

# Microbial Immunity



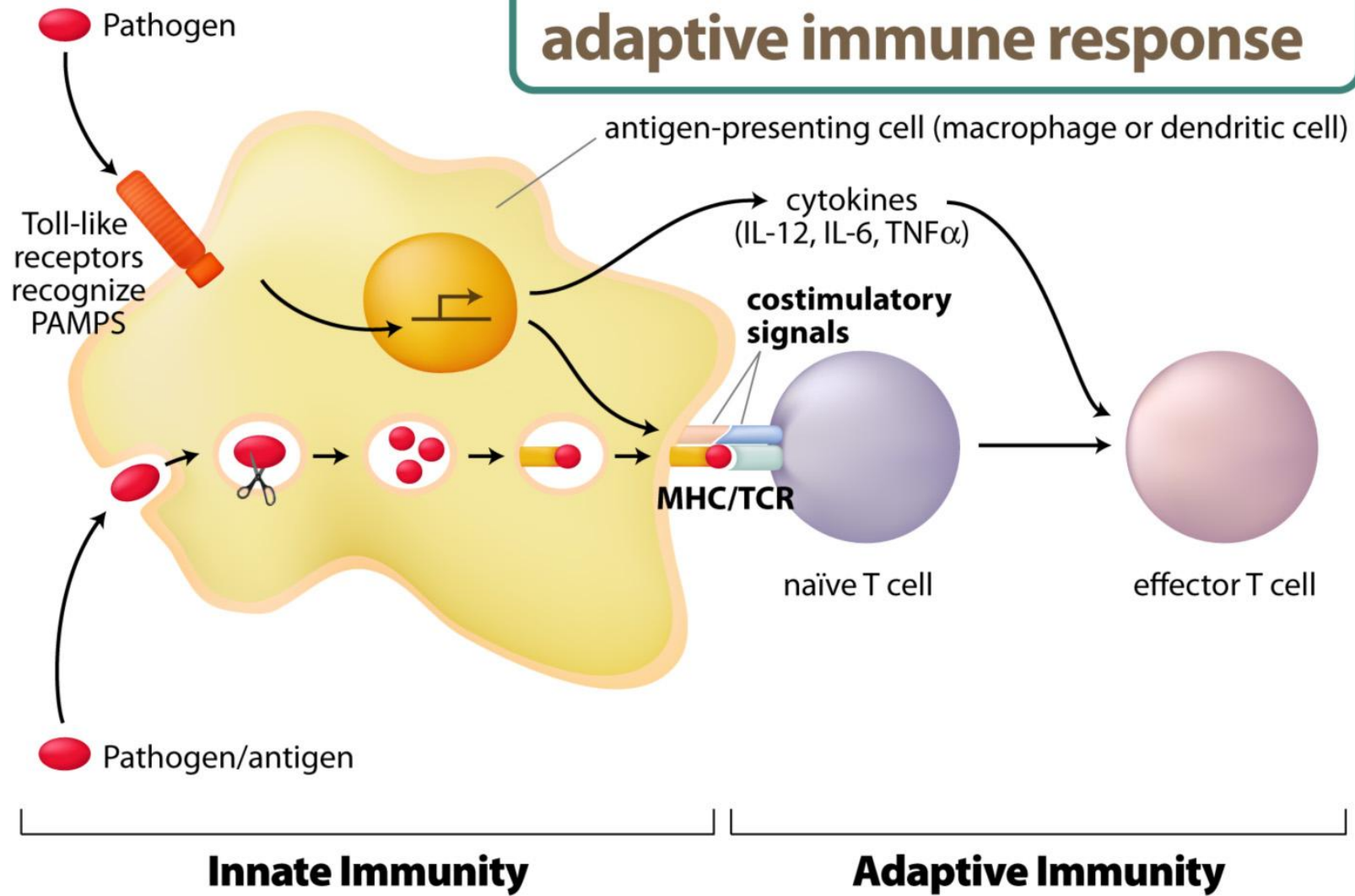
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# General features of immunity to microbes

- Microbial infections are best prevented by both innate and adaptive immune responses.
- As microbes differ a lot in their host attacking regime, their removal from the affected patient requires efficient effector systems.
- The result of many microbial infections is decided by the balance between microbial schemes for withstanding immunity and the host immune responses.

- Immunity against microbes performs almost similar to other defense mechanisms. Although it is essential for host survival but sometimes it may cause damage to the host tissue itself.
- Some microbes especially viruses have the potential to be latent. In such cases the host immune response does not allow the microbe to spread but the microbes survive in the latent form, i.e. infection may prevail under specific conditions like stress etc.

# Innate immunity is critical to adaptive immune response

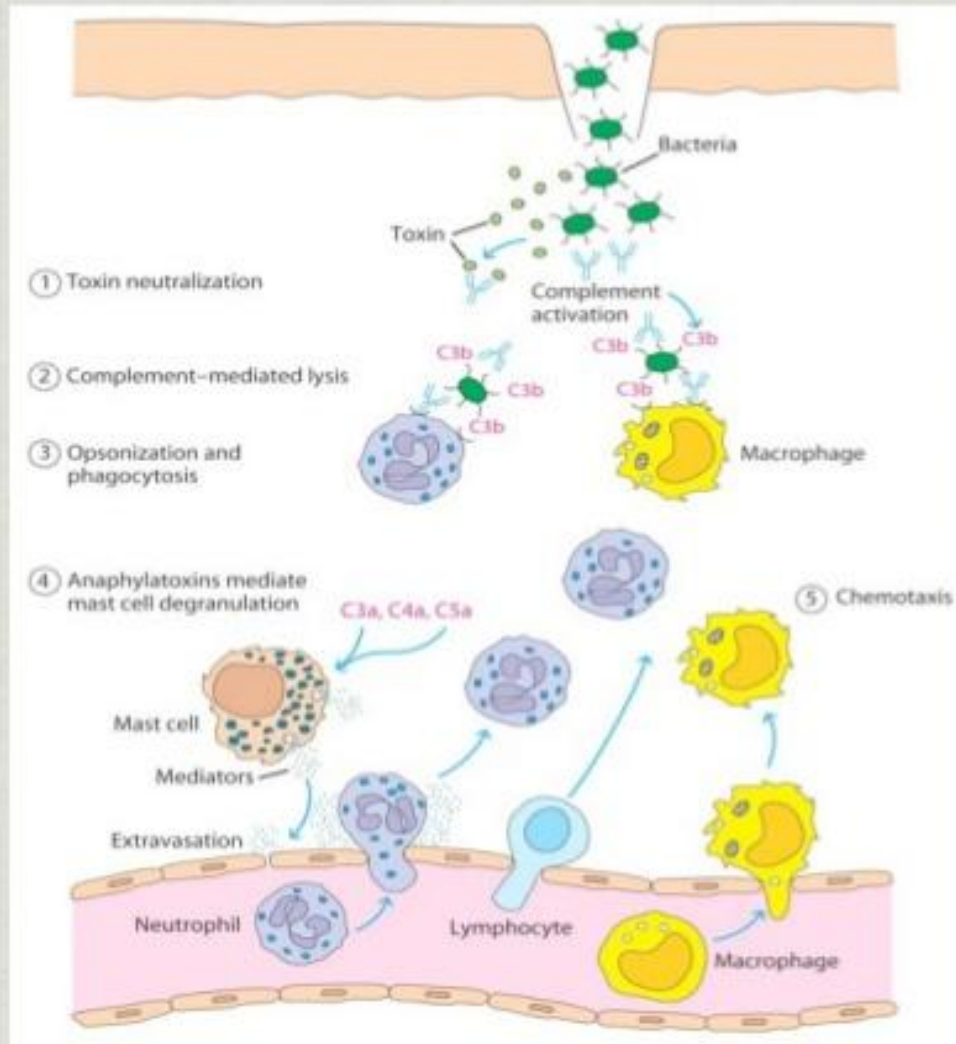


# Immunity to bacteria

## Immunity to extracellular bacteria

- Extracellular bacteria are those that multiply and reside outside the host cell. These bacteria mainly affect the cells in two ways. They either attack by causing inflammation and tissue damage or by producing toxins.

# RESPONSE TO EXTRACELLULAR & INTRACELLULAR BACTERIA



- ✱ Infection by extracellular bacteria induces production of humoral antibodies, which are ordinarily secreted by plasma cells in regional lymph nodes and the submucosa of the respiratory and gastrointestinal tracts
- ✱ The humoral immune response is the main protective response against extracellular bacteria
- ✱ The antibodies act in several ways to protect the host from the invading organisms, including removal of the bacteria and inactivation of bacterial toxins

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# Innate immunity to extracellular bacteria

- Stimulation of phagocytes
- Induction of inflammatory response
- Activation of complement system

# Adaptive immunity to extracellular bacteria

- Humoral or antibody mediated immunity as it prevents the infection by neutralizing the toxins.
- Stimulate the production of CD4+ helper T cells which induces inflammation and phagocytic activity.



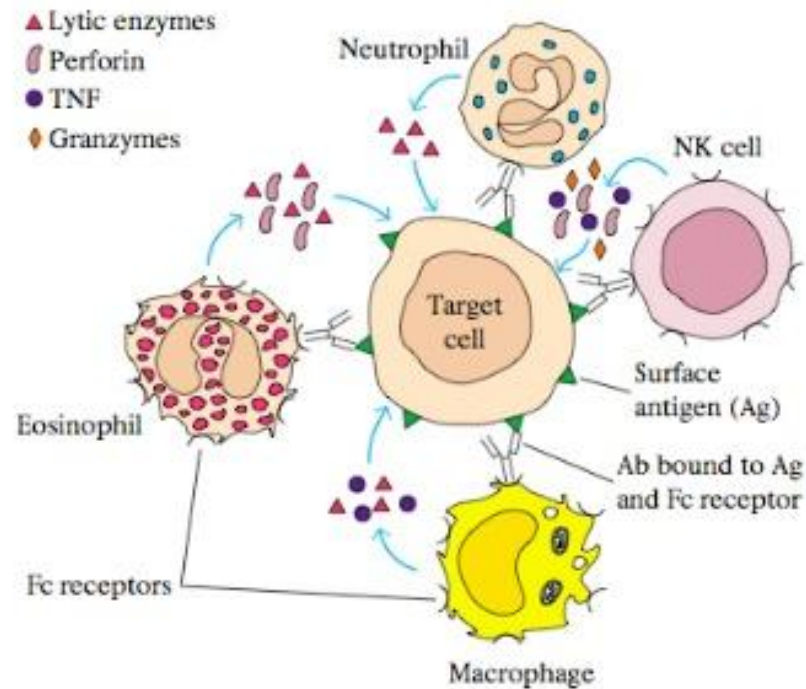
# Immune evasion by extracellular bacteria

1. Polysaccharide antigens or encapsulated bacteria are more lethal as compared to a strain devoid of capsule because they resist phagocytosis.
2. Capsulated bacteria inhibit alternate pathway of complement system due to the presence of sialic acid.
3. One more way of evading immune response by extracellular bacteria is due to the genetic edition of surface antigens. E.g. surface antigen of some specific bacteria is contained in their pili. Pili contain a protein antigen called “pilin” and this pilin undergoes gene variation. Pili are the structures of bacteria responsible for bacterial adhesion to host cells.

# Immunity to intracellular bacteria

- Some intracellular bacteria like pathogenic or facultative are able to multiply within the phagocytes, so their elimination from the patients requires modified strategies.

# RESPONSE TO EXTRACELLULAR & INTRACELLULAR BACTERIA



**FIGURE 14-15** Antibody-dependent cell-mediated cytotoxicity (ADCC). Nonspecific cytotoxic cells are directed to specific target cells by binding to the Fc region of antibody bound to surface antigens on the target cells. Various substances (e.g., lytic enzymes, TNF, perforin, granzymes) secreted by the nonspecific cytotoxic cells then mediate target-cell destruction.

- While innate immunity is not very effective against intracellular bacterial pathogens, intracellular bacteria can activate NK cells, which, in turn, provide an early defense against these bacteria
- Intracellular bacterial infections tend to induce a cell-mediated immune response, specifically, delayed-type hypersensitivity
- In this response, cytokines secreted by CD4<sup>+</sup> T cells are important—notably IFN-gamma, which activates macrophages to kill ingested pathogens more effectively

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# Innate immunity to intracellular bacteria

- Phagocytes and natural killer cells provide innate immunity to the intracellular bacteria.
- The secretions from these bacteria are recognized by TLRs and cytoplasmic proteins of the NOD-like receptor (NLR) family so that they stimulate the phagocytes to degrade the invading bacteria.
- Activated natural killer cells produce IFN- $\gamma$ , which consecutively stimulates macrophages and cytokines.

# Adaptive immunity to intracellular bacteria

- CD4+ T-cells and CD8+ cytotoxic T lymphocytes are the two major forms of cell mediated immunity that participate in phagocytosis or killing of infected cells, respectively.
- Granulomatous inflammation acts as a marker for most of the infections due to intracellular bacteria, which occurs because of T-cell and macrophage stimulation.

# Dodging of immune system by intracellular bacteria

- Intracellular bacteria tend to dodge the immune system in many ways comprising evading into the cytosol or preventing phagolysosome fusion and by overpowering the reactive oxygen species by their microbicidal activity.