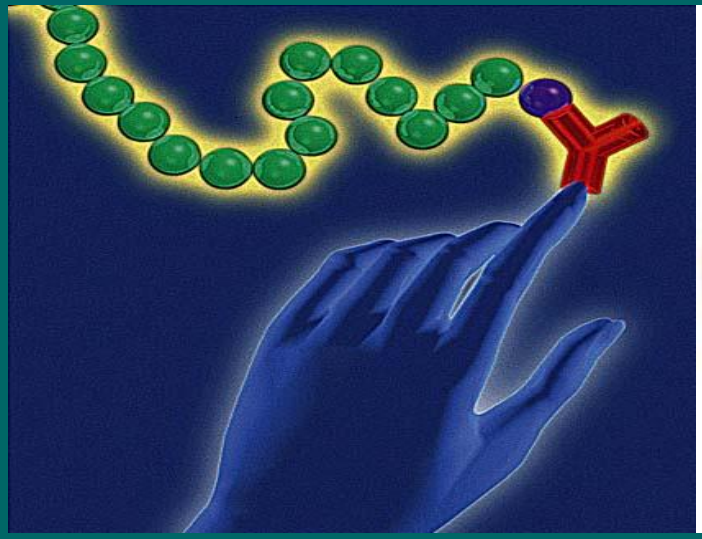
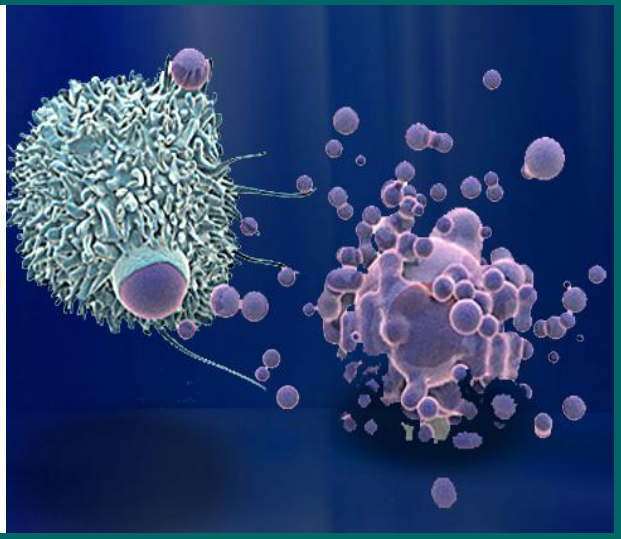
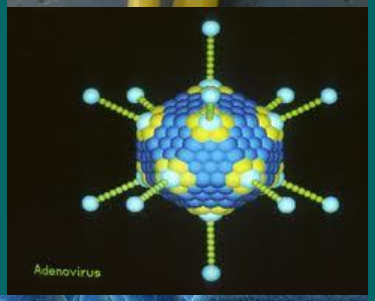
Overview on Immune mechanism

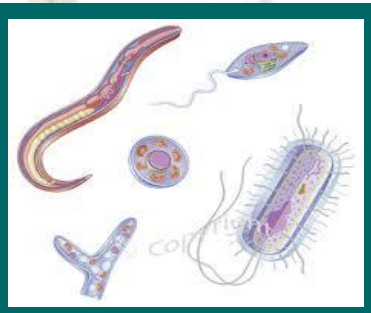




J. Dandapat
Dept. of Biotechnology
Utkal University

Man is floating in the ocean of microbes





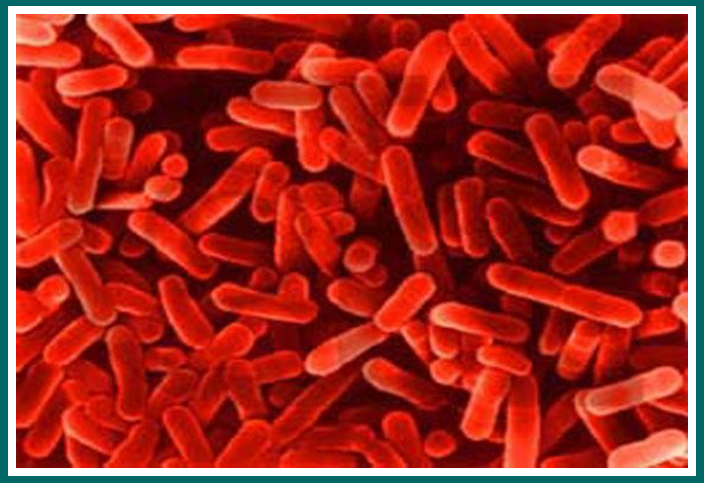
Every single moment we are in the state of war

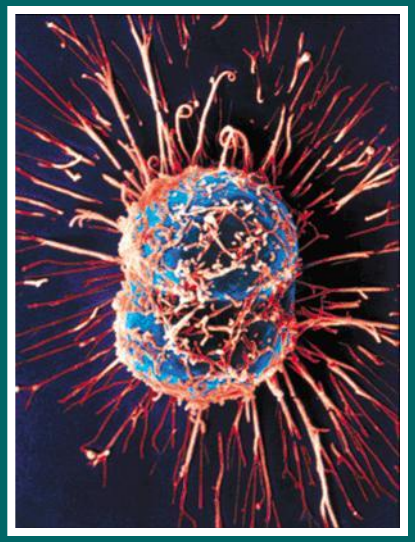
The defense organization of human body is so efficient, so well structured and so sophisticated it can manage / try to manage every adverse situation.

That is why the body emerges victories in its battle most of the time.

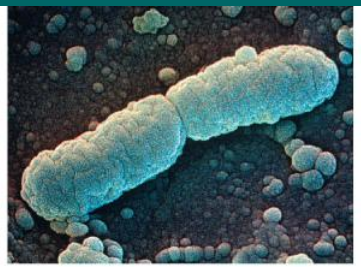
What is the immune system?

- The body's defense against disease causing organisms, malfunctioning cells, and foreign particles





Defense Against Pathogens



Nonspecific External Barriers
skin, mucous membranes

If these barriers are penetrated,
the body responds with

Innate Immune Response
phagocytic and natural killer cells,
inflammation, fever

If the innate immune response is insufficient,
the body responds with

Adaptive Immune Response
cell-mediated immunity, humoral immunity

Immune System

- Non Specific Response
  - Complement System
  - Interferon Response
  - Inflammatory Response
  - Fever Response
- Specific Response
  - Antibody Mediated
  - Cell Mediated

IMMUNITY

INNATE IMMUNITY

- Physical and chemical barriers
- Phagocytes (Neutrophils & Macrophages) -Inflammatory process.

ACQUIRED IMMUNITY

Specific towards particular antigen and enhanced with repeated exposure

Naturally Acquired Immunity

Active Immunity

- Lifelong: Chickenpox
- Temporary: Influenza, Intestinal infections

Passive Immunity

- Colostrum

Artificially Acquired Immunity

Active Immunity

- Life Long: Oral polio vaccine
- Temporary: Tetanus toxoid

Passive Immunity

- Antiserum: Snake antivenom

The Immune System- Line of Defense Against Infection

Nonspecific defense mechanisms		Specific defense mechanisms (immune system)
First line of defense	Second line of defense	Third line of defense
• Skin • Mucous membranes • Secretions of skin and mucous membranes	• Phagocytic white blood cells • Antimicrobial proteins • The inflammatory response	• Lymphocytes • Antibodies

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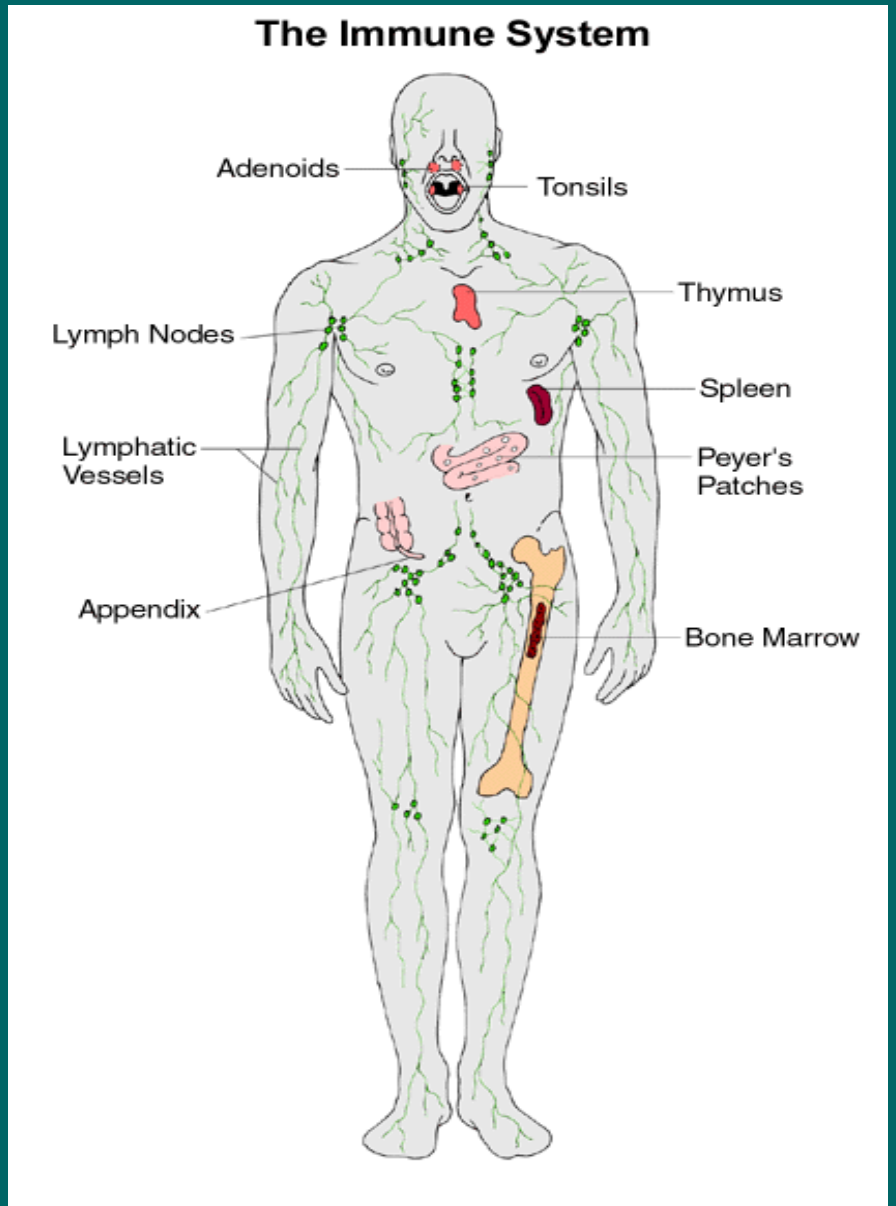
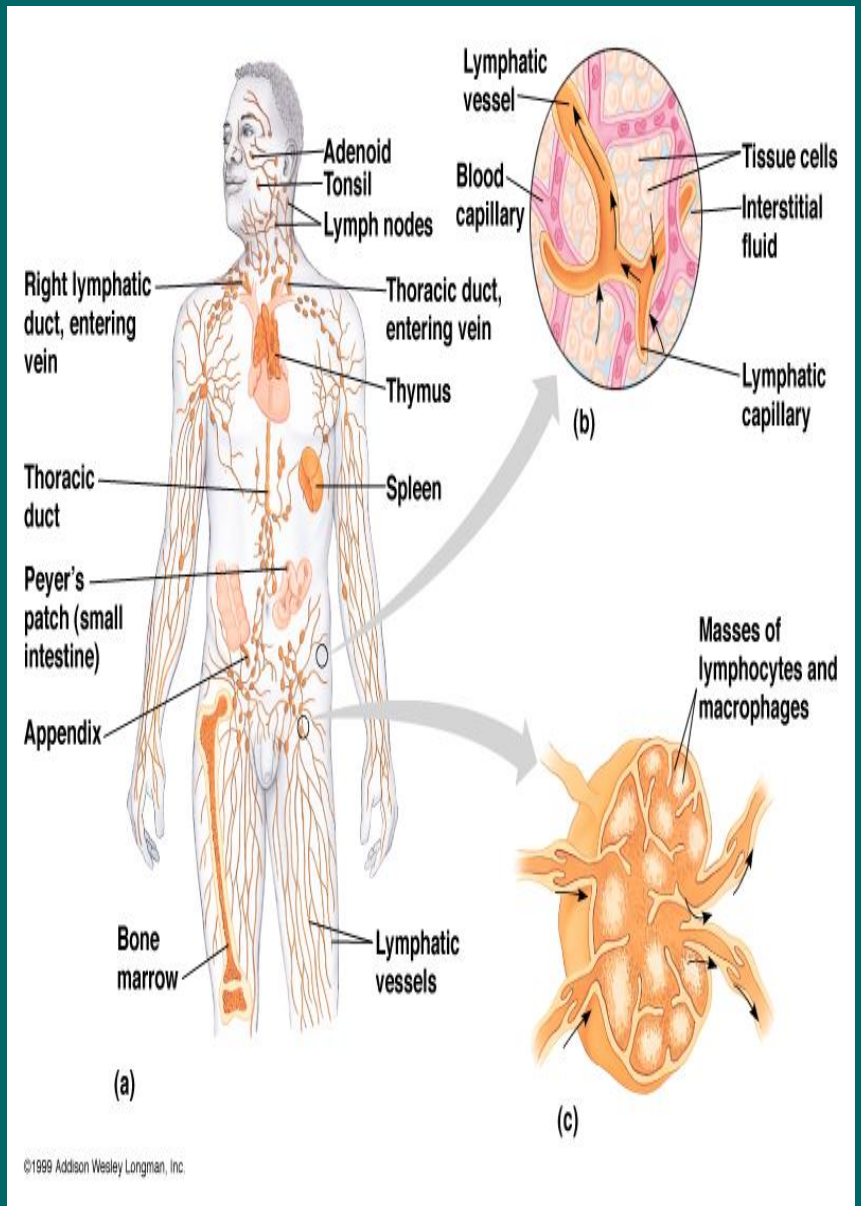
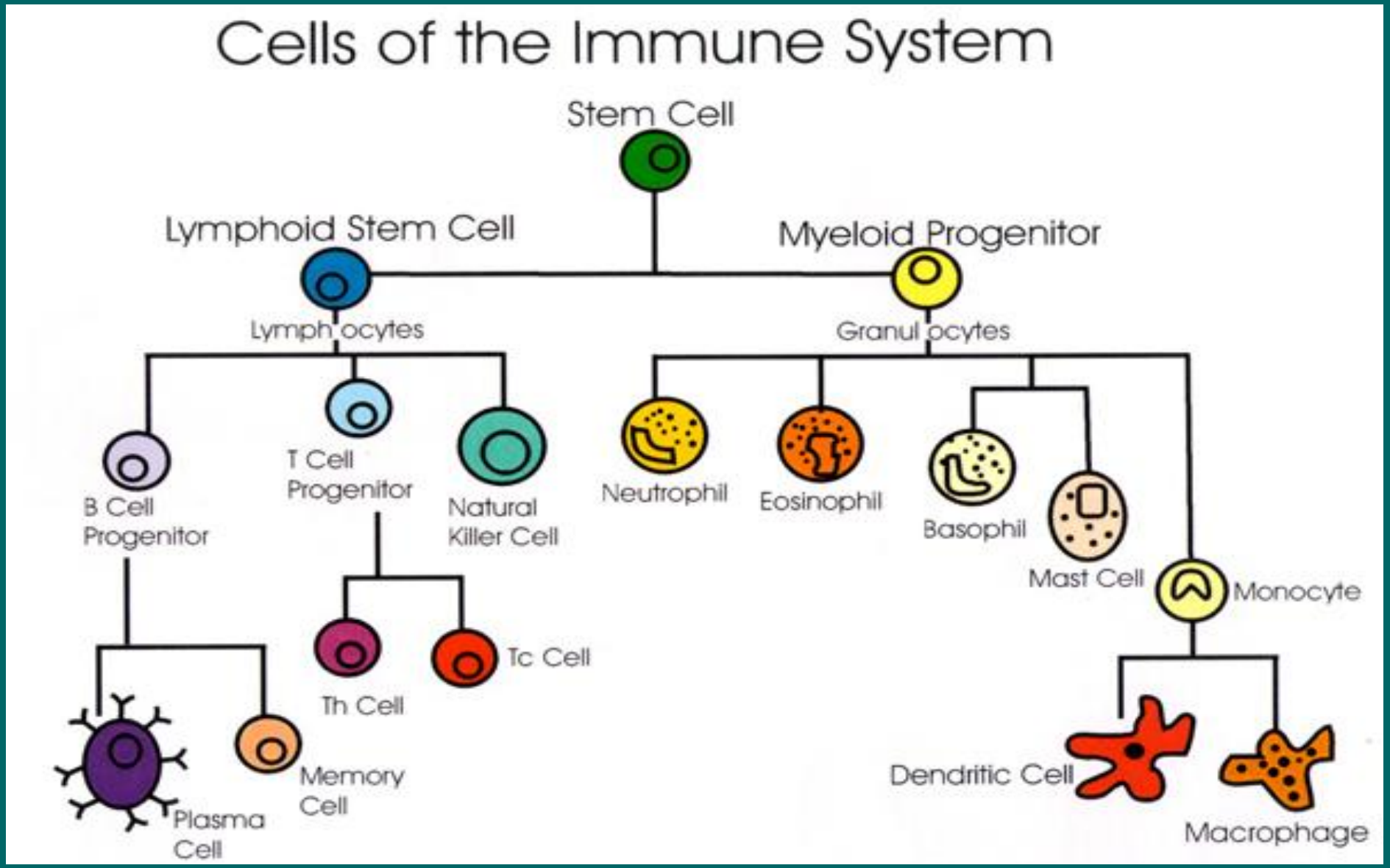
ANATOMY OF THE IMMUNE SYSTEM

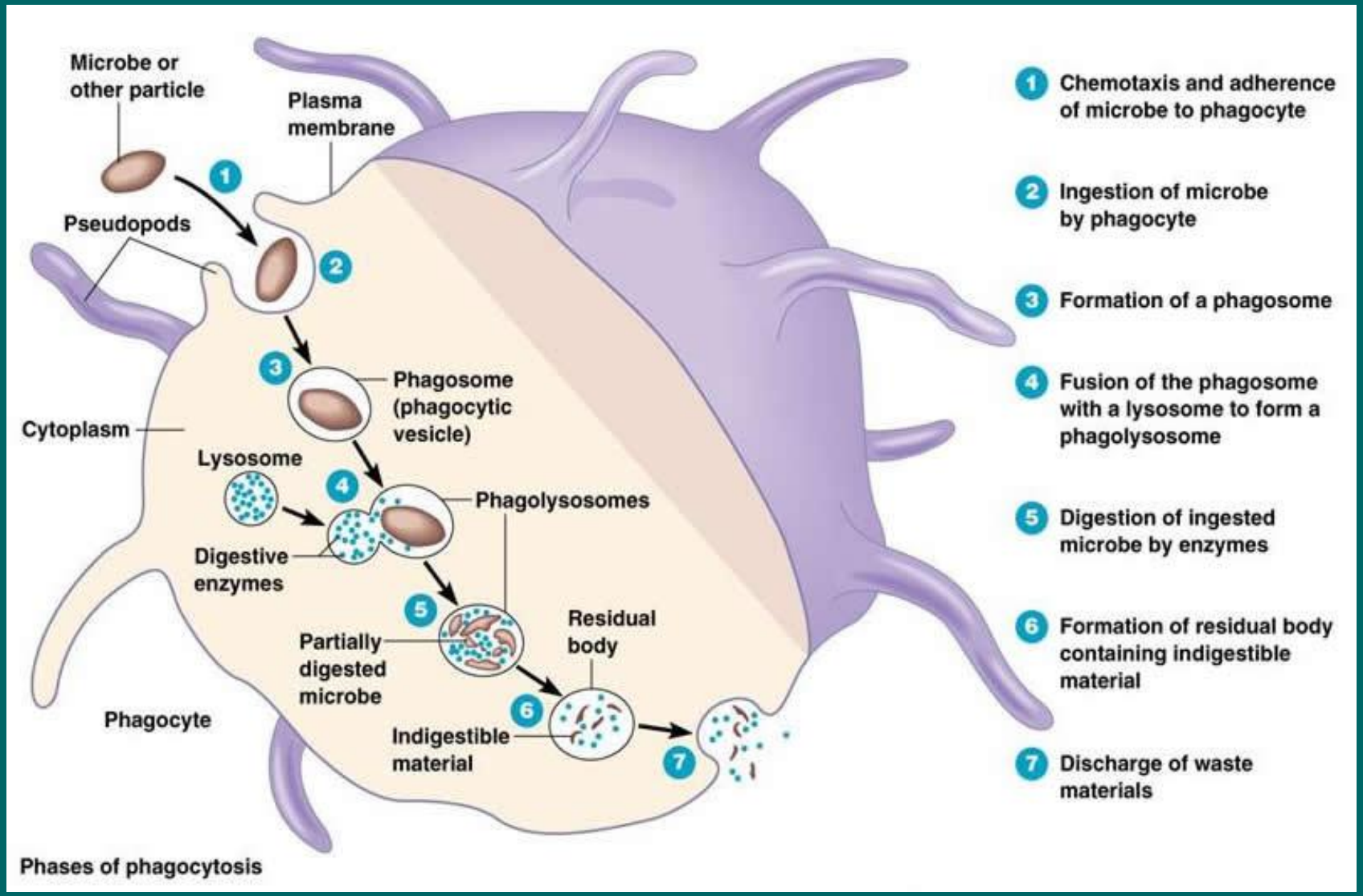




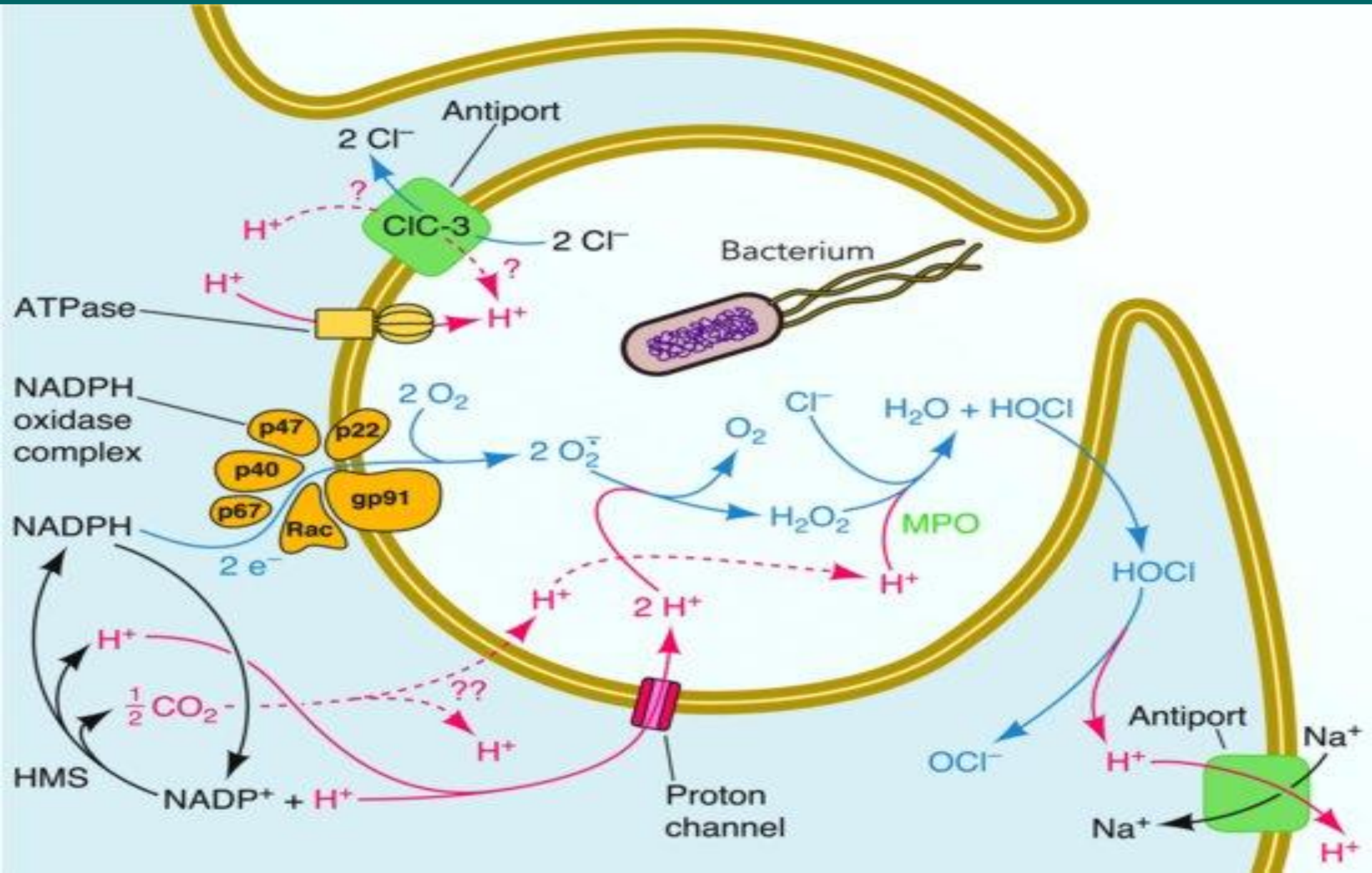
CELLS OF THE IMMUNE SYSTEM



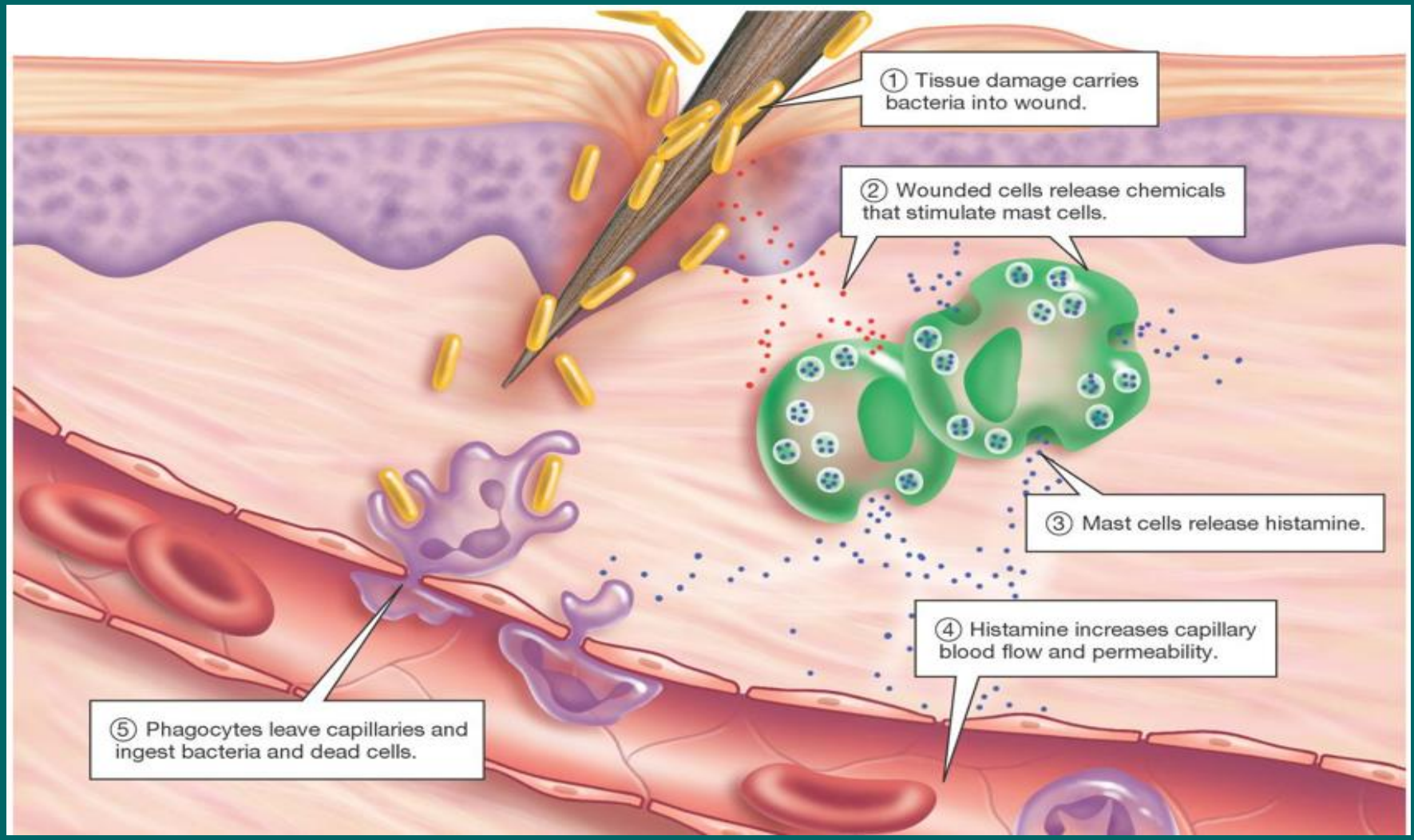
PHAGOCYTOSIS



PHAGOCYTIC KILLING OF MICROBES: OXIDATIVE BURST

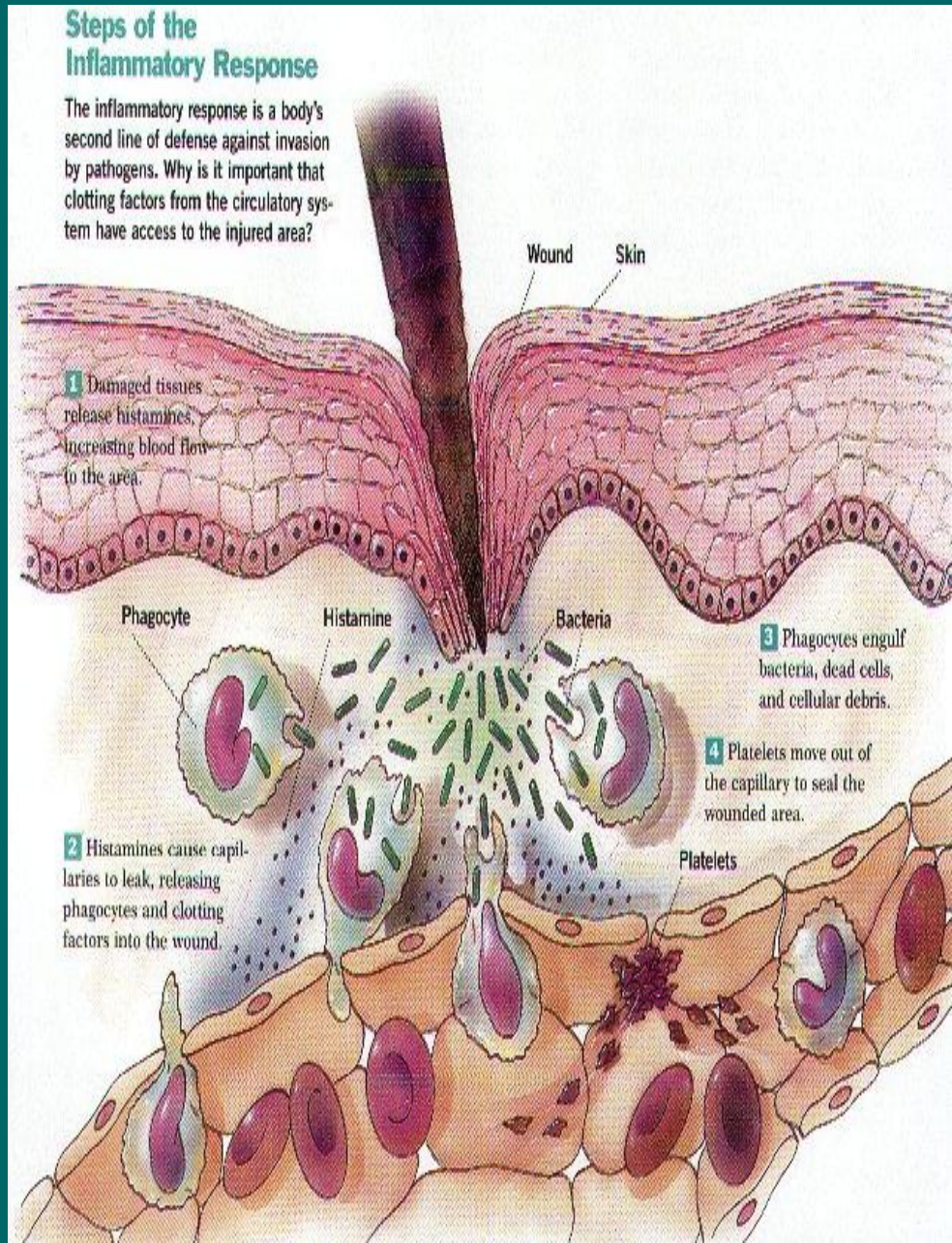


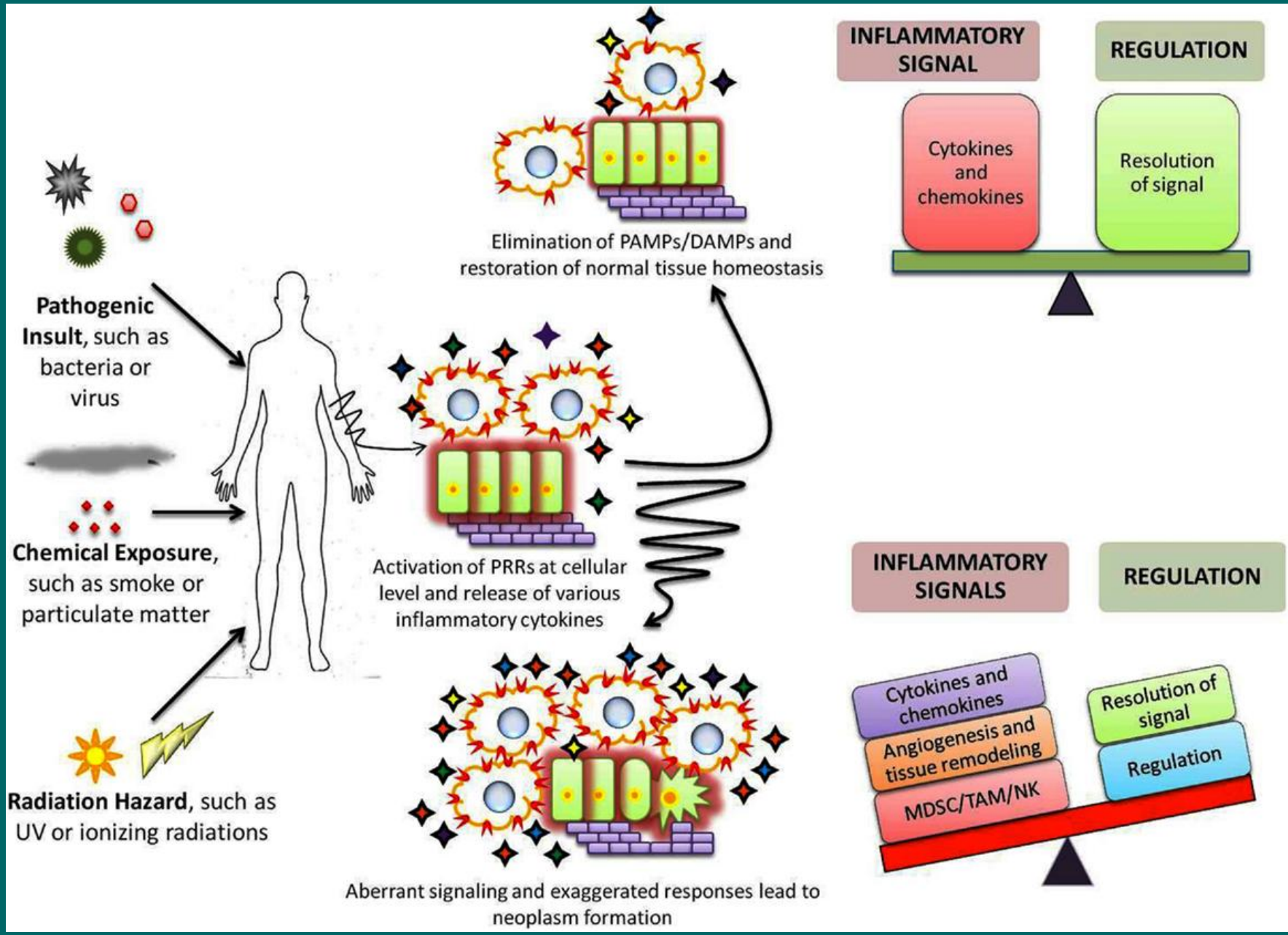
Ouch!


① Tissue damage carries bacteria into wound.
② Wounded cells release chemicals that stimulate mast cells.
③ Mast cells release histamine.
④ Histamine increases capillary blood flow and permeability.
⑤ Phagocytes leave capillaries and ingest bacteria and dead cells.

INFLAMMATION

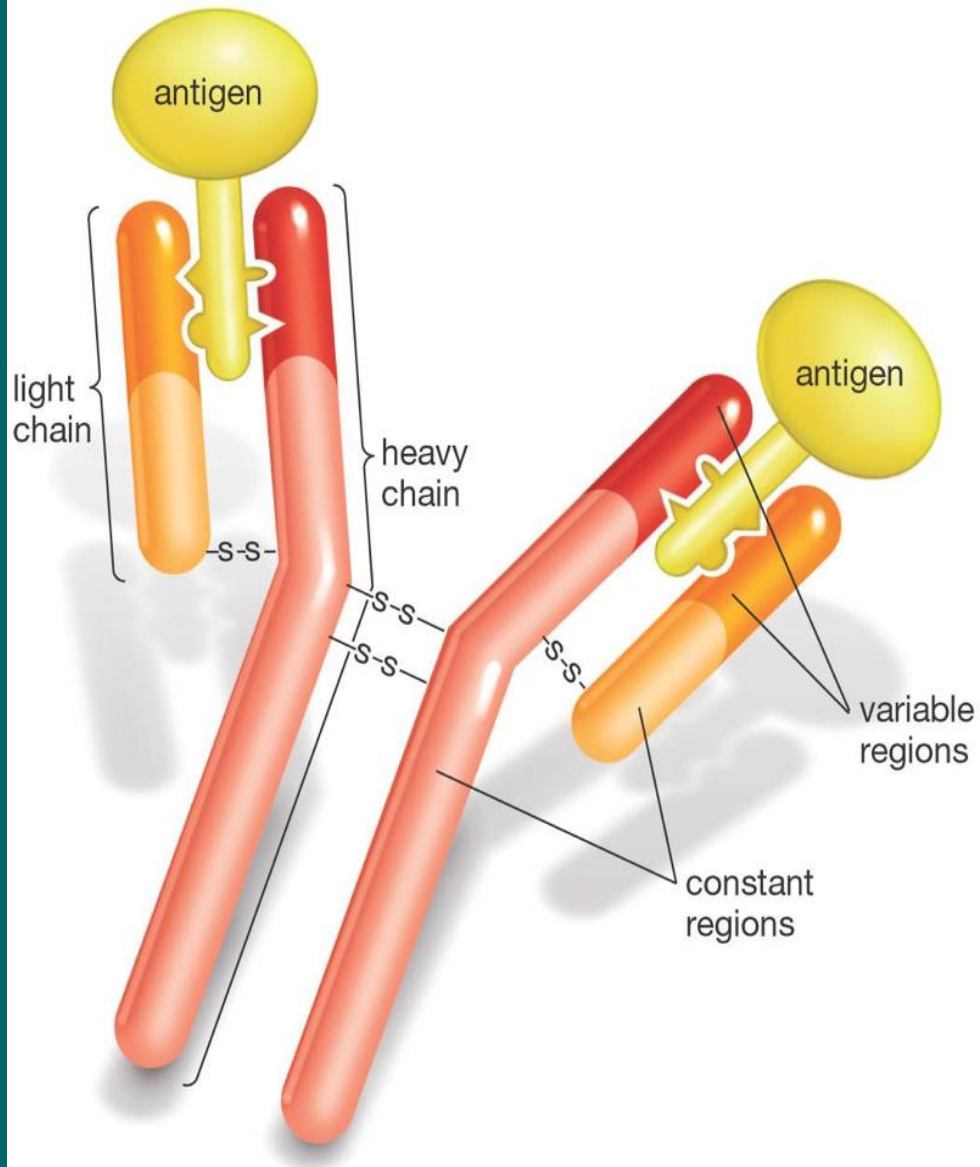
- A non-specific response to injury or necrosis that occurs in a vascularized tissue.
- Signs:Redness,heat, swelling, pain, and loss of function
- (Rubor, calor, tumor, dolor)
- It refers to an inflammatory condition.



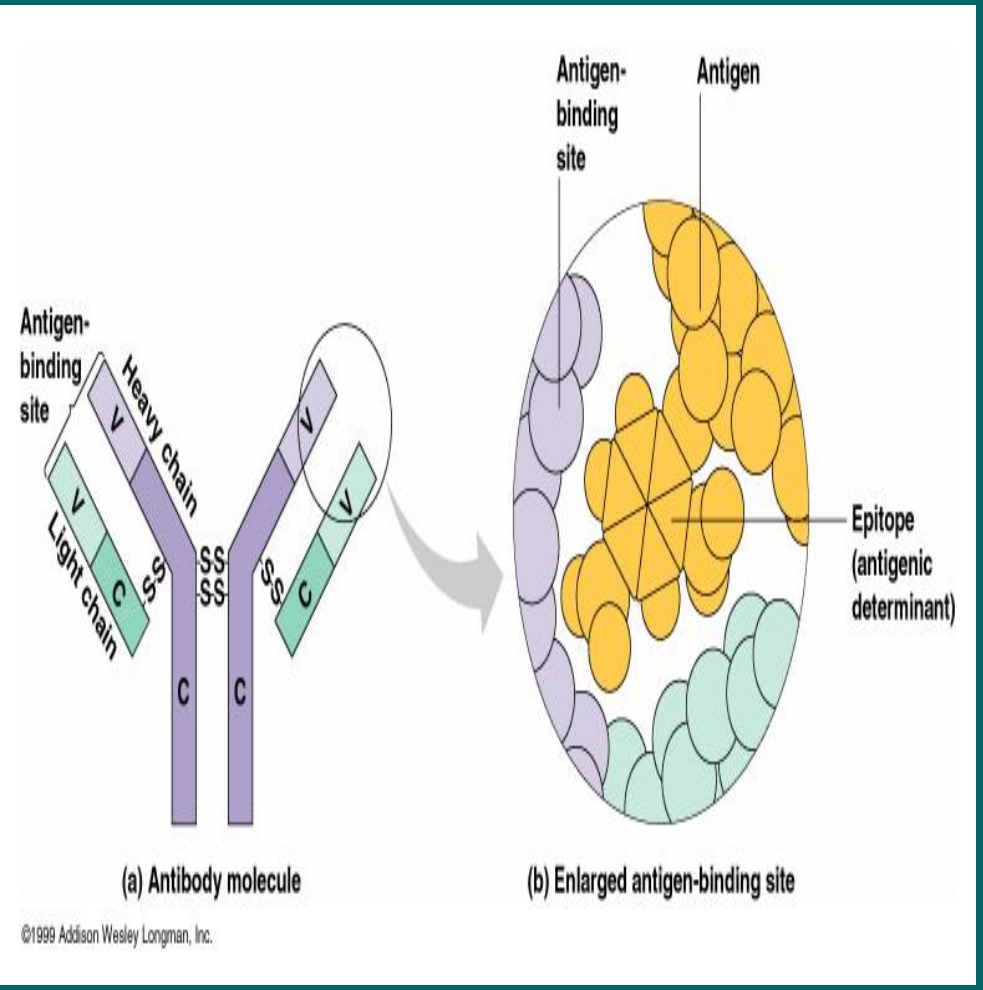

Elimination of PAMPs/DAMPs and restoration of normal tissue homeostasis
INFLAMMATORY SIGNAL
REGULATION
Cytokines and chemokines
Resolution of signal
Pathogenic Insult, such as bacteria or virus
Chemical Exposure, such as smoke or particulate matter
Radiation Hazard, such as UV or ionizing radiations
Activation of PRRs at cellular level and release of various inflammatory cytokines
INFLAMMATORY SIGNALS
REGULATION
Cytokines and chemokines
Angiogenesis and tissue remodeling
MDSC/TAM/NK
Resolution of signal
Regulation
Aberrant signaling and exaggerated responses lead to neoplasm formation

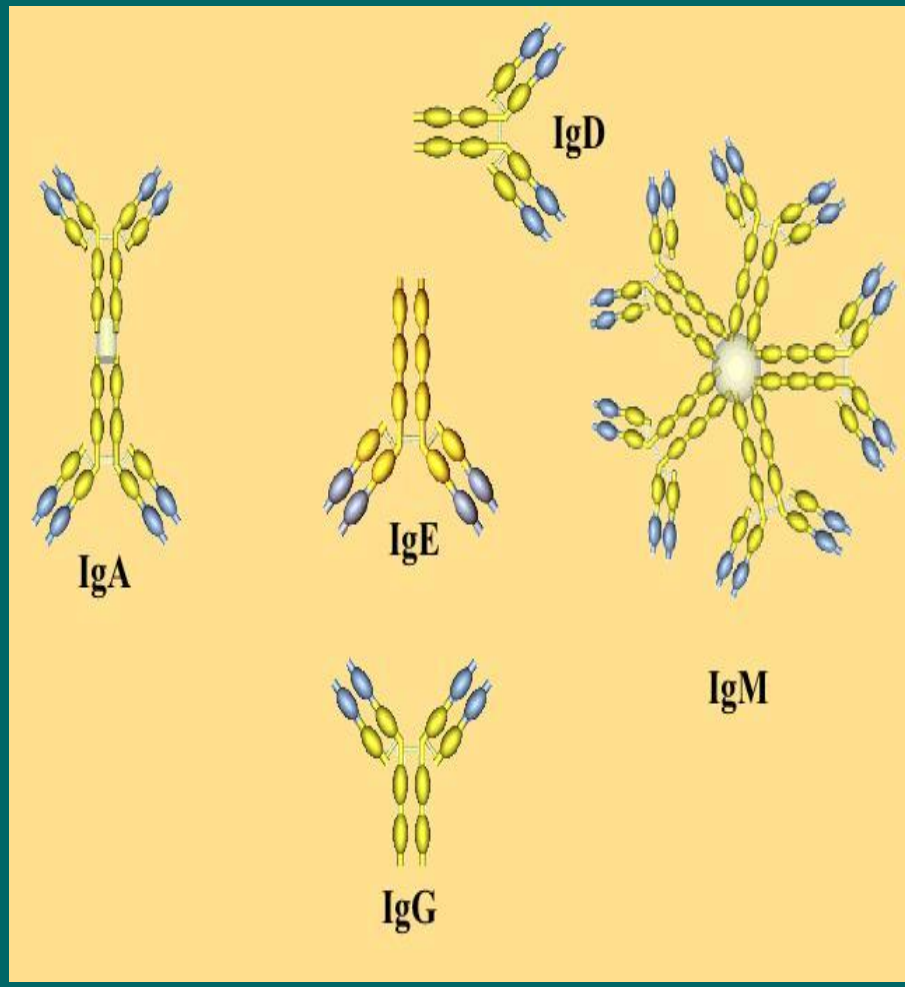
Antibodies: The Targeted Weapon of Adapative Immunity

- Antibodies are assembled out of protein chains.
- There are many different chains that the immune system assembles in different ways to make different antibodies.



Antibodies are Proteins that Recognize Specific Antigens

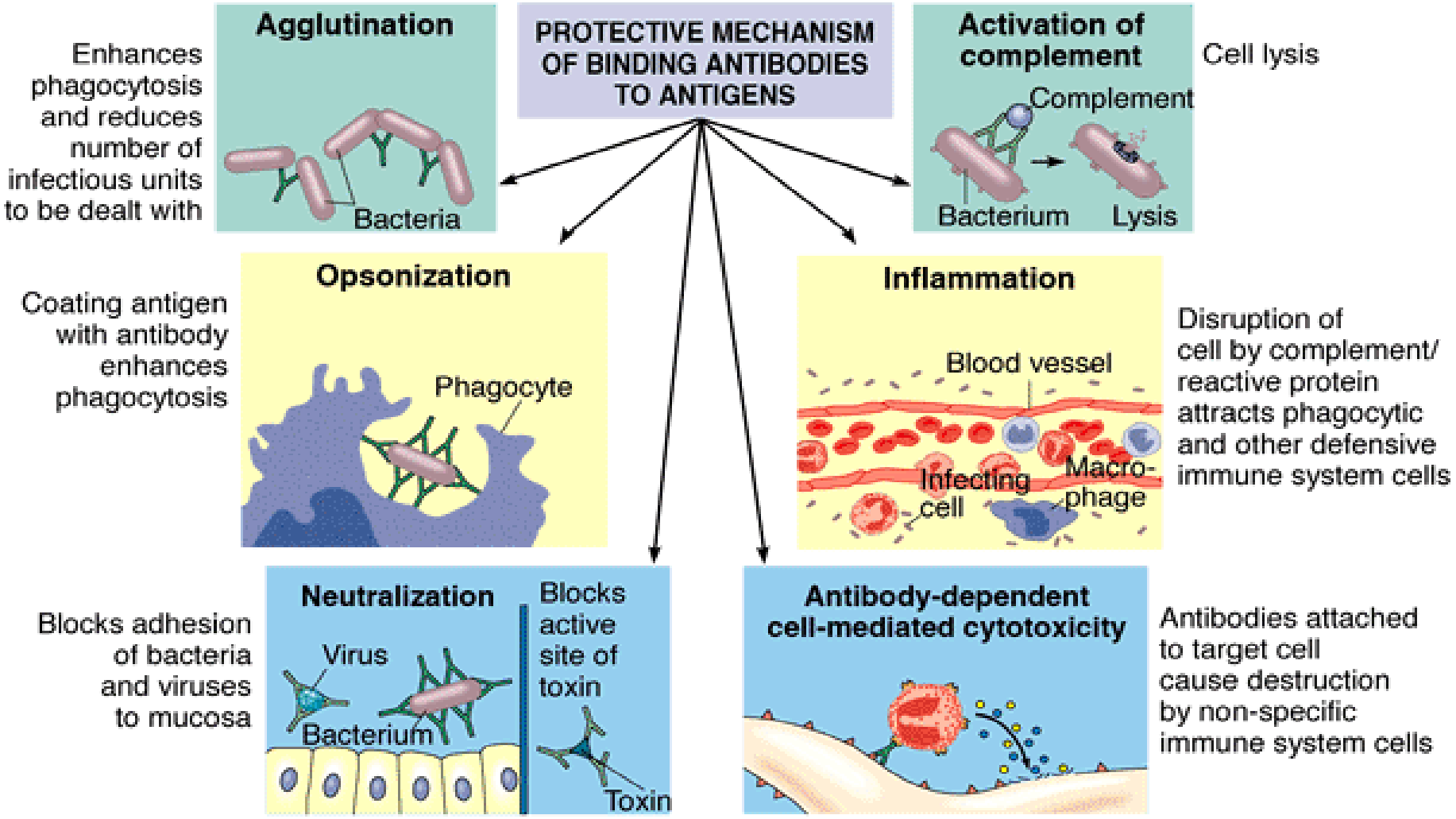




Role of antibodies

- Antibodies released into the blood stream will bind to the antigens that they are specific for.
- Antibodies may disable some microbes, or cause them to stick together (agglutinate). They “tag” microbes so that the microbes are quickly recognized by various white blood cells.

Consequences of Antibody Binding



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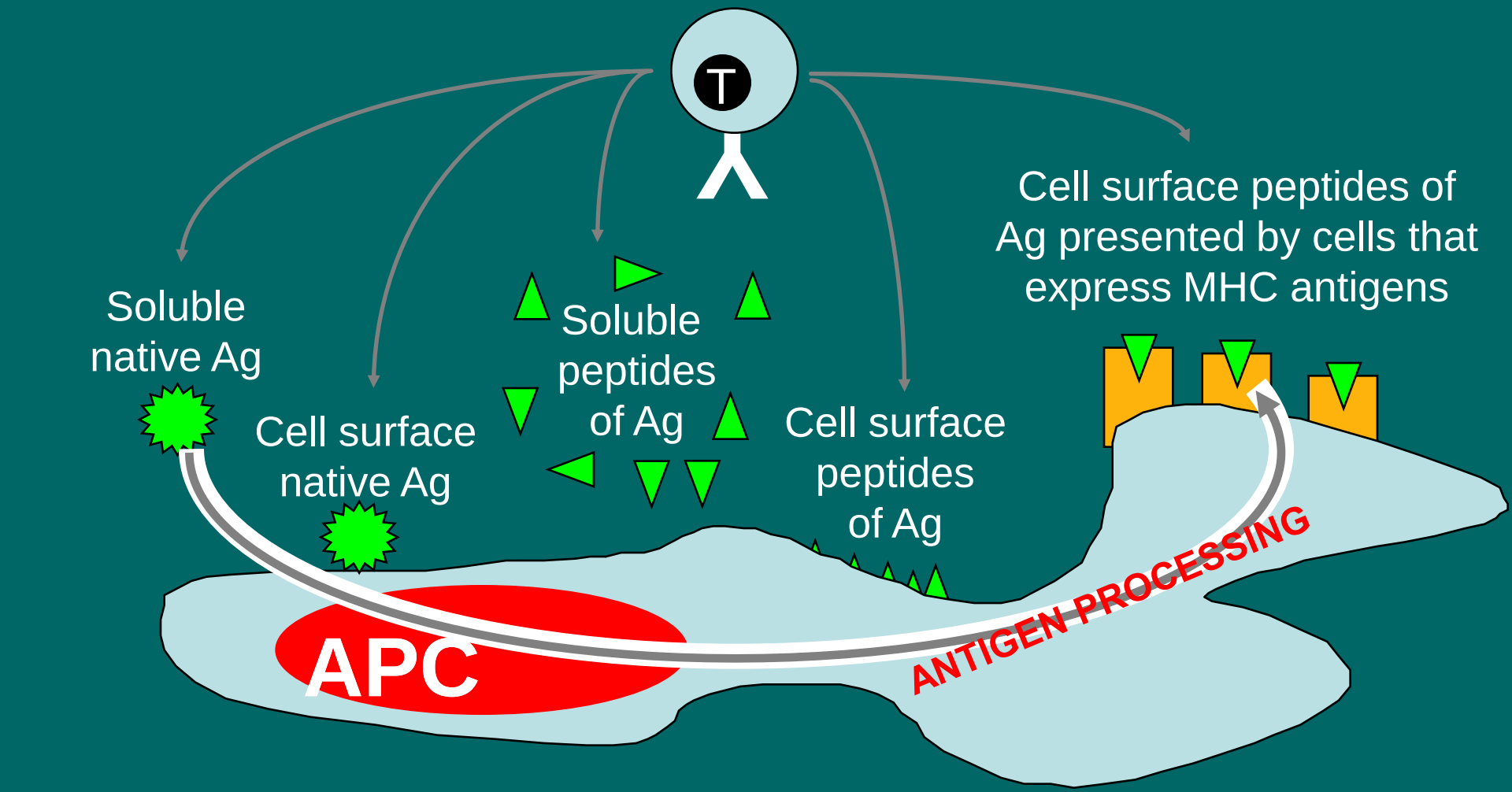
Antigens must be processed in order to be recognised by T cells



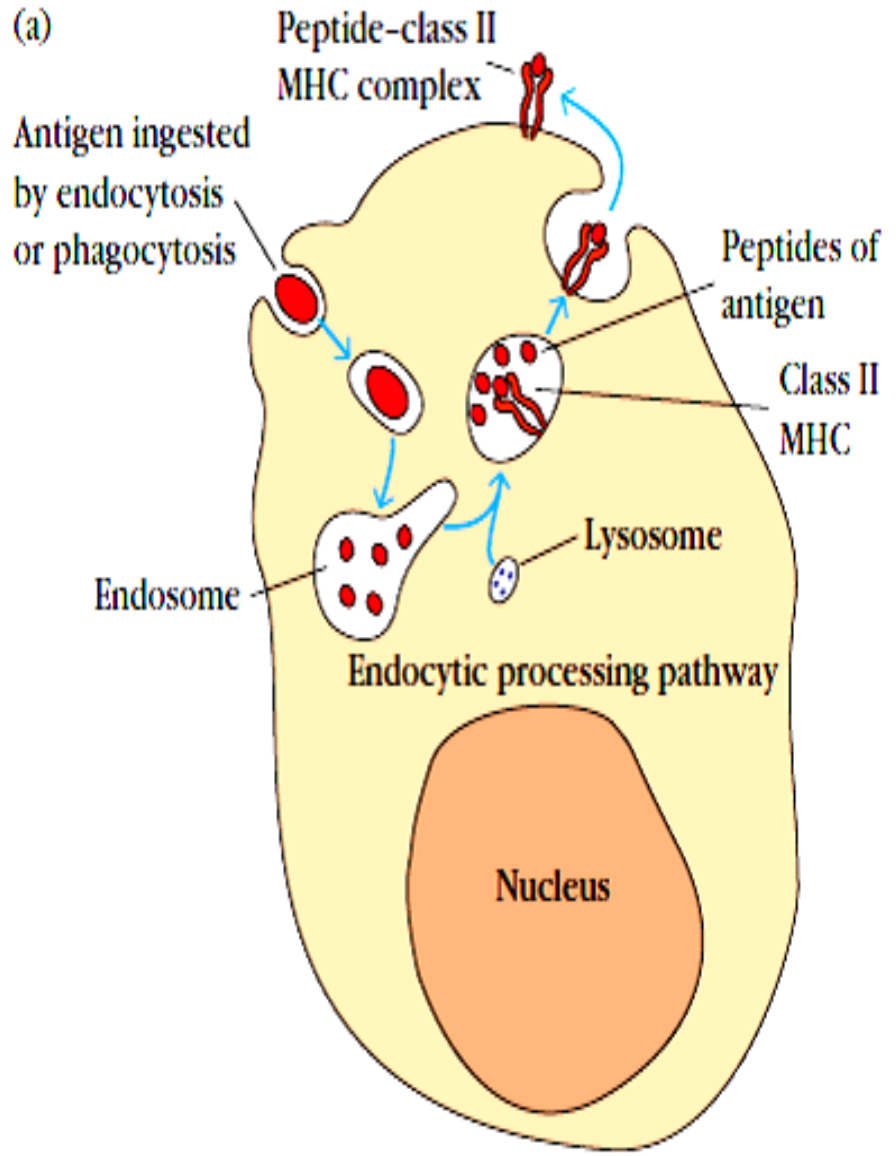
No T cell response

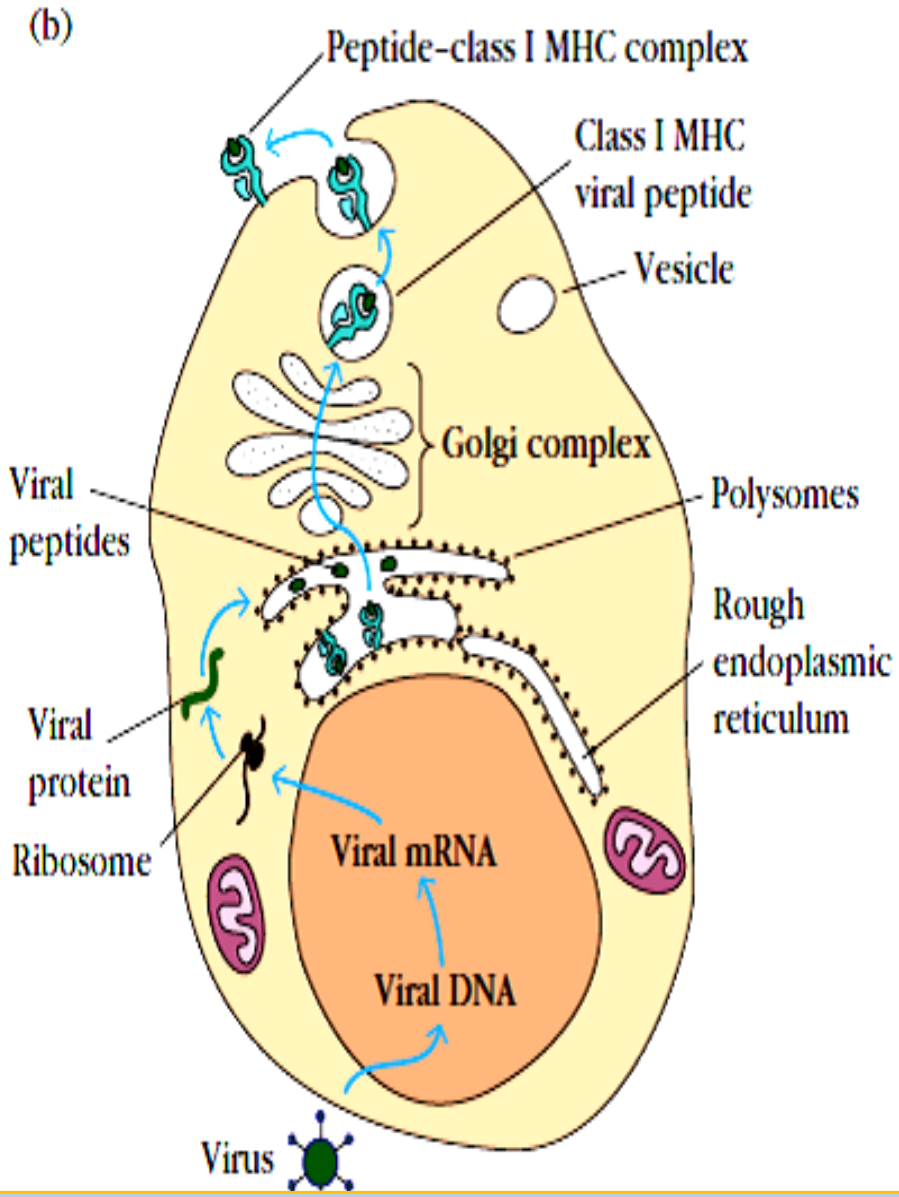
No T cell response

No T cell response

No T cell response

T cell response



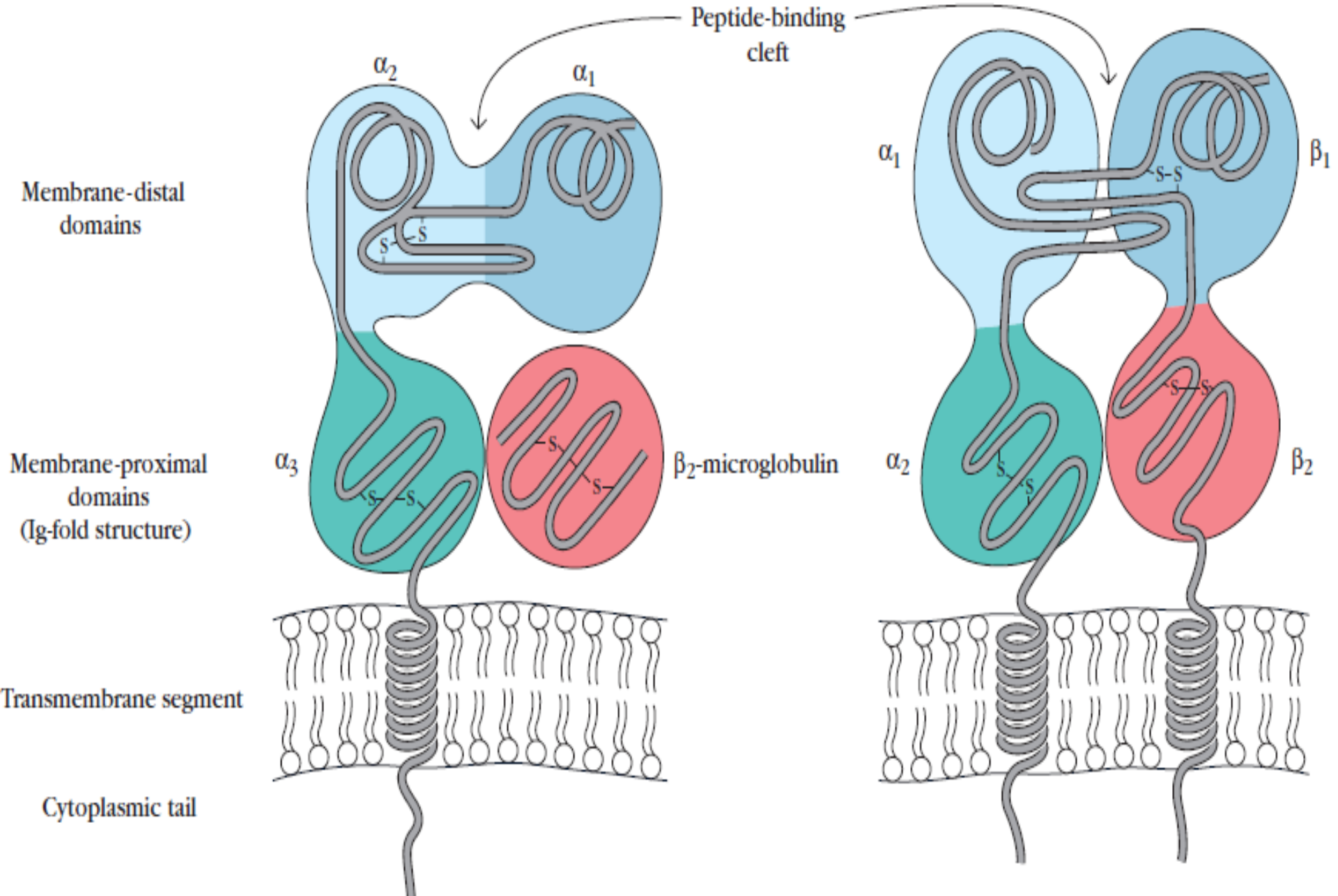


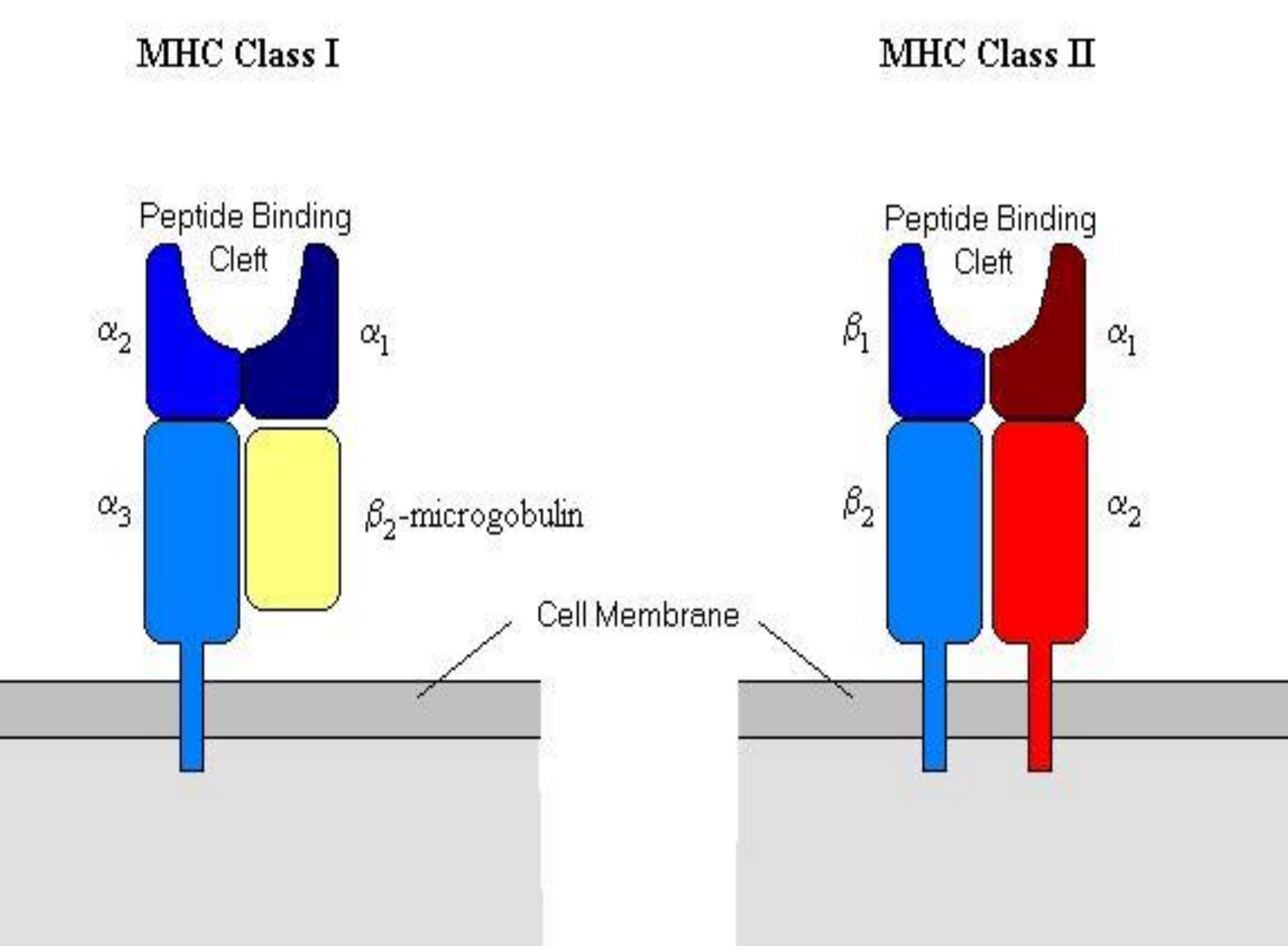
PROCESSING OF EXOGENOUS ANTIGEN

PROCESSING OF ENDOGENOUS ANTIGEN

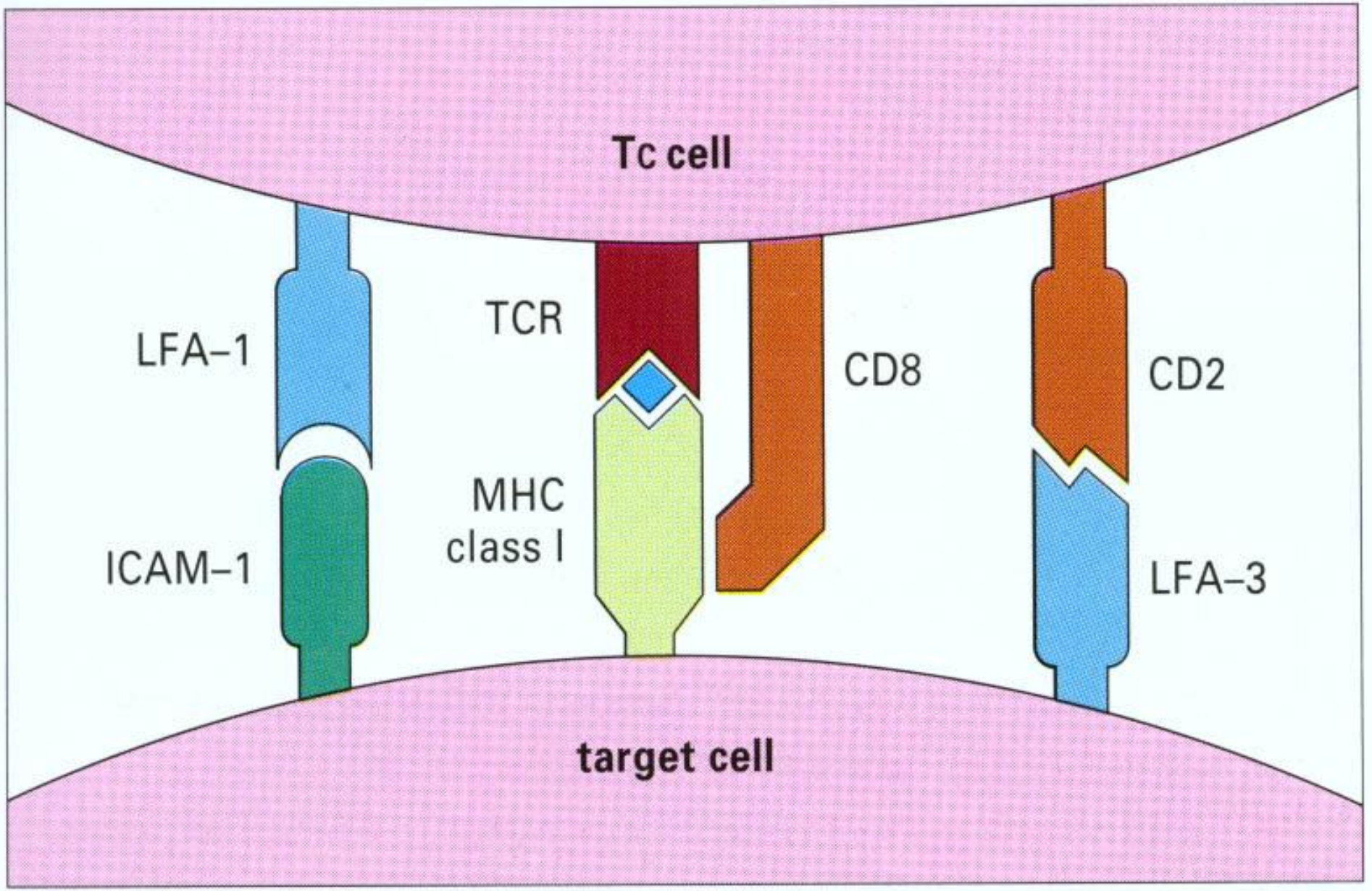
MHC CLASS-I MOLECULE

MHC CLASS-II MOLECULE




MHC Class I
MHC Class II
Peptide Binding Cleft
Peptide Binding Cleft
α_2
α_1
α_3
β_2-microgobulin
β_1
α_1
β_2
α_2
Cell Membrane

Interactions between Tc and target cells

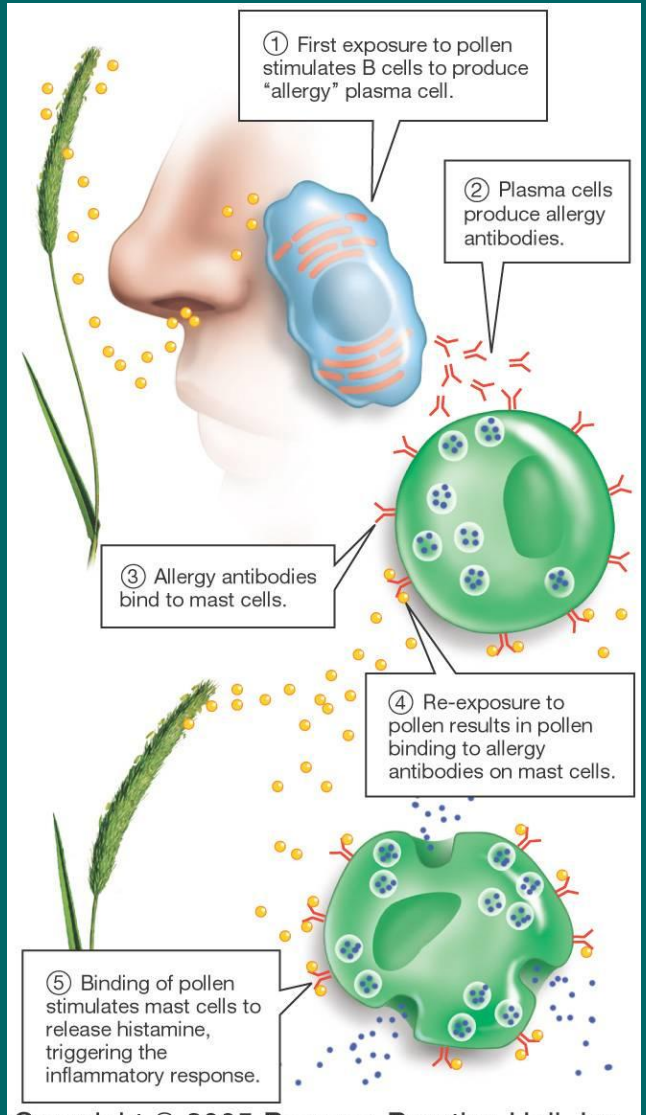


Allergies

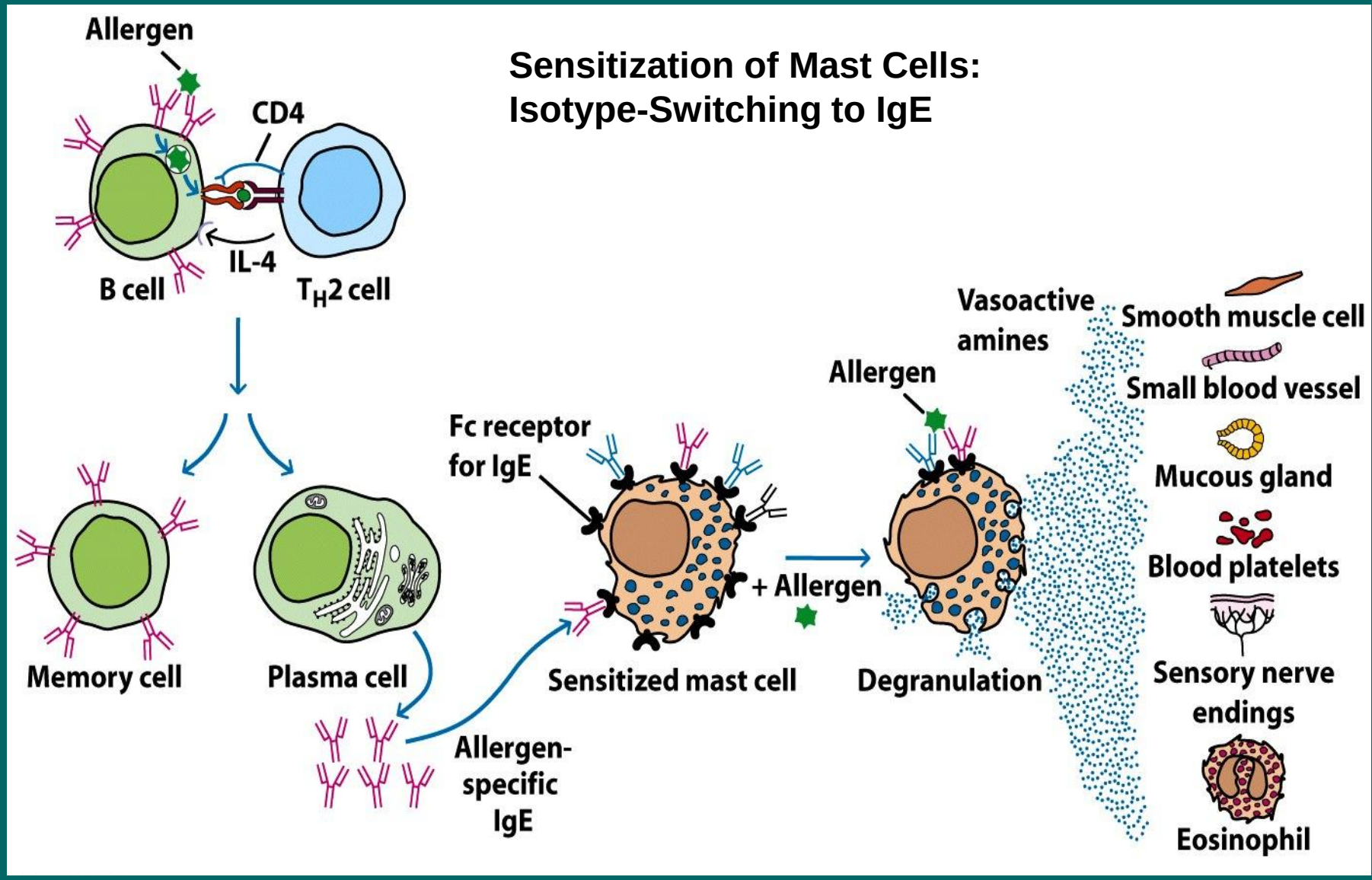
- Allergies / Hypersensitivities are inappropriate and heightened immune reactions to antigens.
- Some, such as pollen, may get in through the respiratory system. Fragments of food proteins may get through the digestive system.
- The next time these proteins are encountered, the immune system attacks them.

Achoo!

- Pollen is a harmless protein, yet we can become allergic to it.
- Most of the symptoms are caused by histamines released by mast cells. That is why antihistamines are used to treat allergies.



Sensitization of Mast Cells: Isotype-Switching to IgE



An Example of Signal Transduction: Type I Allergy Signal Transduction Cascade. (Details not to be memorized. Concept of Signal Transducxtion is Illustrated

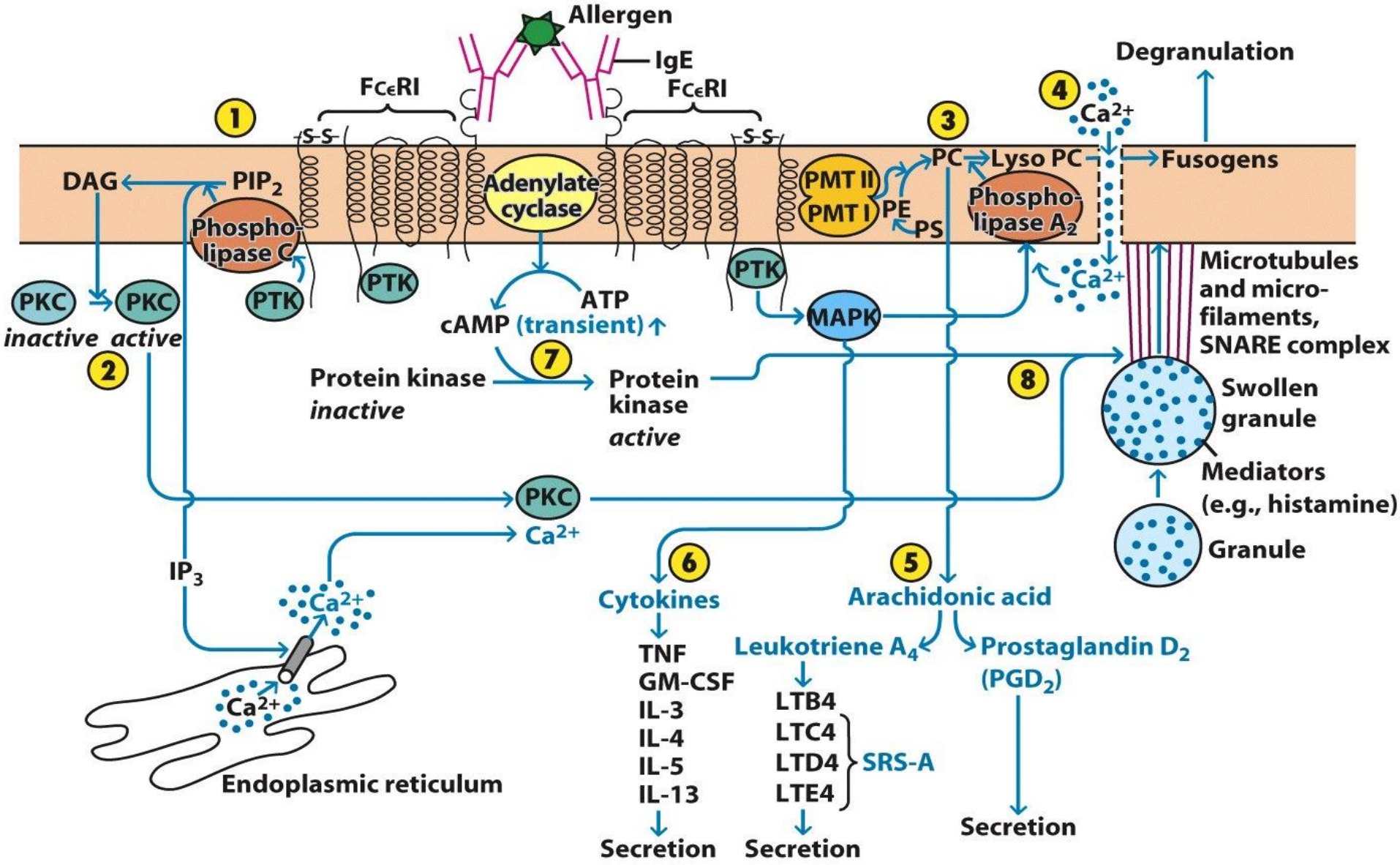


Figure 15-6
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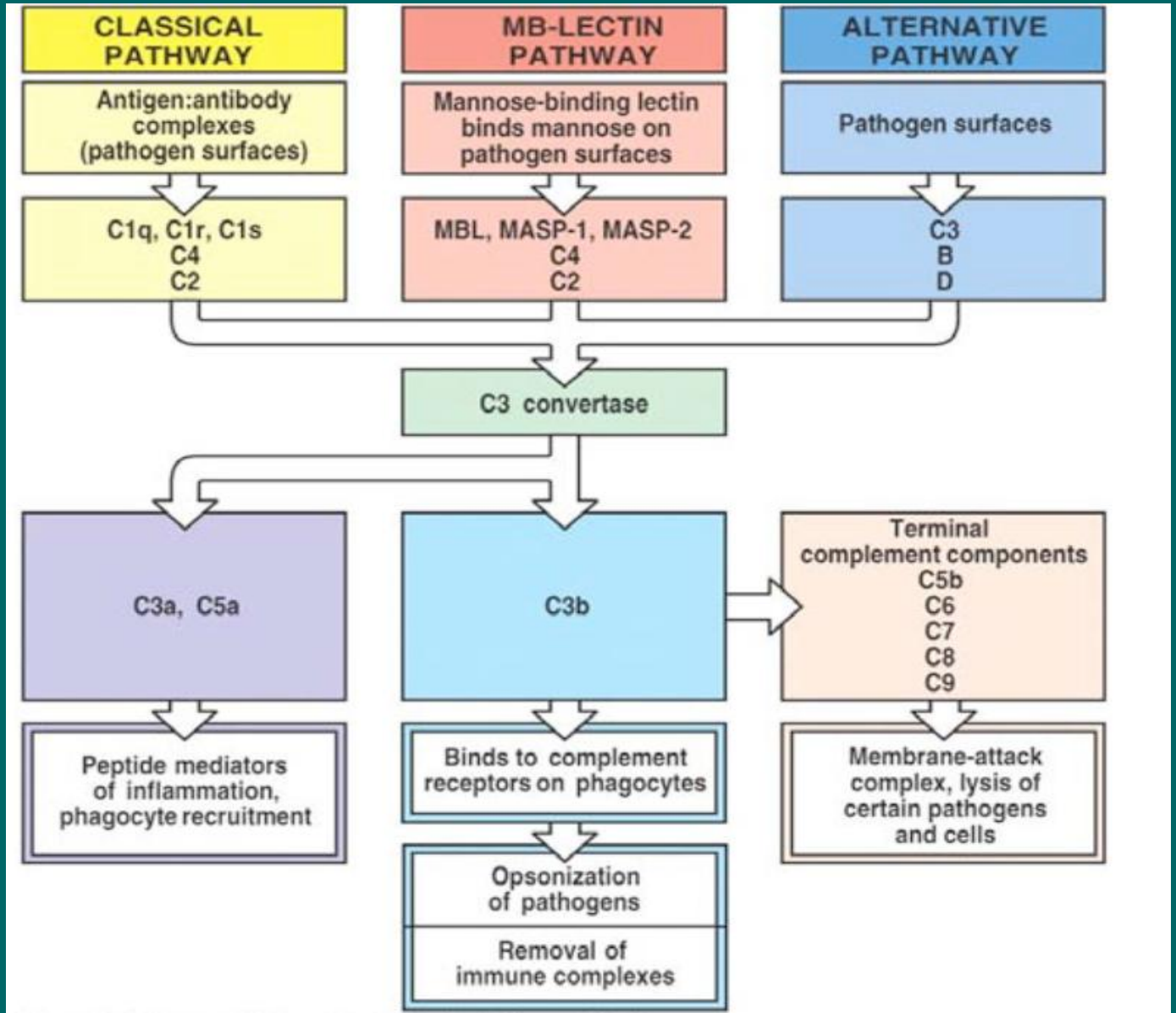
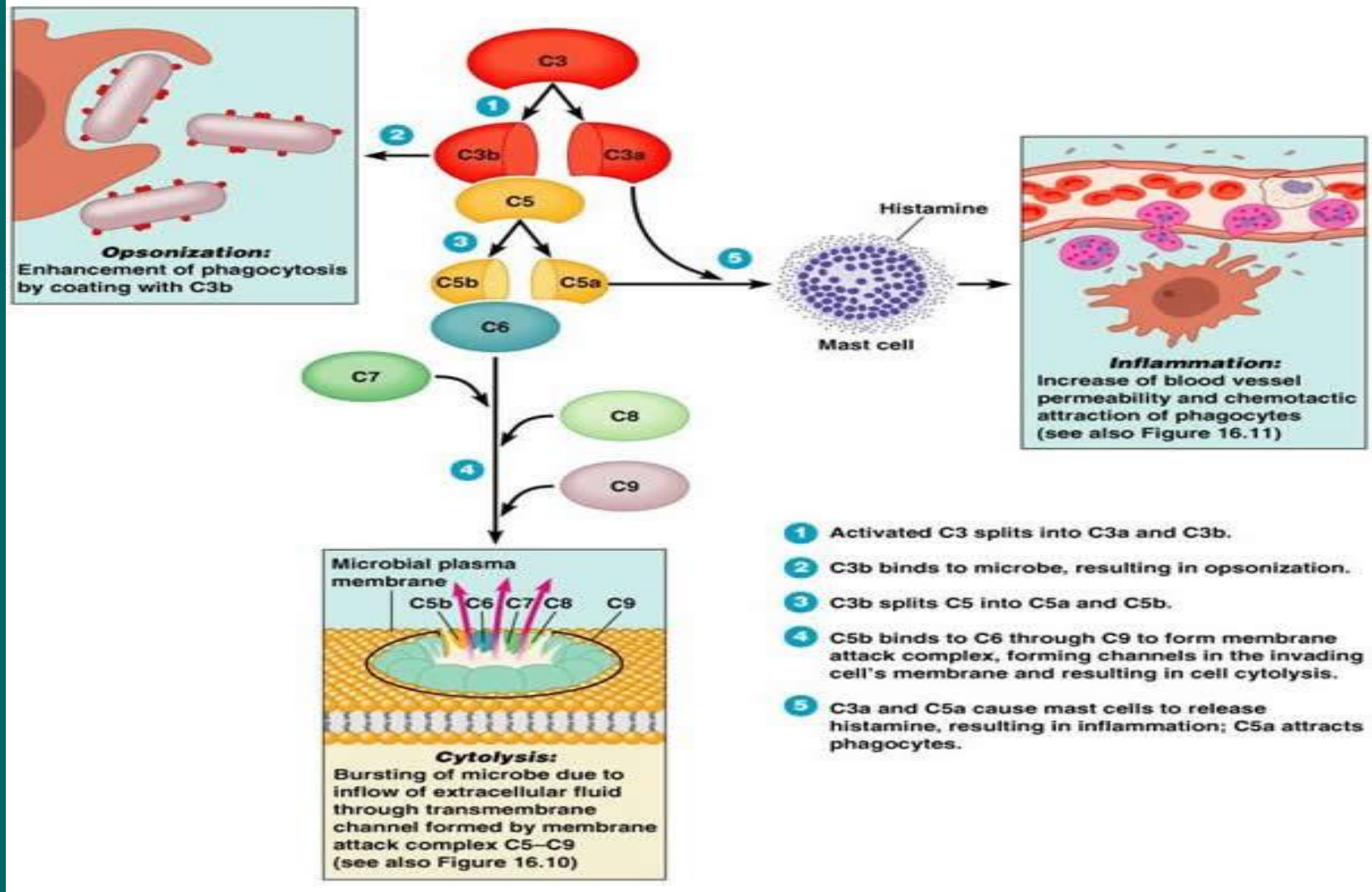
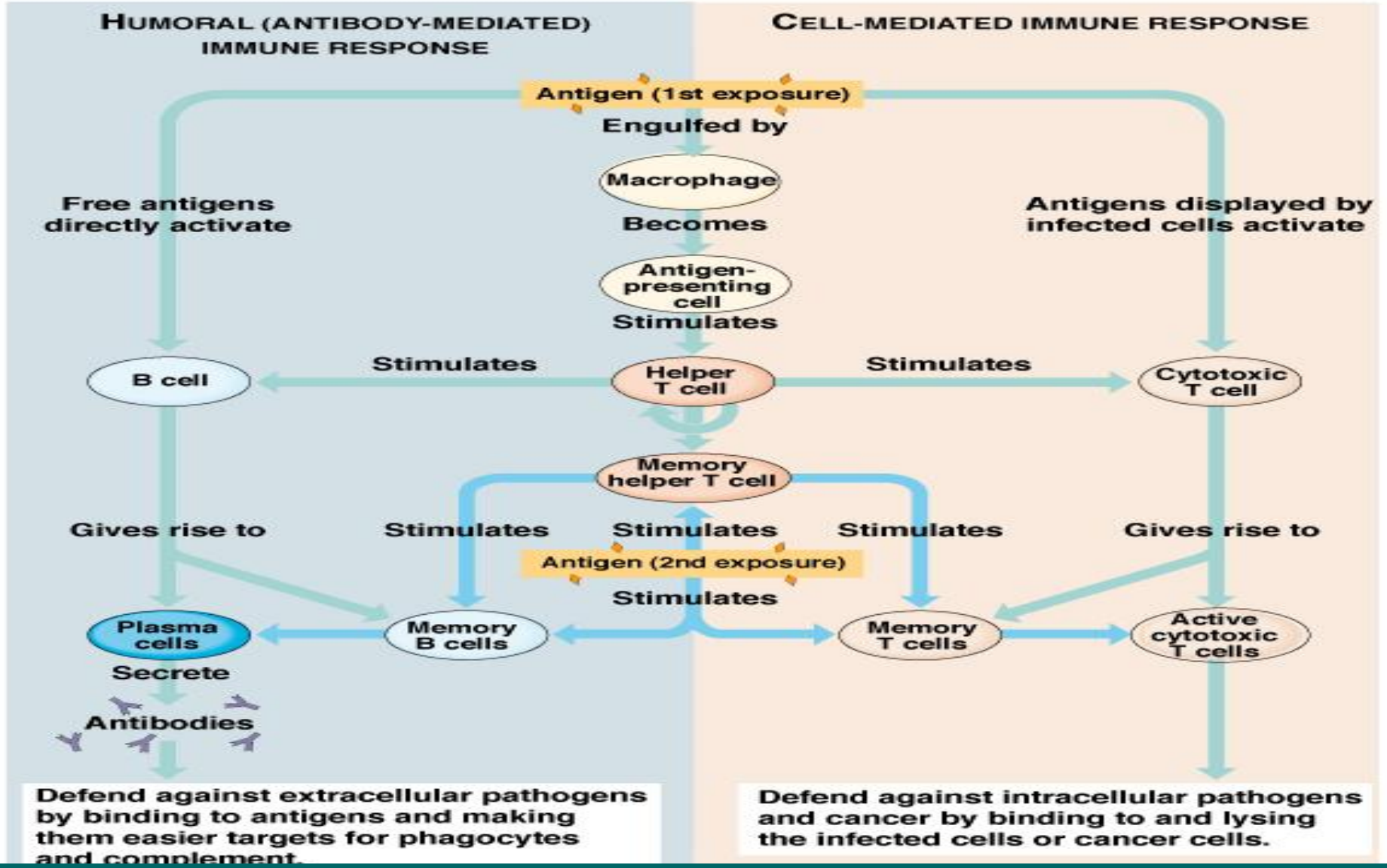
COMPLEMENT SYSTEM ACTIVATION



COMPLEMENT MEDIATED LYSIS



Overview of the Immune Response



Thank you
for your attention