Chapter 16/17: Immune system

Lecture

Chapter 16: Nonspecific defenses
First line of defense
Formed elements
Second line of defense
Complement system

Chapter 17: Specific defenses
Antibodies
Humoral response
Cellular response

Lab

Review results from Wed. (innoculate Lac/Glu broths)

Lab EXAM

Immunity terminology

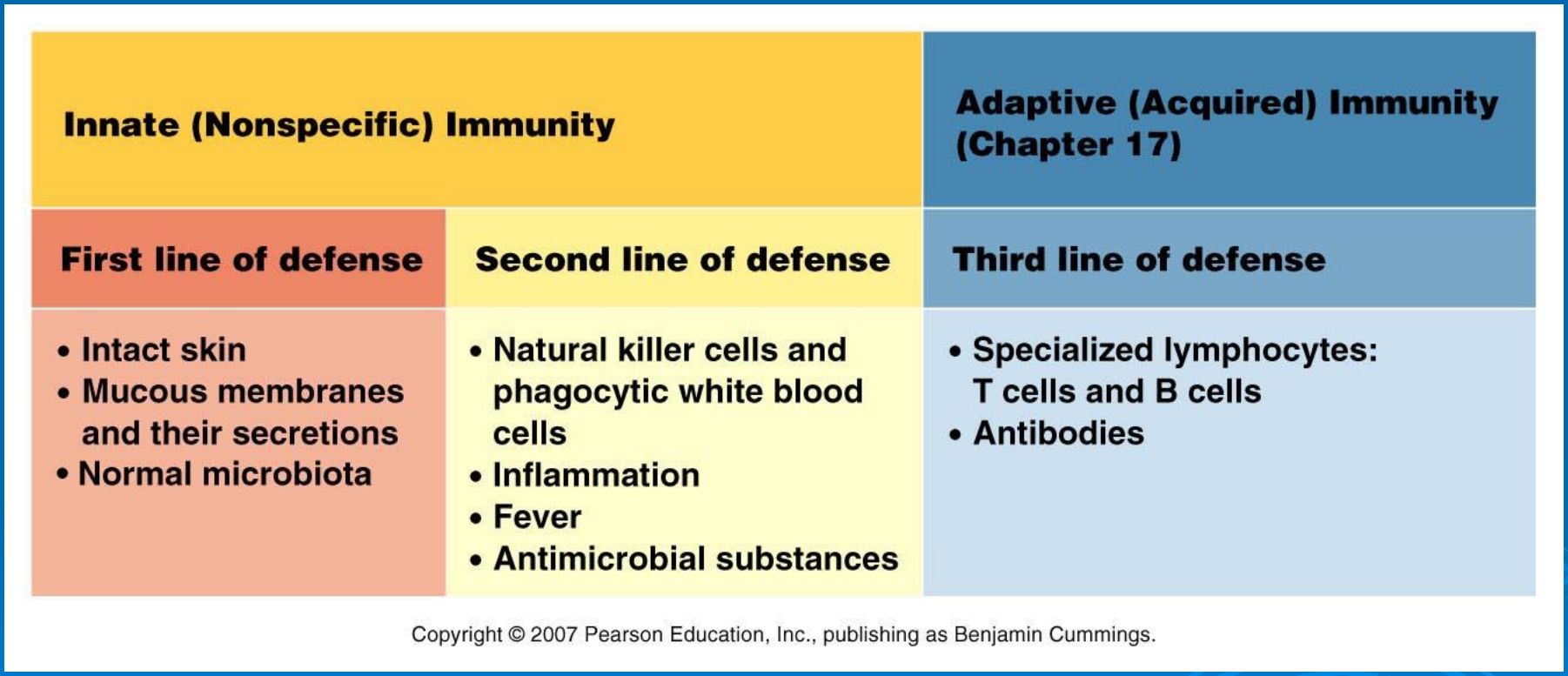
Susceptibility- Lack of resistance to a disease

Resistance/ immunity- Ability to ward off disease

Innate (nonspecific) immunity- Resistance to all microbes; present from birth (can be species specific)

Adaptive (specific) resistance- Resistance to a specific pathogen

Host defense systems



Innate (Nonspecific) Immunity		Adaptive (Acquired) Immunity (Chapter 17)
First line of defense	**Second line of defense**	**Third line of defense**
• Intact skin • Mucous membranes and their secretions • Normal microbiota	• Natural killer cells and phagocytic white blood cells • Inflammation • Fever • Antimicrobial substances	• Specialized lymphocytes: T cells and B cells • Antibodies

Figure 16.1 - Overview (1 of 3)

First lines of defense

(Table 16.3)

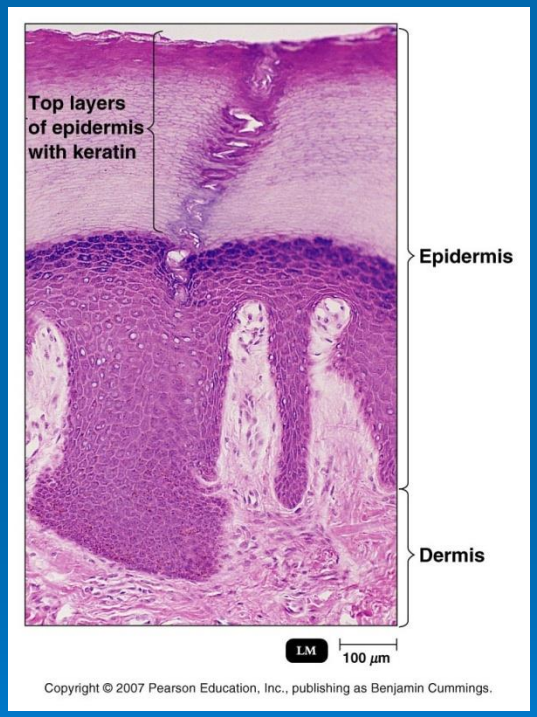


Figure 16.2

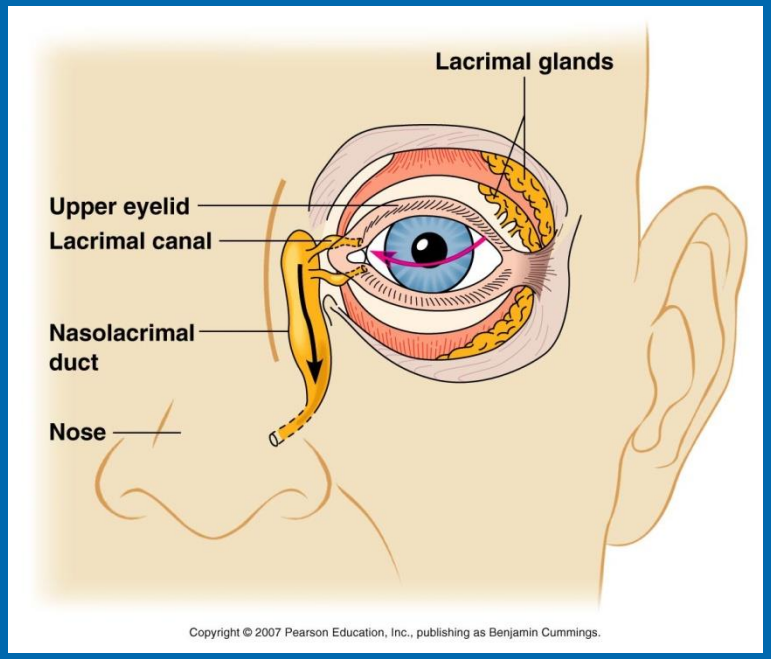


Figure 16.3

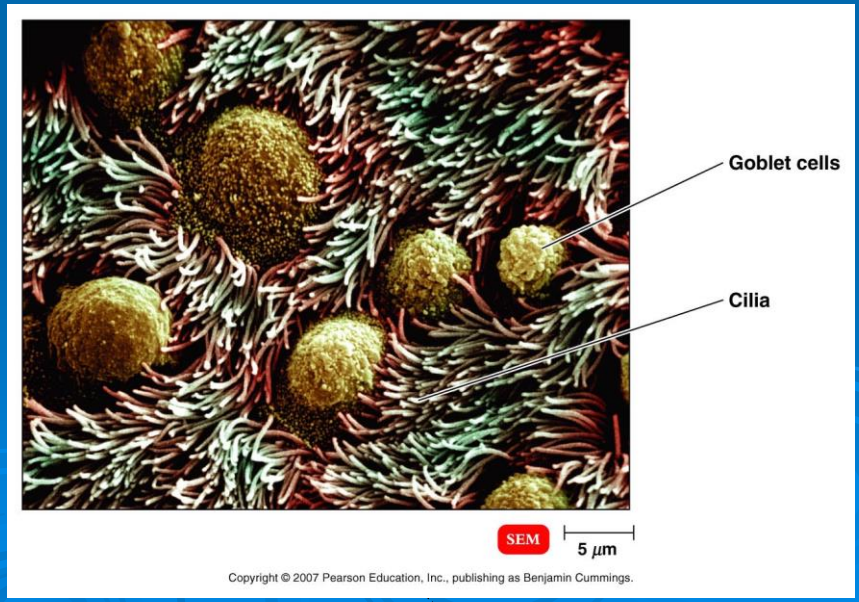
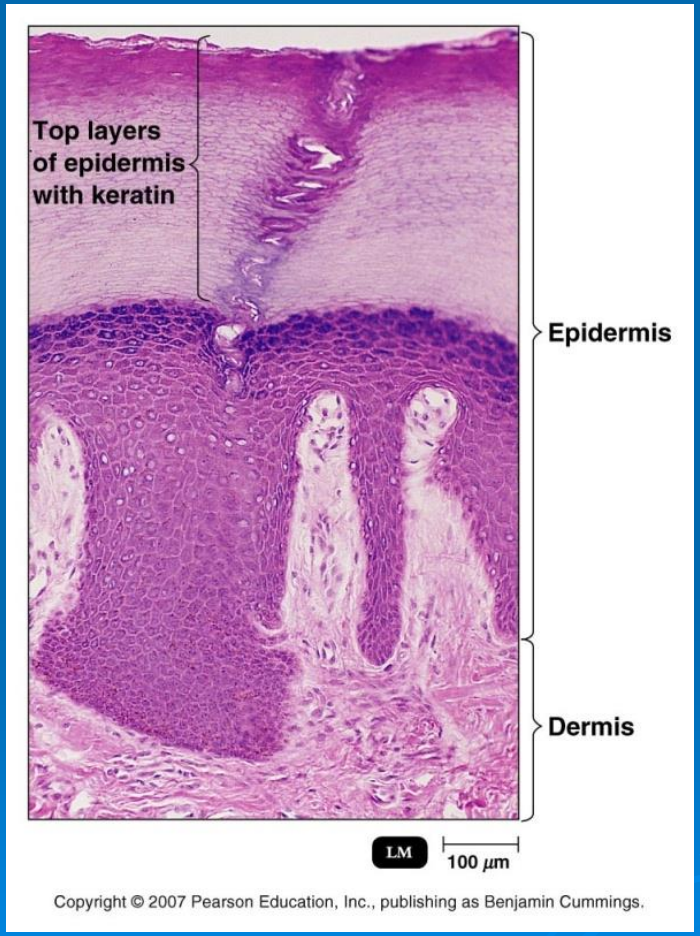


Figure 16.4 (2 of 3)

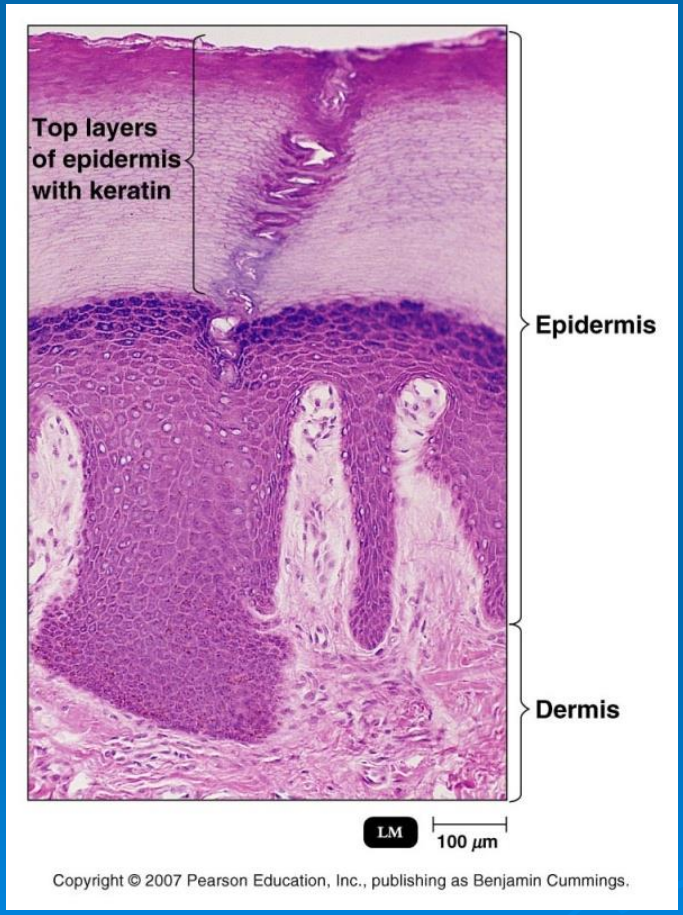
First line of defense- skin



-**Physical factors**

* Dermis and epidermis
* Lots of keratin
* Dry conditions, low temperature

First line of defense- skin



-**Physical factors**

* Dermis and epidermis
* Lots of keratin
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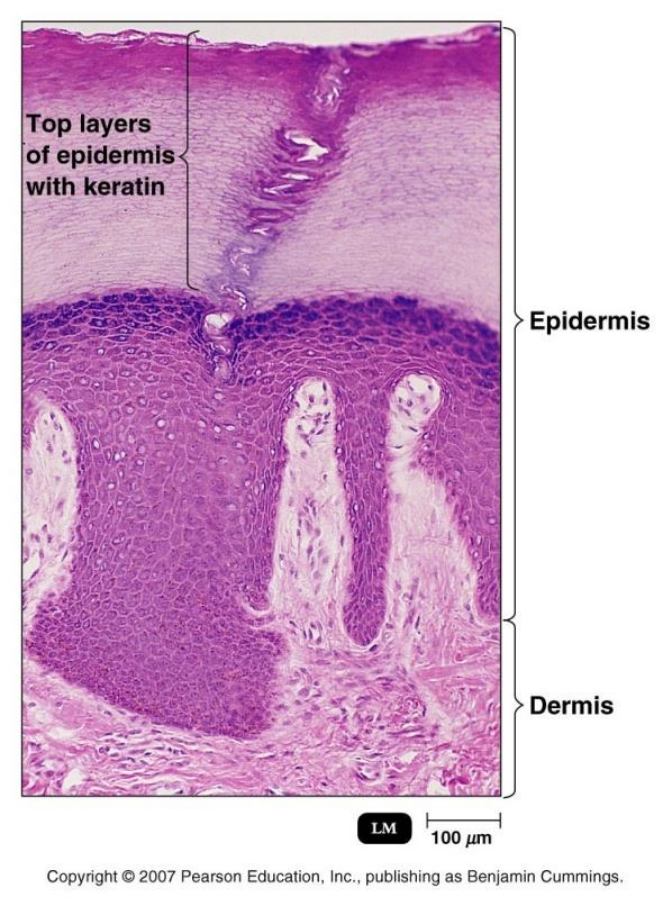
-**Chemical factors**

* Sebum (includes fungistatic and bacteriostatic fatty acids)
* Low pH
* High salt
* Lysozymes (sweat)
* IgA (sweat)

First line of defense- skin



-**Physical factors**

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-**Chemical factors**

* Sebum (includes fungistatic and bacteriostatic fatty acids)
* Low pH
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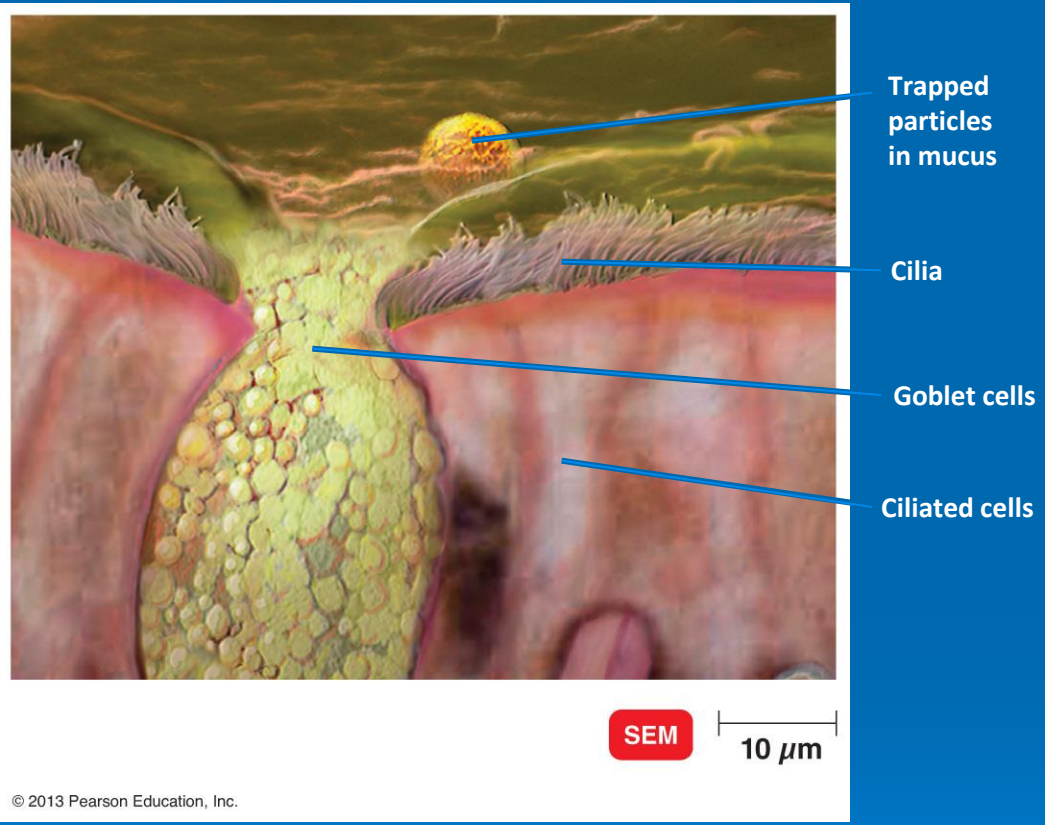
* Lysozymes (sweat)
* IgA (sweat)

- **Normal microbiota**

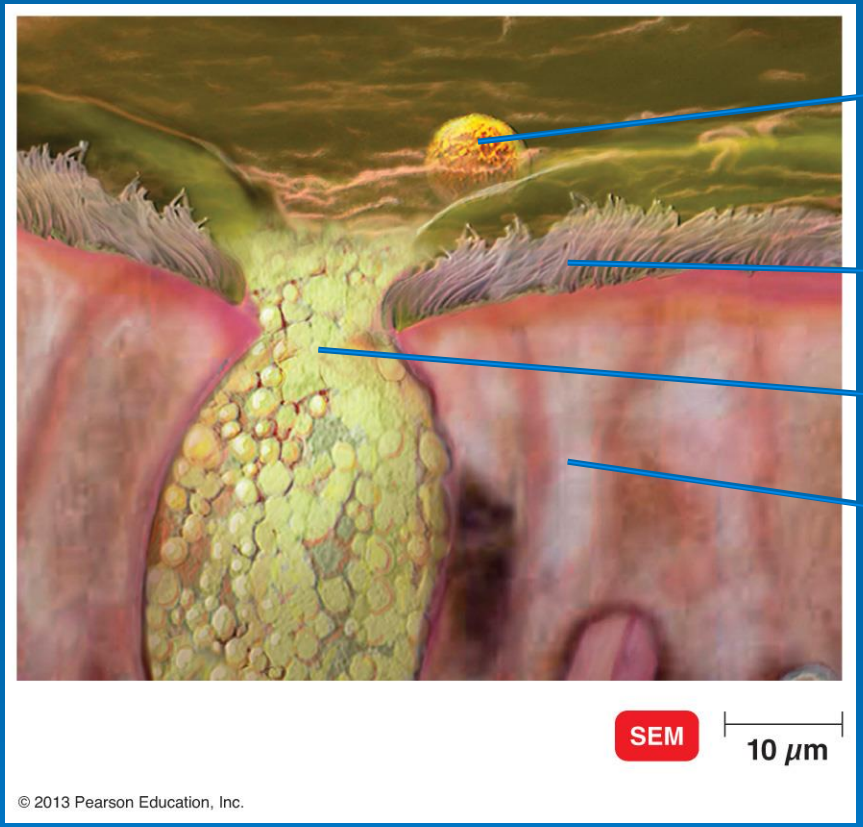
First line of defense- mucosal surfaces



-**Physical factors**

* Mucous production
* Cilia
* Hairs

First line of defense- mucosal surfaces



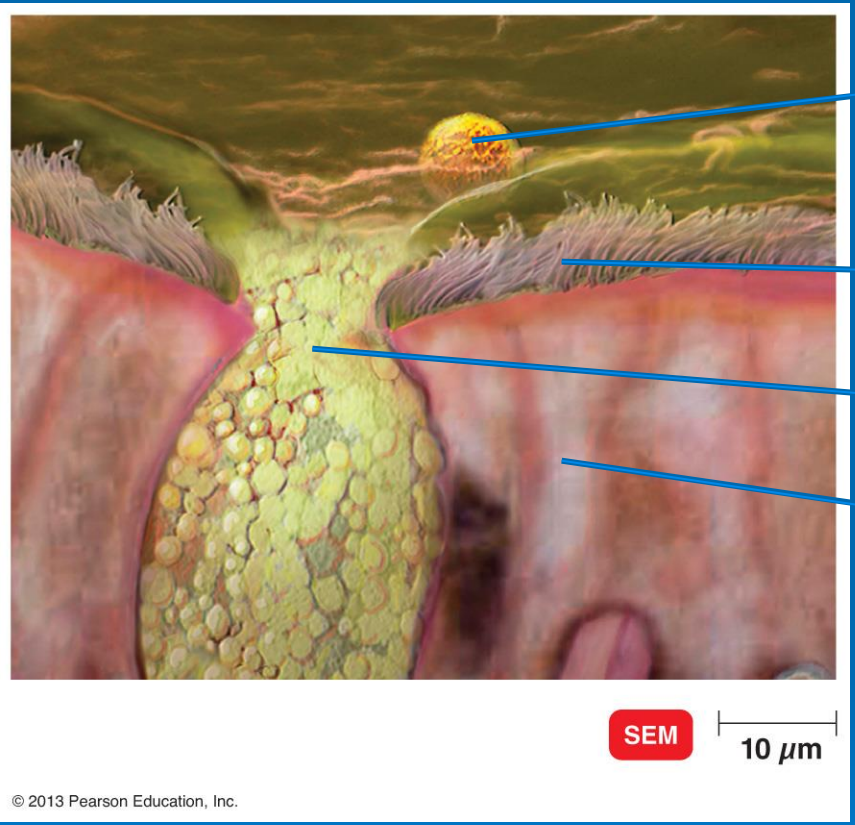
-Physical factors

* Mucous production
* Cilia
* Hairs

-Chemical factors

* Lysozymes
* Lactoferrin
* α and β Defensin
* IgA

First line of defense- mucosal surfaces



-Physical factors

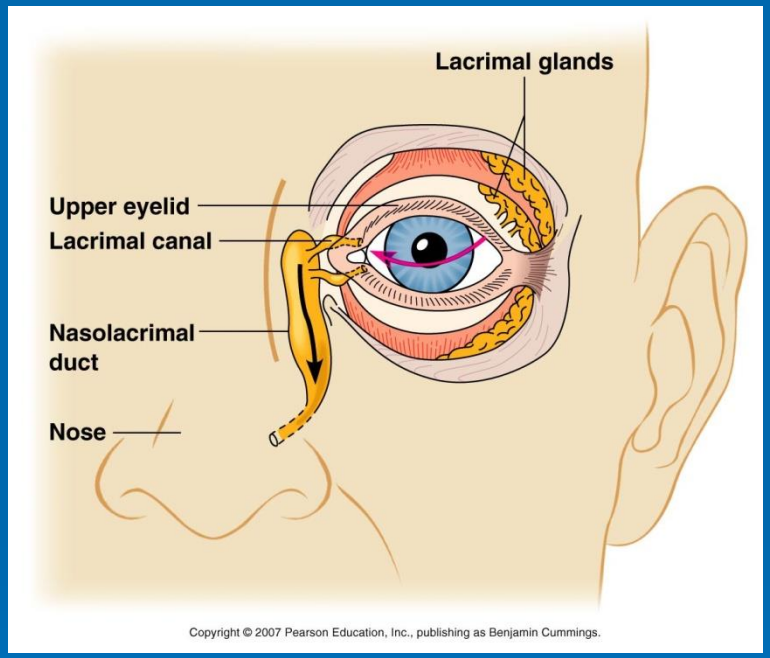
* Mucous production
* Cilia
* Hairs

-Chemical factors

* Lysozymes
* Lactoferrin
* α and β Defensin
* IgA

- Normal microbiota

First line of defense- lacrimal apparatus



-Physical factors

* Tears

-Chemical factors

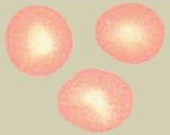
* Lysozyme
* β Defensin
* IgA

Second line of defense: Formed Elements in Blood

TABLE **16.1** **Formed Elements in Blood**

I. Erythrocytes (Red Blood Cells)

4.8–5.4 million per µl or mm^3
Function: Transport of O_2 and CO_2



II. Leukocytes (White Blood Cells)

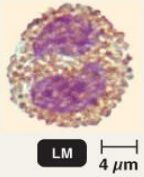
5000–10,000 per µl or mm^3

A. Granulocytes (stained)

1. Neutrophils (PMNs) (60–70% of leukocytes)
Function: Phagocytosis

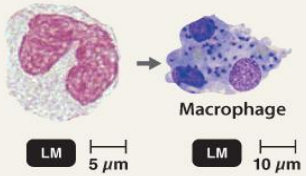
2. Basophils (0.5–1%)
Function: Production of histamine

3. Eosinophils (2–4%)
Functions: Production of toxic proteins against certain parasites; some phagocytosis

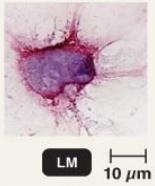


B. Agranulocytes (stained)

1. Monocytes (3–8%)
Function: Phagocytosis (when they mature into macrophages)

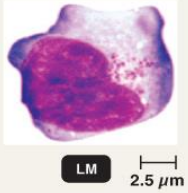


2. Dendritic cells
Functions: Derived from monocytes; phagocytosis and initiation of adaptive immune responses

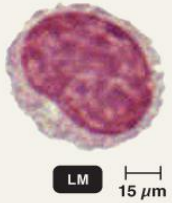


3. Lymphocytes (20–25%)

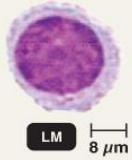
• Natural killer (NK) cells
Function: Destroy target cells by cytolysis and apoptosis



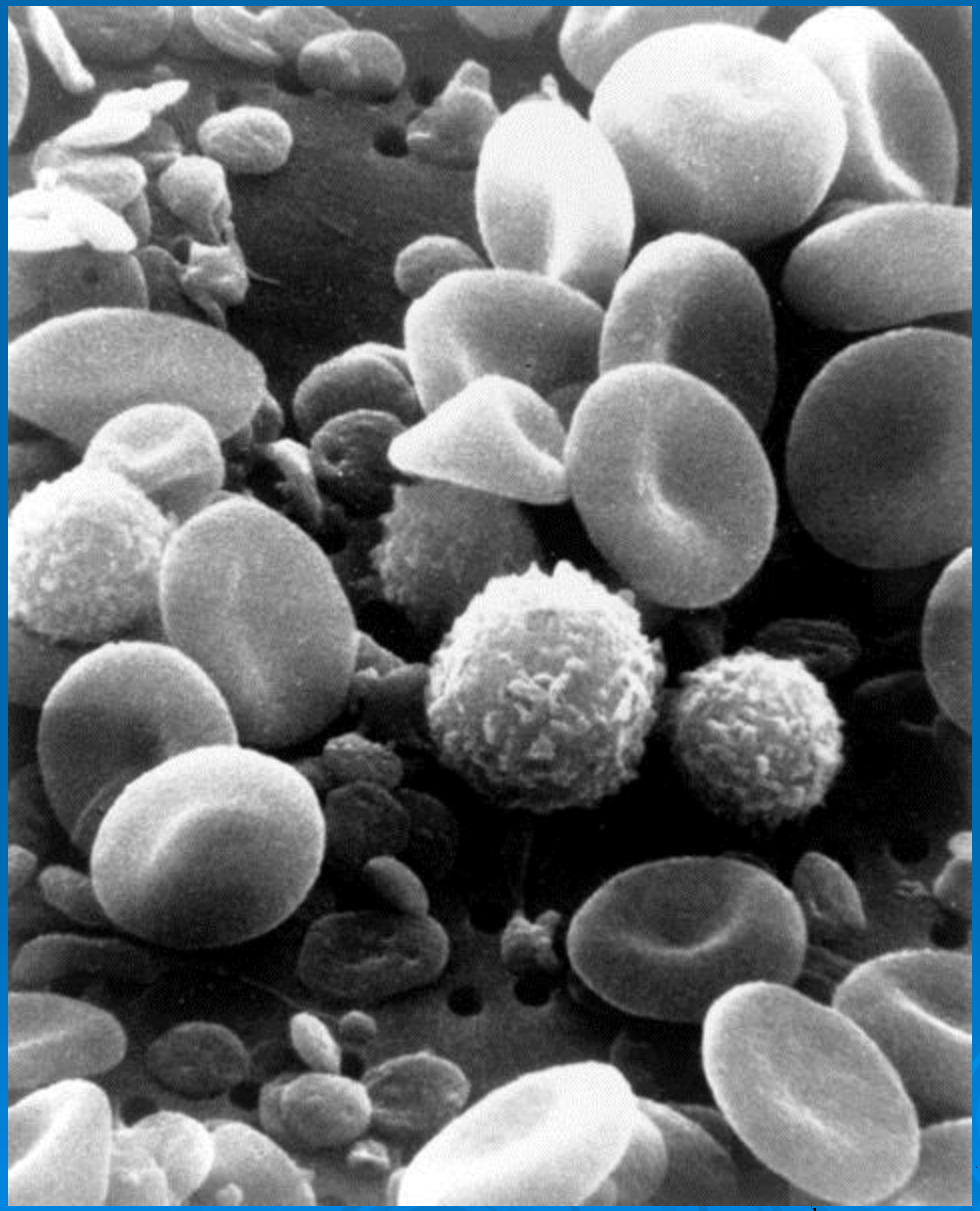
• T cells
Function: Cell-mediated immunity (discussed in Chapter 17)



• B cells
Function: Descendants of B cells (plasma cells) produce antibodies



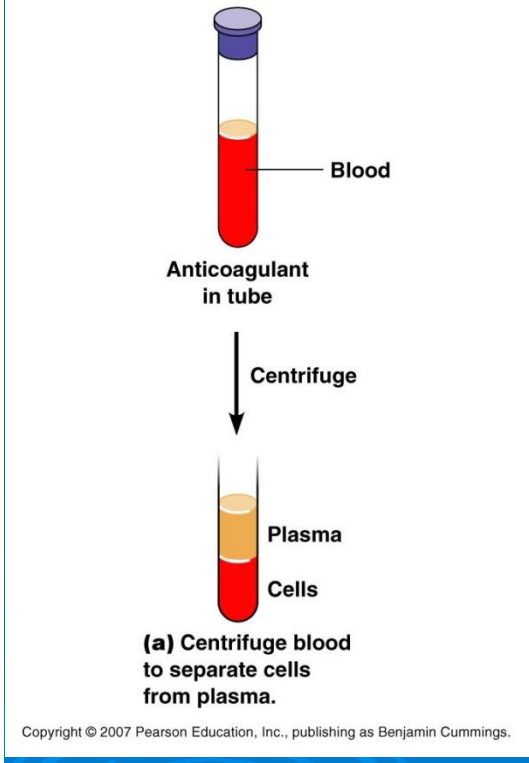
SEM of formed elements



Bruce Wetzel (photographer). Harry Schaefer (photographer)
National Cancer Institute

Complete blood count (CBC)

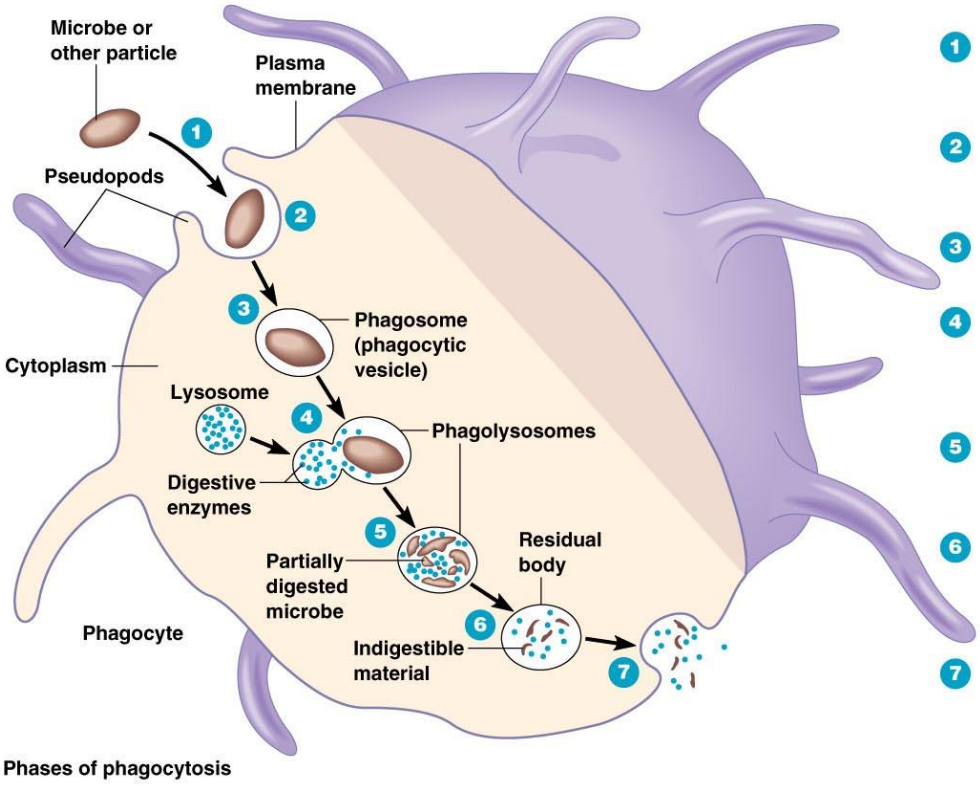
Type of cell	Increase	Decrease
RBC	Erythrocytosis Polycythemia	Anemia
WBCs	Leukocytosis	Leukopenia
- lymphocytes	Lymphocytosis	Lymphocytopenia
- granulocytes	Granylocytosis	Granulocytopenia
- neutrophils	Neutrophilia	Neutropenia
- eosinophils	Eosinophilia	Eosinopenia
Platelets	Thrombocytosis	Thrombocytopenia
ALL cell lines		Pancytopenia



Self-study for Thursday

- Preview the following processes:
  - Phagocytosis
  - Fever
  - Inflammation
  - Complement proteins

Second line of defense: Phagocytosis



Phases of phagocytosis

Figure 16.6

Figure 16.7 - Overview

Microbial evasion of phagocytosis

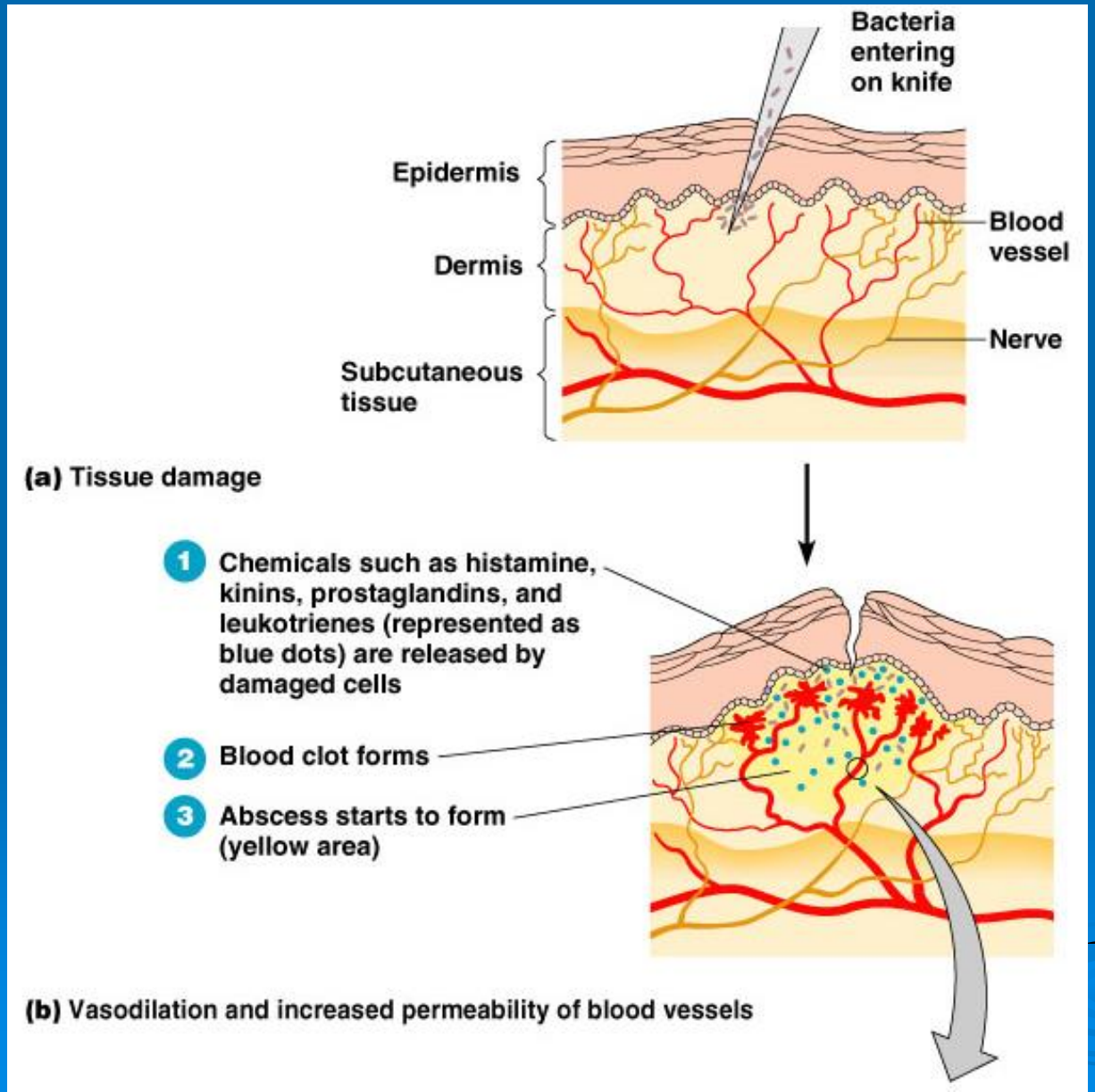
• **Inhibit adherence: M protein, capsules**	*Streptococcus pyogenes, S. pneumoniae*
• **Kill phagocytes: Leukocidins**	*Staphylococcus aureus*
• **Lyse phagocytes: Membrane attack complex**	*Listeria monocytogenes*
• **Escape phagosome**	*Shigella*
• **Prevent phagosome-lysosome fusion**	HIV
• **Survive in phagolysosome**	*Coxiella burnetti* and *Mycobacteria spp*

Second line of defense: Fever

-Usually set at 37° C

-Some chemical signals set it higher
- -Cytokine interleukin-1
- -Cytokine alpha-tumor necrosis factor
- -Prostoglandins reset hypothalamic thermostat

Second line of defense: Inflammation



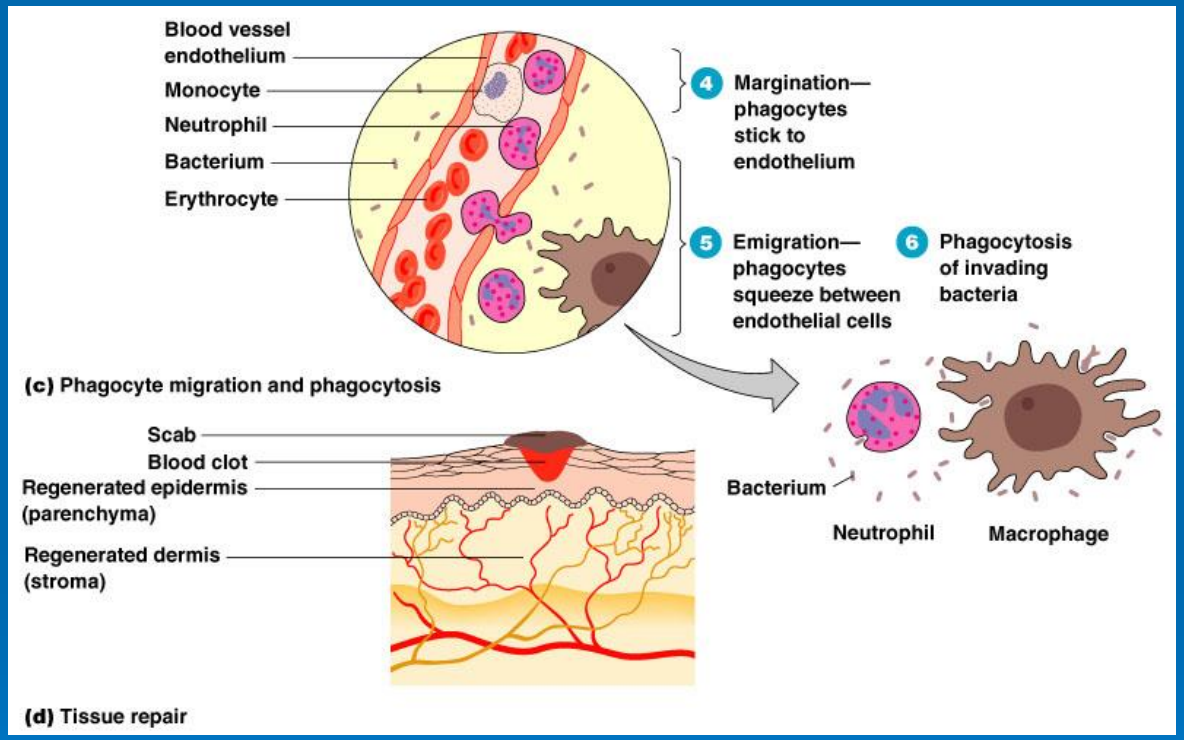
1. Chemicals released
    1. Histamine
    2. Kinins
    3. Prostaglandins
    4. Leukotrienes
2. Vasodilation
3. Increased permeability
4. Activation of acute phase proteins

(5. Clot formation, abscess, tissue repair)

Inflammation- chemical signals

• **Histamine**	Vasodilation, increased permeability of blood vessels
• **Kinins**	Vasodilation, increased permeability of blood vessels
• **Prostaglandins**	Intensity histamine and kinin effect
• **Leukotrienes**	Increased permeability of blood vessels, phagocytic attachment

Inflammation



MORE DETAIL:

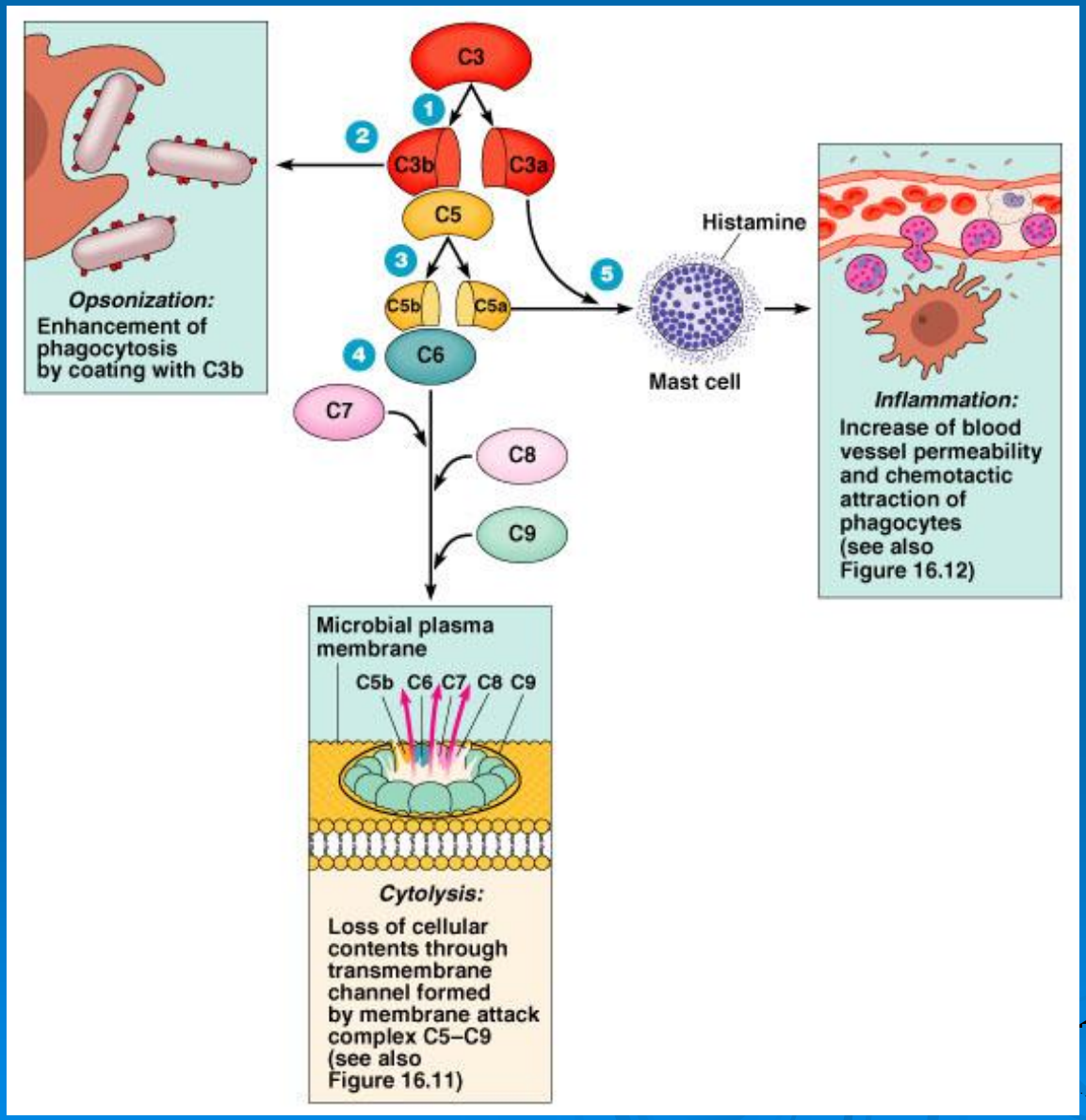
<u>Vasodilation/ increased Permeability</u>

- Margination WBCs
- Emigration WBCs

<u>Activation of acute-phase proteins</u>

- Cytokines
- Kinins
- Complement proteins
- (Interferons)

Complement system



Independent Study

- Review the following processes:
  - Phagocytosis
  - Fever
  - Inflammation
  - Complement proteins