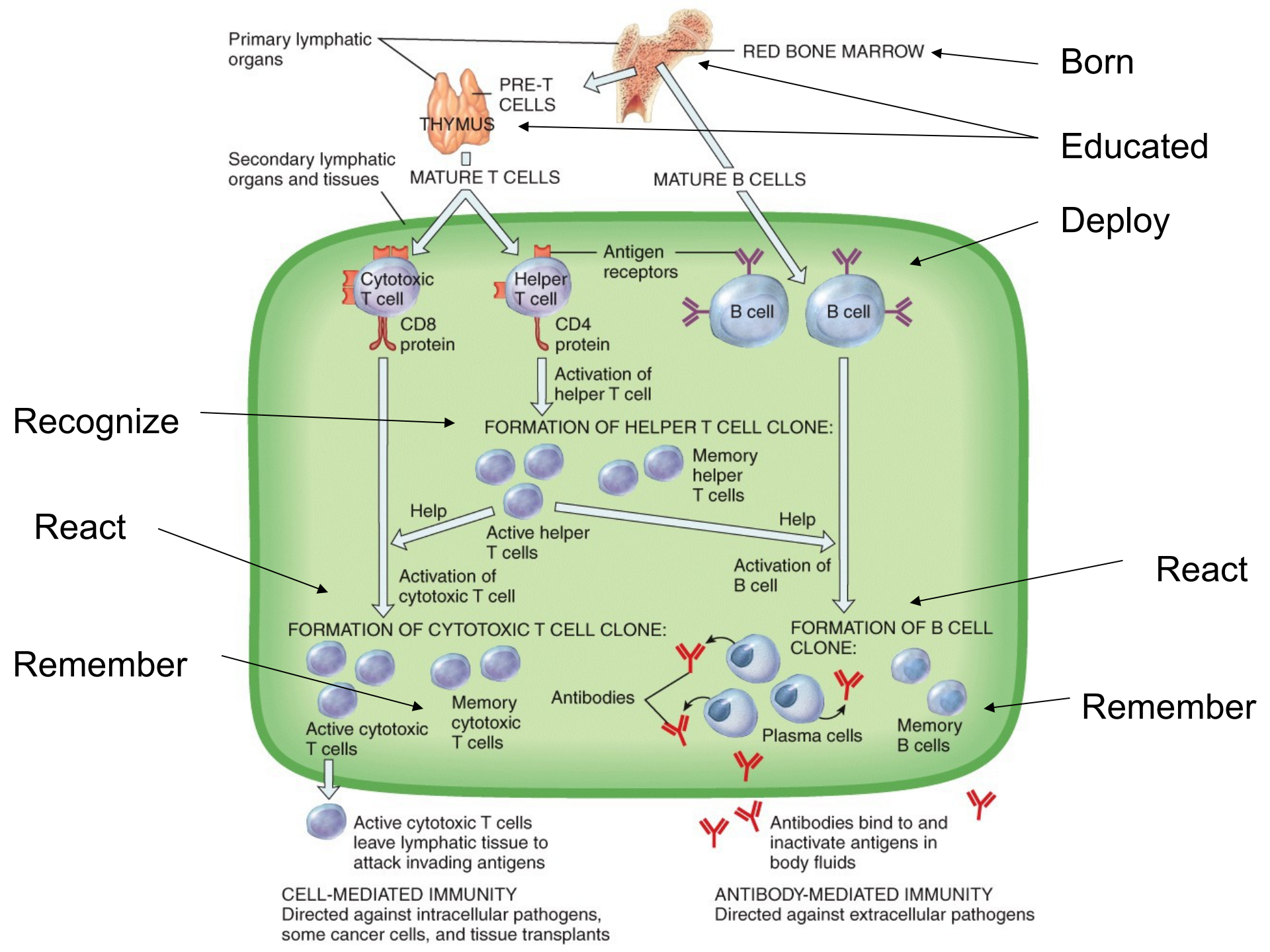
The capacity for antibodies to aggregate, or **agglutinate,** antigens is the consequence of their cross-linking cells or particles into large clumps. Agglutination renders microbes immobile and enhances their phagocytosis. This is a principle behind certain immune tests discussed in chapter 15.



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.


Primary lymphatic organs
RED BONE MARROW
Born
PRE-T CELLS
THYMUS
Educated
Secondary lymphatic organs and tissues
MATURE T CELLS
MATURE B CELLS
Deploy
Antigen receptors
Cytotoxic T cell
Helper T cell
B cell
B cell
CD8 protein
CD4 protein
Activation of helper T cell
Recognize
FORMATION OF HELPER T CELL CLONE:
Memory helper T cells
React
Help
Help
Active helper T cells
Activation of cytotoxic T cell
Activation of B cell
React
FORMATION OF CYTOTOXIC T CELL CLONE:
FORMATION OF B CELL CLONE:
Remember
Antibodies
Memory cytotoxic T cells
Active cytotoxic T cells
Plasma cells
Memory B cells
Remember
Active cytotoxic T cells leave lymphatic tissue to attack invading antigens
Antibodies bind to and inactivate antigens in body fluids
CELL-MEDIATED IMMUNITY
Directed against intracellular pathogens, some cancer cells, and tissue transplants
ANTIBODY-MEDIATED IMMUNITY
Directed against extracellular pathogens

Humoral Immunity Responses

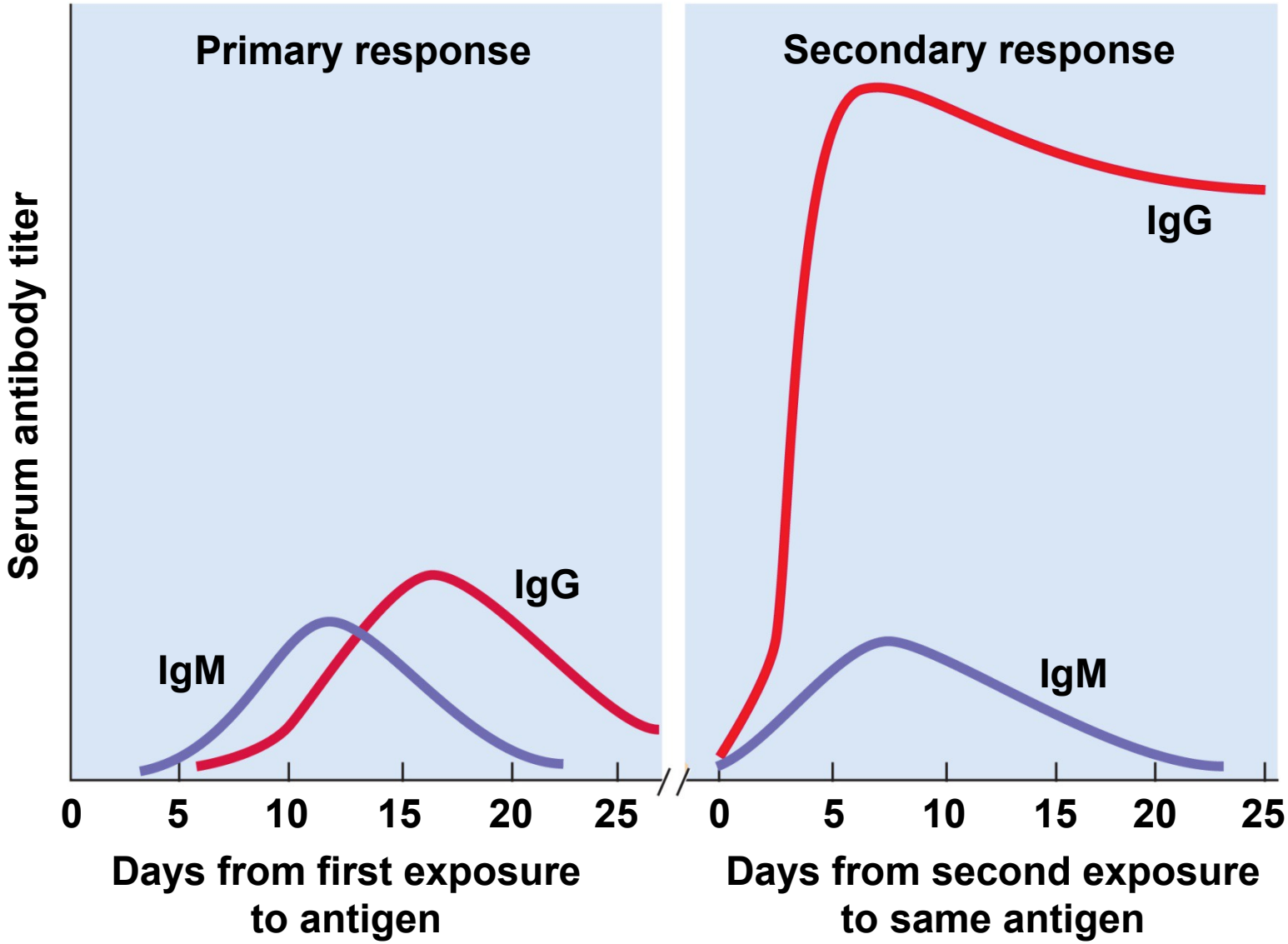
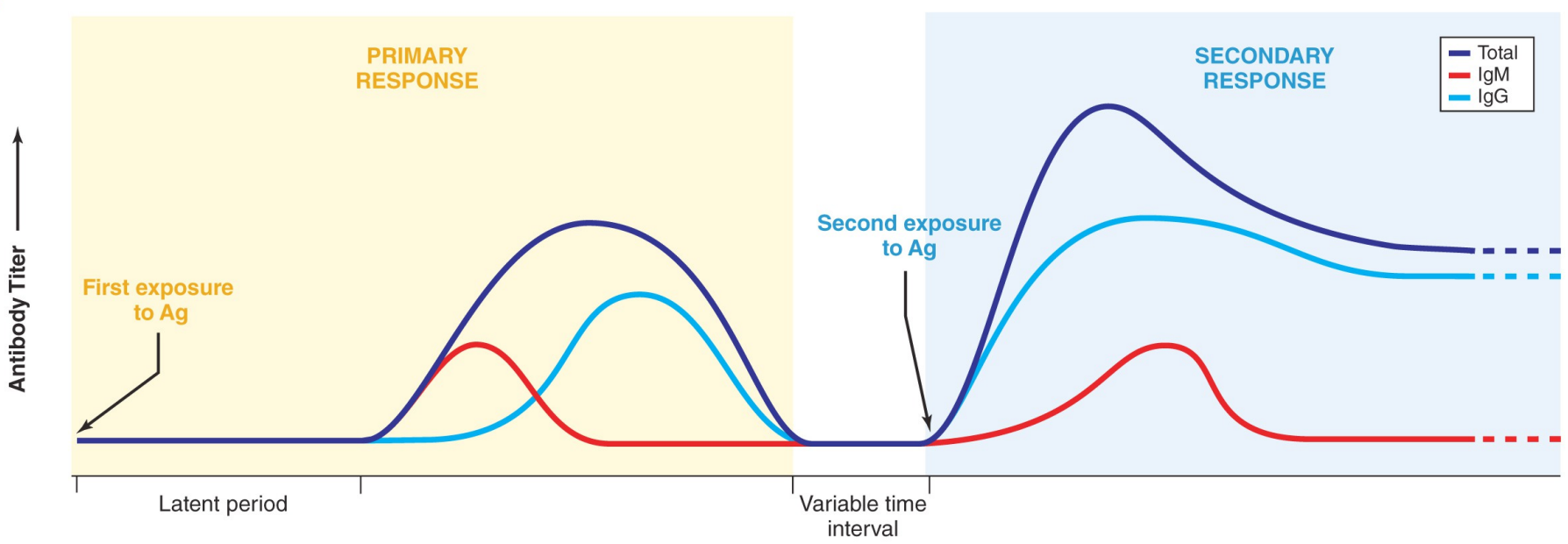


Table 13.9 Primary and Secondary Response to Antigens



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.