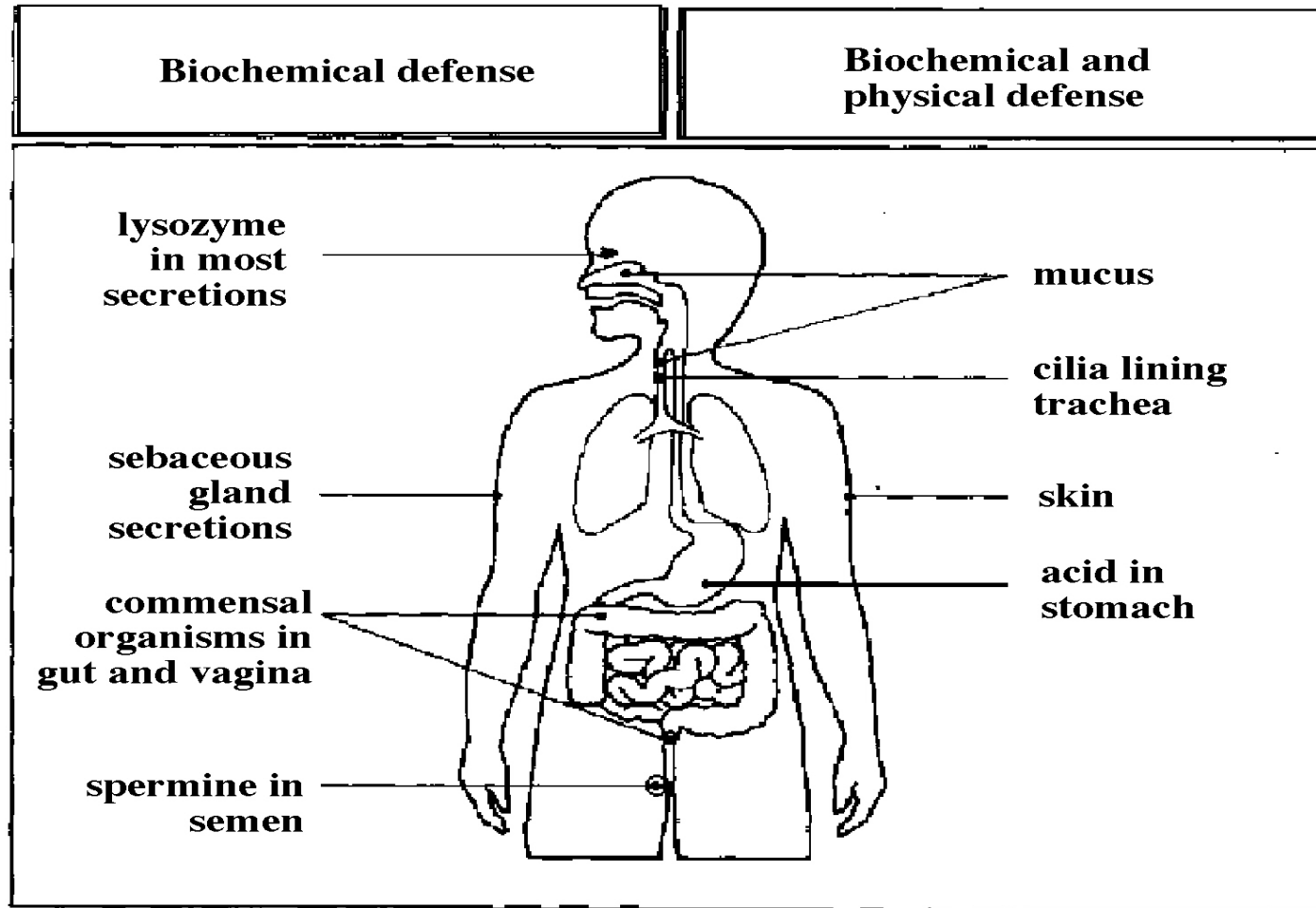


Bacterial defense against specific immune responses

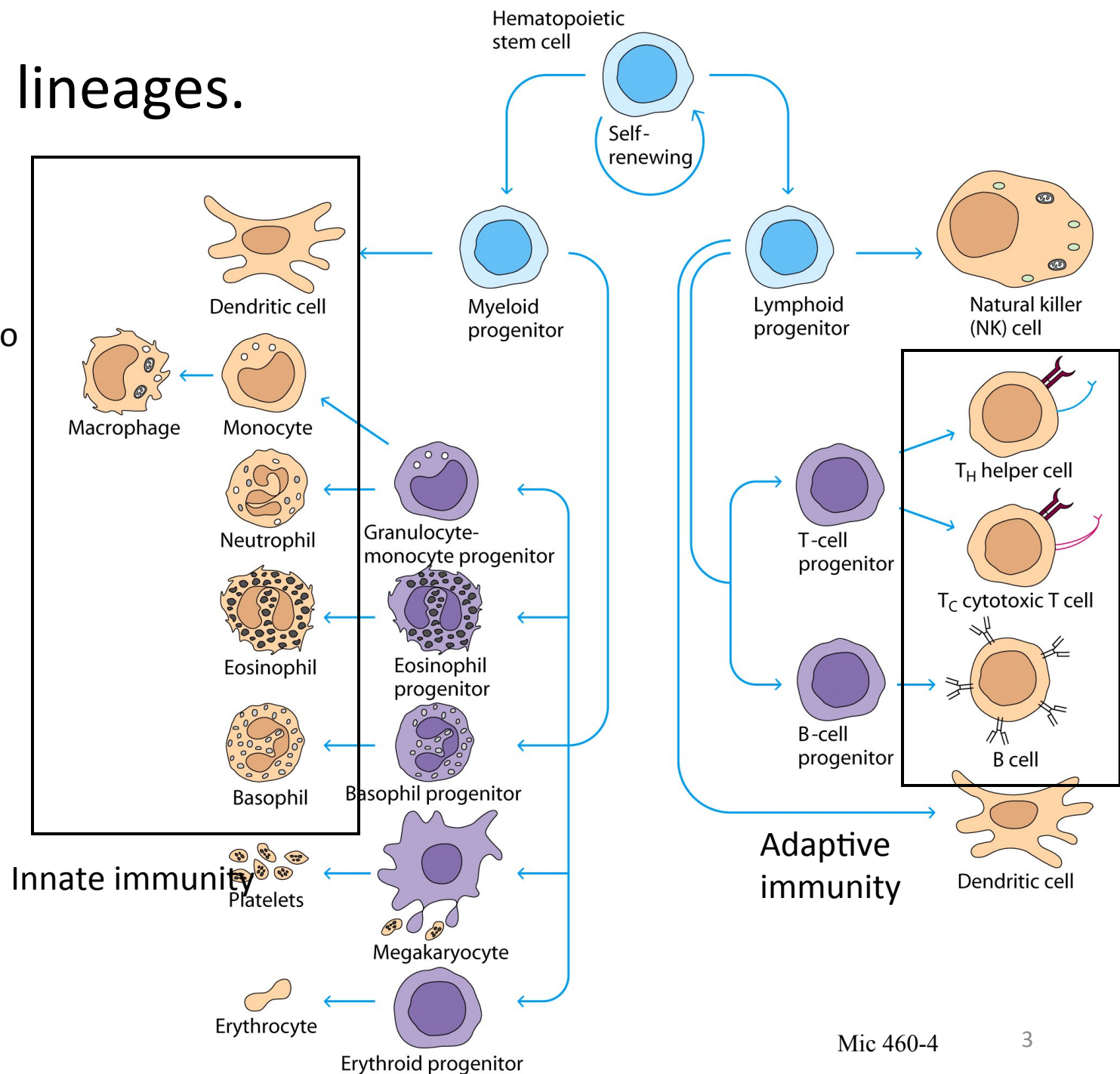
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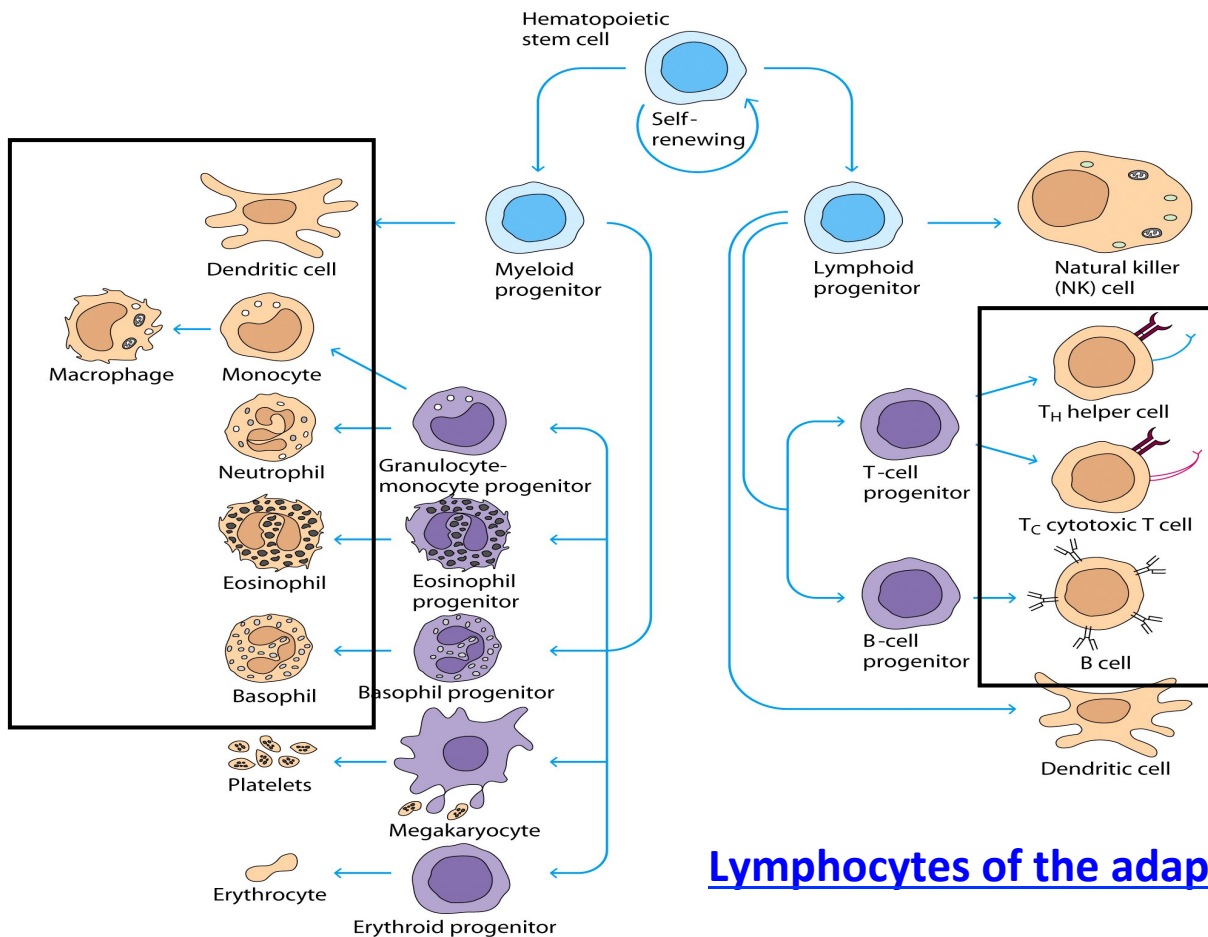
Physical & Biochemical barriers



Blood cells lineages.

Most blood cells act to fight infection.





Lymphocytes of the adaptive immune system

Dendritic cells and macrophage: directly kill microbes by phagocytosis and other mechanisms. They also help to activate T cells (**connection between innate and adaptive immunity**)

T helper cells: regulate other immune cells
T cytotoxic (killer) cells: kill infected cells
B cells: produce antibodies (immunoglobulin)

NK cells: are lymphocytes that have characteristics of innate and adaptive immunity.

Phagocytosis “cellular eating”

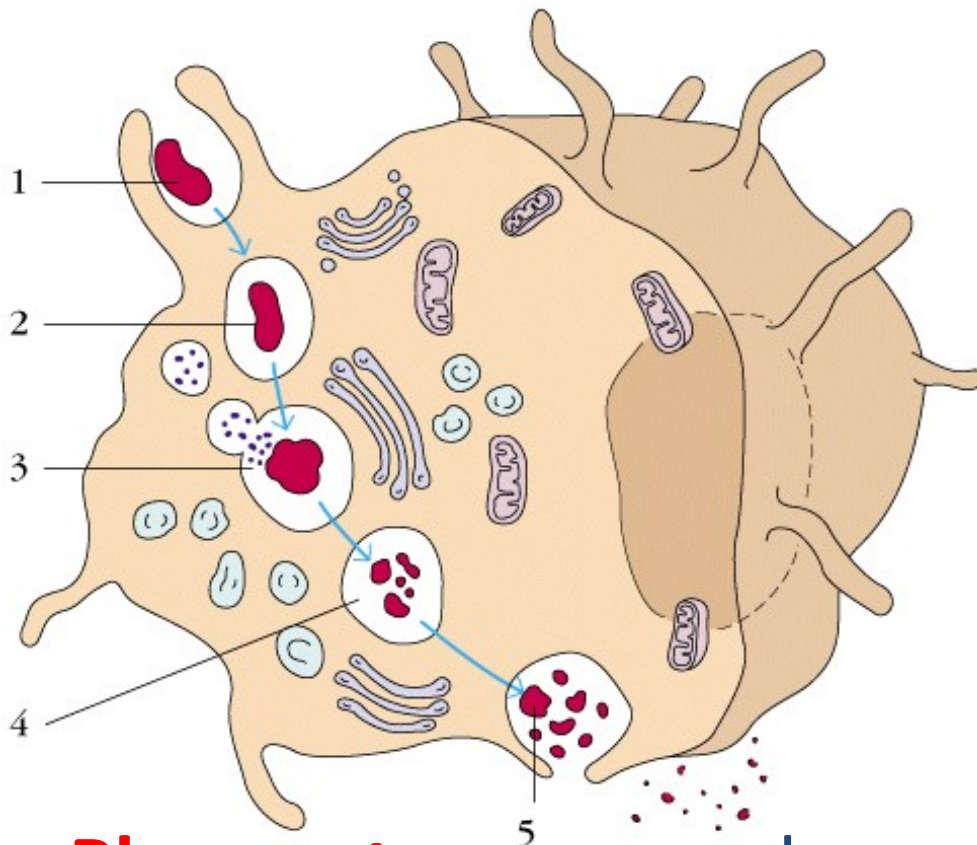
1. Bacterium attaches to membrane

2. Bacterium is ingested, forming phagosome,

3. Phagosome fuses with lysosome.

4. Lysosomal enzymes digest the bacteria.

5. Digested material is released from cell.



Phagocytes: macrophage,
neutrophils, dendritic cells

Bacterial defense against specific immune responses

- Bacteria evolve very rapidly in relation to their host.
- Consequently, pathogenic bacteria have developed numerous ways to bypass or overcome the immunological defenses of the host, which contributes to the virulence of the microbe and the pathology of the disease.

PATHOGEN STRATEGIES TO DEFEND AGAINST THE SPECIFIC IMMUNE DEFENSES

- 1. Immunological Tolerance to a Bacterial Antigen**
- 2. Antigenic Disguises**
- 3. Immunosuppression**
- 4. Persistence of a Pathogen at Bodily Sites Inaccessible to Specific Immune Response**
- 5. Induction of Ineffective Antibody**
- 6. Antibodies Absorbed by Soluble Bacterial Antigens**
- 7. Local Interference with Antibody Activity**
- 8. Antigenic Variation**

PATHOGEN STRATEGIES TO DEFEND AGAINST THE SPECIFIC IMMUNE DEFENSES

1. Immunological Tolerance to a Bacterial Antigen

Tolerance:

- ☐ Is a property of the host in which there is an immunologically-specific reduction in the immune response to a given antigen (Ag).
- ☐ Involve a general failure in the immune response but a particular deficiency in relation to the specific antigen(s) of a given bacterium.
- ☐ If there is a depressed immune response to relevant antigens the process of infection is facilitated.

PATHOGEN STRATEGIES TO DEFEND AGAINST THE SPECIFIC IMMUNE DEFENSES

Tolerance to an Ag can arise in a number of ways, but three are possibly relevant to bacterial infections.

a. Fetal exposure to Ag. If a fetus is infected at certain stages of immunological development, the microbial Ag may be seen as "self", thus inducing tolerance to the Ag (failure to undergo an immunological response)

b. High persistent doses of circulating Ag. Tolerance to a bacterium or one of its products might arise when large amounts of bacterial antigens are circulating in the blood. The immunological system becomes overwhelmed.

PATHOGEN STRATEGIES TO DEFEND AGAINST THE SPECIFIC IMMUNE DEFENSES

Tolerance to an Ag can arise in a number of ways, but three are possibly relevant to bacterial infections.

c. Molecular mimicry. If a bacterial Ag is very similar to normal host "antigens", the immune responses to this Ag may be weak giving a degree of tolerance "known as molecular mimicry". The antigenic determinants of the bacterium are closely related chemically to host tissue components that the immunological response cannot be raised. **Ex.,** Some bacterial capsules are composed of polysaccharides (hyaluronic acid, sialic acid) similar to host tissue that they are not immunogenic.

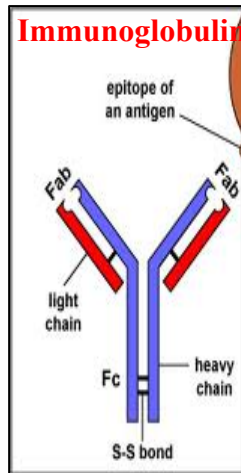
PATHOGEN STRATEGIES TO DEFEND AGAINST THE SPECIFIC IMMUNE DEFENSES

2. Antigenic Disguises

Bacteria may be able to coat themselves with host proteins such as fibrin, fibronectin, or immunoglobulin molecules. In this way they hide their own antigenic surface from the immunological system.

Ex.

- *Staphylococcus aureus* produces cell-bound **coagulase** and **clumping factor** that cause fibrin to clot on the cell surface, so that bacteria will not be identified as antigens and no immunological response.
- **Protein A** produced by *S. aureus*, and the analogous **Protein G** produced by *Streptococcus pyogenes*, bind the Fc portion of immunoglobulins, thus coating the bacteria with antibodies and canceling their opsonizing capacity by the disorientation.
- *E. coli* K1, that causes meningitis in newborns, has a capsule composed of **sialic acid** providing an antigenic disguise, as does the hyaluronic acid capsule of *Streptococcus pyogenes*.



PATHOGEN STRATEGIES TO DEFEND AGAINST THE SPECIFIC IMMUNE DEFENSES

3. Immunosuppression

Suppressed immune responses are occasionally observed during chronic bacterial infections such as leprosy and tuberculosis.

4. Persistence of a Pathogen at Bodily Sites Inaccessible to Specific Immune Response

Intracellular pathogens can escape host immunological responses as long as they stay inside of infected cells and they do not allow microbial Ag to form on the cell surface (Brucella, listeriae)

5. Induction of Ineffective Antibody Antibodies tend to range in their capacity to react with Ag (the ability of specific Ab to bind to an Ag is called **avidity**). If Abs formed against a bacterial Ag are of low avidity, or if they are directed against unimportant antigenic determinants, they may have only weak antibacterial action. Such "**ineffective**" (non-neutralizing) (*Neisseria gonorrhoeae*)

PATHOGEN STRATEGIES TO DEFEND AGAINST THE SPECIFIC IMMUNE DEFENSES

6. Antibodies Absorbed by Soluble Bacterial Antigens

soluble antigens are able to combine with and "neutralize" antibodies before they reach the bacterial cells.

7. Antigenic Variation

Many pathogenic bacteria exist in nature as **multiple antigenic types** or serotypes, meaning that they are variant strains of the same pathogenic species. **Ex.** there are multiple serotypes of *Salmonella enterica* based on differences in cell wall (O) antigens and/or flagellar (H) antigens.

