Innate Immunity

Dr. Nadisha Badanasinghe
Senior Lecturer
Dept. of Medical Microbiology

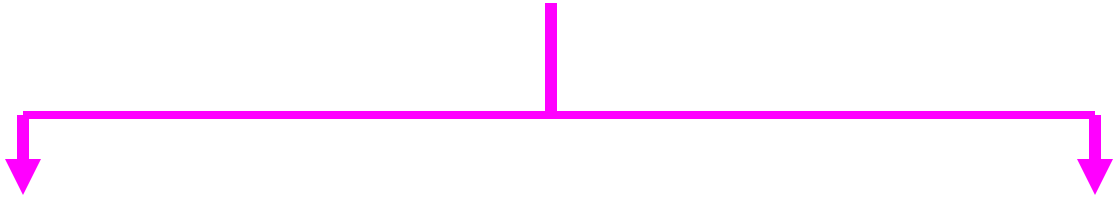
Objectives

- What is innate immunity?
- Components of innate immune response
- Differences b/w innate and acquired responses
- Recognition, Activation and Elimination of pathogens by the innate immune response

Defenses

1) Innate immunity (Natural or Non specific)

2) Acquired immunity (Adaptive or Specific)



Cell-mediated immunity Humoral immunity

Innate Immunity

- Born with it
- Natural/ native
- First line of defense
- Non specific
- No immunologic memory
- Non adaptive

Innate Vs. Adaptive

- Born with it
- 1st line- acts immediately
- Less specific
- No memory
- Only acts on foreign substances
- Recognize broad molecules on pathogens by a small set of rceptors
- Components
  - Barriers
  - Secretions
  - cells

- Stimulated by pathogens
- 2nd line- takes time
- Specific
- Memory
- Can act on self tissues
- Recognize specific molecules (Antigens) on pathogens by a vast array of receptors
- Components
  - Secretions
  - cells

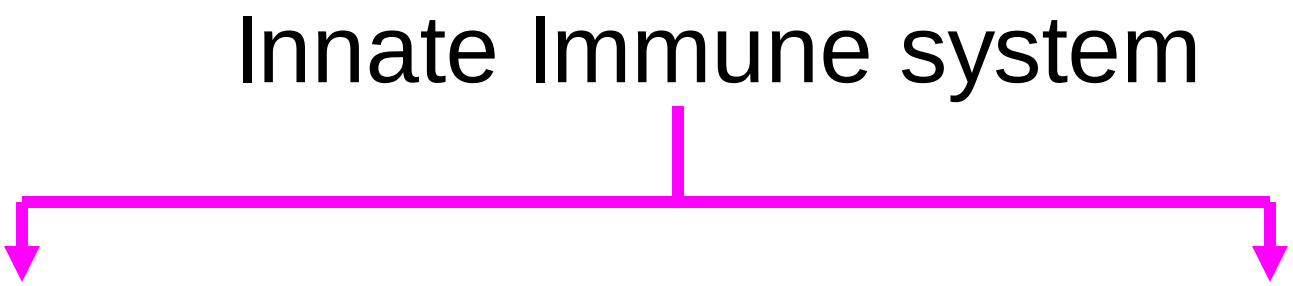
Innate Immunity

- A universal and evolutionarily conserved mechanism of host defense against infection
- Predates the adaptive immune response
- Provide protection against a wide variety of pathogens
- Distinguishes self from non-self perfectly
- Do immune surveillance
- Directs adaptive immunity in the correct way

Components

- Barriers
- Soluble factors
- Cells
- All these act differently but synergistically

Component of Innate Immunity



1) Mechanical barriers
2) Chemical barrier
3) Microbiological barrier

1)cells (NK cells, neutrophils, macropahages, eosino etc)
2)Soluble factors
3) Inflammation

Mechanical barriers

- Intact skin
- Mucous coat
- Mucous secretion
- Blinking reflex and tears
- The hair at the nares
- Coughing and sneezing reflex

Chemical barrier

- Sweat and sebaceous secretion
- Hydrolytic enzymes in saliva
- HCl of the stomach
- Proteolytic enzyme in small intestine
- Lysozyme in tears
- Acidic pH in the adult vagina

Microbiological barrier

Normal bacterial flora

- Competition for essential nutrients

- Production of inhibitory substances

Cells

1.Natural killer (NK) cells

- Large granular lymphocytes circulate in blood
- Innate cytotoxic lymphocytes

Functions : Secrete perforins which makes punctures in the target cells (cytotoxic)

- » Kill virus infected cells
- » Kill tumor cells

Responsible for antibody–dependent cell mediated cytotoxicity (ADCC) – SDL Please

Cells ctd….

2.*Neutrophils :* (Polymorphonuclear leucocytes/ phagocytes)

- granulocytes circulate in blood
- Specialized cells for capture, Ingestion and destruction of invading microorganisms (Phagocytosis)

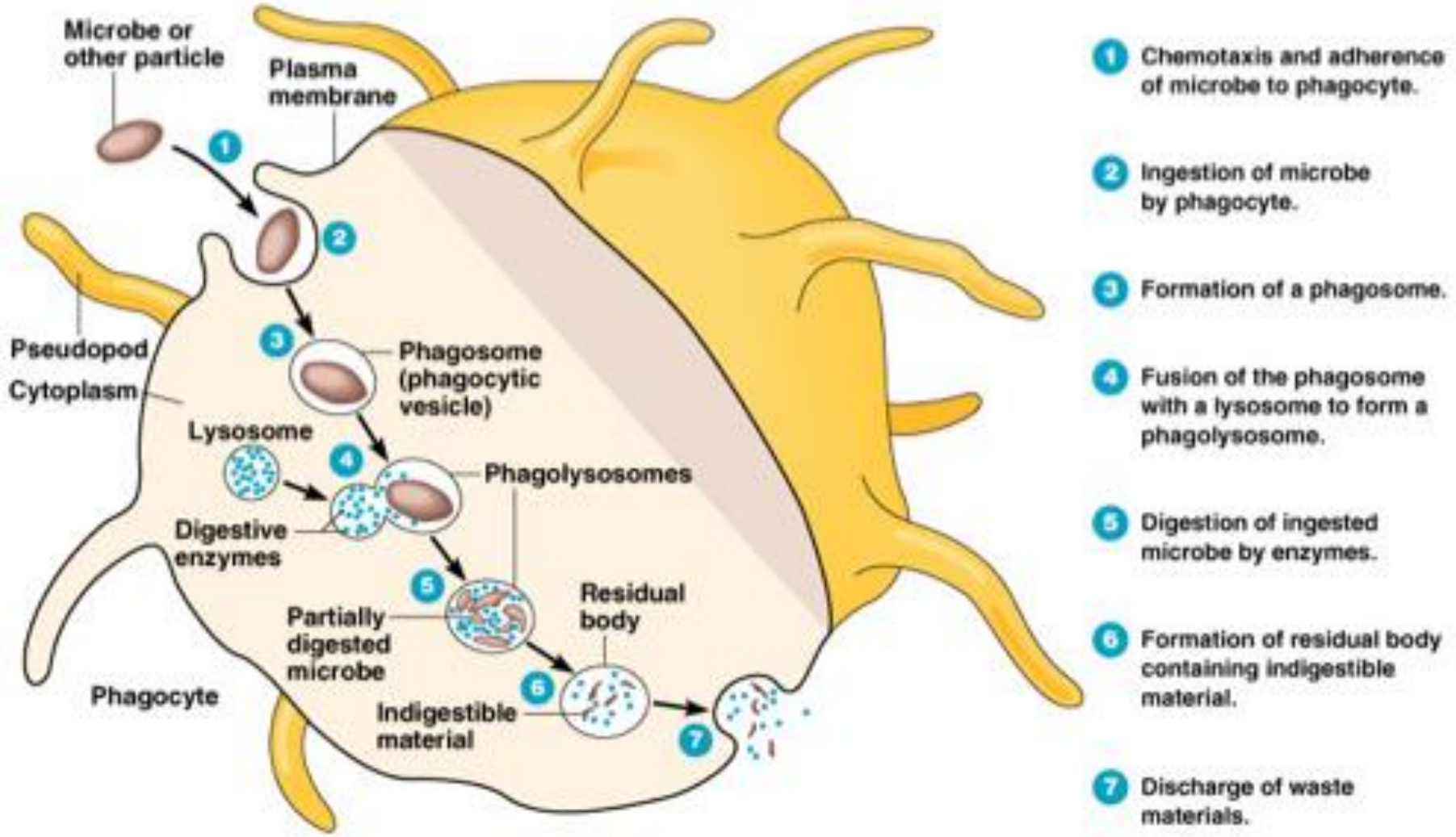
3.*Macrophages* (Mononuclear cells/ Phagocytes)

- Monocytes in blood
- Histeocytes in connective tissues
- Fixed reticuloendothelial cells in liver spleen, LN, BM
- Functions
  - Phagocytosis
  - Antigen presentation to T lymphocytes (Antigen Presenting cells)
  - Secrete cytokines

Phagocytosis (eating up)

- Steps
  - Opsonization of microbe (make it more tastier)
  - Chemotaxis (attraction of cells along a chemical gradient)and attachment to microbe
  - Engulfment and Phagosome formation
  - Fusion with lysosomal granules and Phagolysosome formation
  - Killing → Oxygen depended system
    → Oxygen-independent system

Phagocytosis



Cells ctd…

Mast cells, Basophils and Eosinophils

- Mast cells- found throughout the body in connective tissues
- Basophils- found in circulating blood
- Eosnophils- in blood
- Upon stimulation they release granular contents (e.g. Histamine, cytokines) and cause extracellular killing of pathogens

Dendritic cells

- Communicate b/w innate and adaptive systems
    - Antigen presentation to T lymphocytes (Antigen Presenting cells)
        - Act as APC (Antigen Presenting cells)

Soluble factors

1- Acute phase proteins- (CRP=C reactive protein, Fibrin etc.)
2- Complement (proteins in serum, body fluids)
2- Interferons (Proteins against viral infections)
3- Properdin (Complement activation)
4- Beta lysine (Antibacterial protein from Platelets)
5- Lactoferrin,Transferrin (Iron binding protein)
6- Lactoperoxidase (Saliva & Milk)
7- Lysozyme (Hydrolyze cell wall)

Components of Innate Immunity

Innate Immune system

First line

1) Mechanical barriers
2) Chemical & biochemical inhibitors
3) Normal flora

Second line

A- cells

1)Natural killer
2)Phagocytes
3) Mast cells and eosinophils
4 Dendritic cells

B- Soluble factors

C- Inflammatory barriers

Inflammatory Barriers

Inflammatory response

Release of chemical mediators from

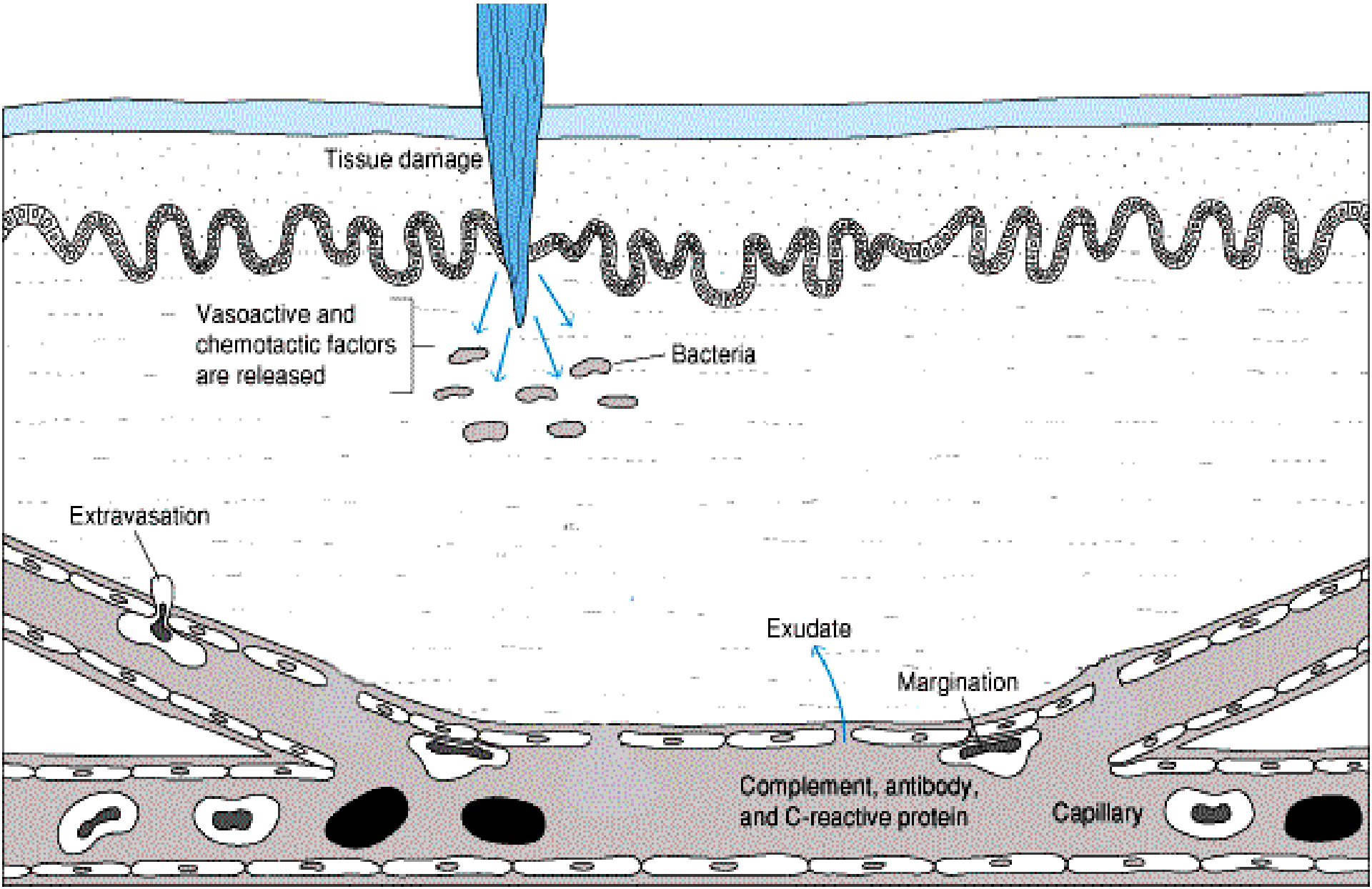
(Histamine, fibrin, kinins, cytokines and APP)

- Tissue damage
- Leukocytes
- Invading microbe

Vasodilatation of capillaries

- Redness of tissue
- Tissue temperature
- Capillary permeability
- Influx of fluids
- Influx of phagocytes into tissues

INFLAMMATION


Tissue damage
Vasoactive and
chemotactic factors
are released
Bacteria
Extravasation
Exudate
Margination
Complement, antibody,
and C-reactive protein
Capillary

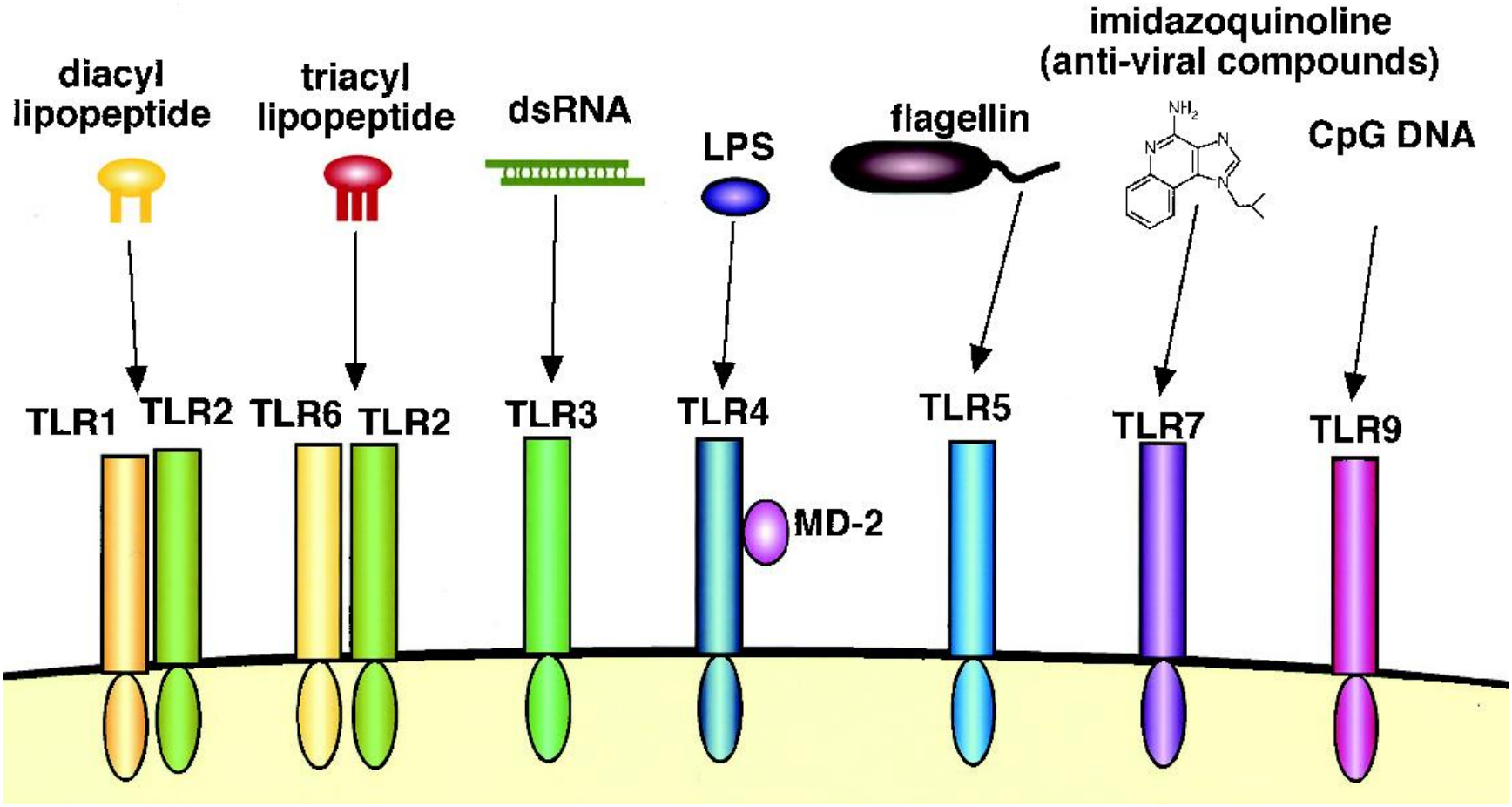
Phases of immune response

- Recognition
- Activation
- Elimination (effector phase)

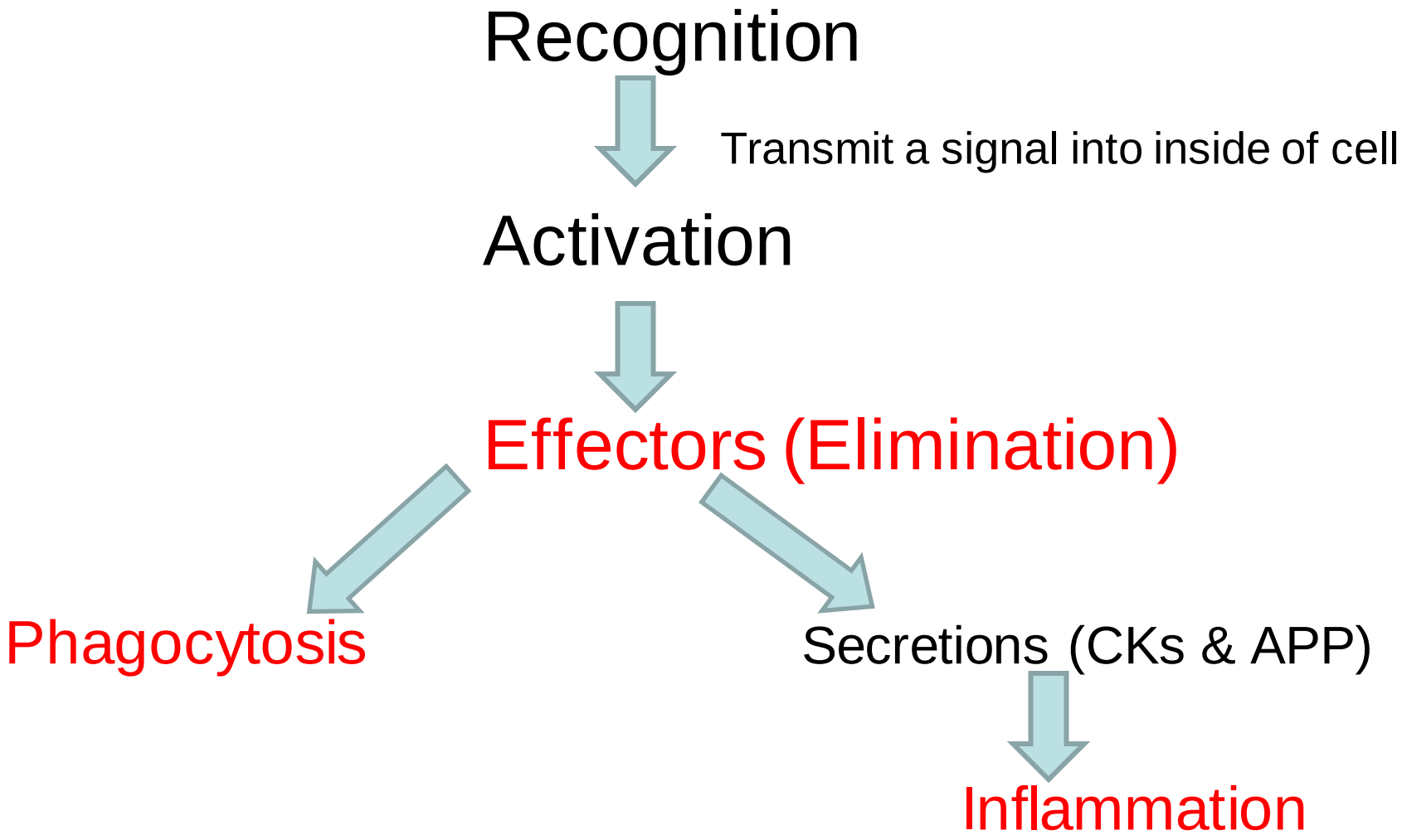
Recognition by Innate Immune System

- Microbes evolve rapidly, so innate immunity must focus on broadly expressed molecules shared by broad groups of microbes ("pathogen-associated molecular patterns" PAMPs) e.g. – bac DNA, LPS, teichoic acid
- These are not present on host cells (only on pathogens)
- They are essential for survival, so are conserved (cannot get mutated)
- Cells of innate system have receptors to identify PAMPs called "pattern recognition receptors"
- E.g. Manose receptors, Toll like receptors, Scavenger receptors

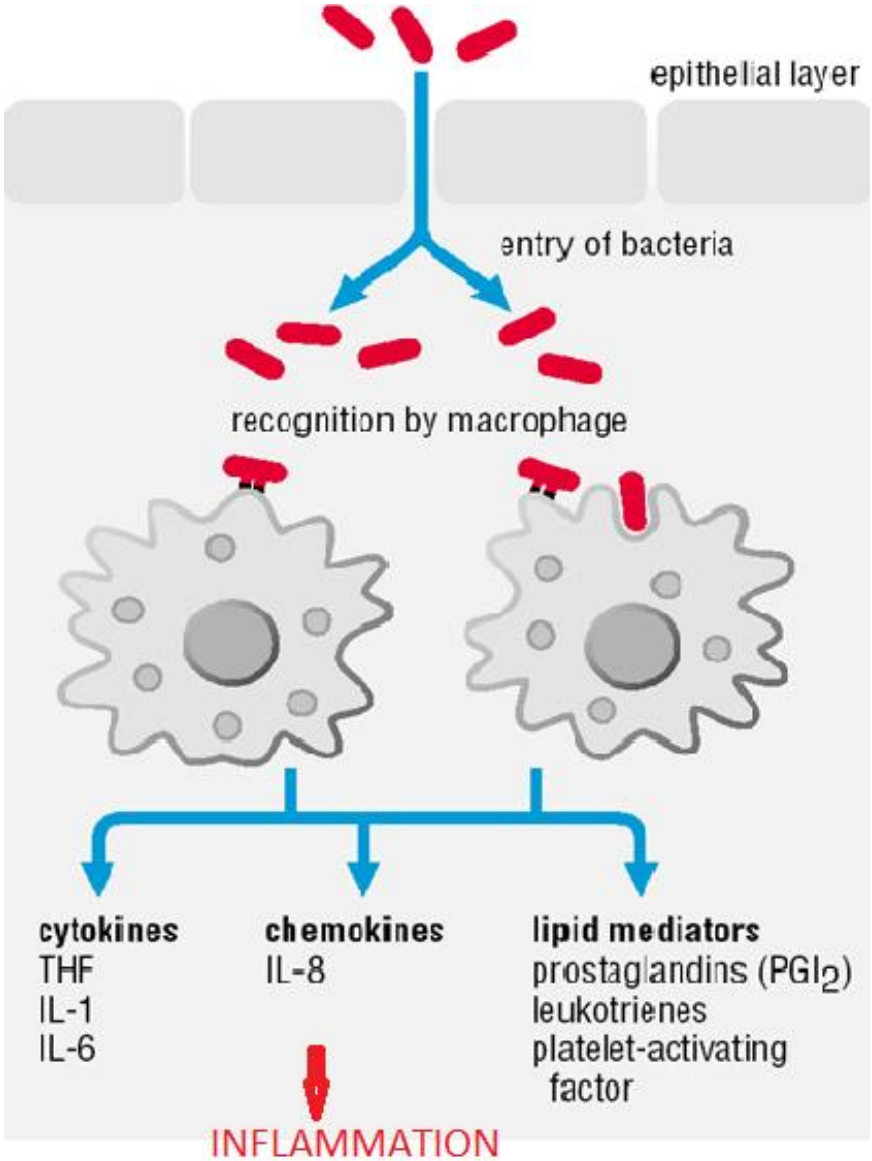
Toll-like receptors and recognition of pathogens



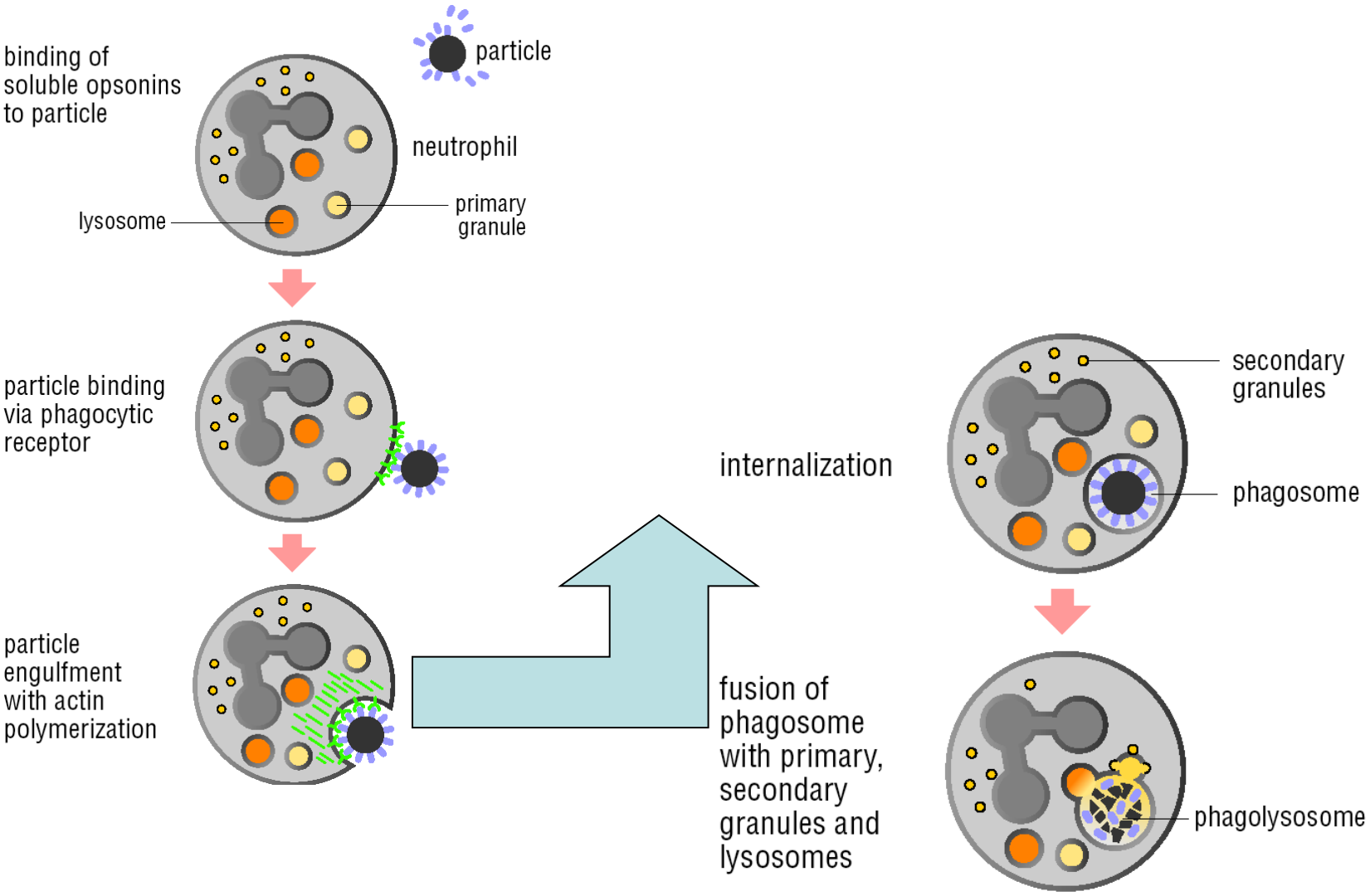
Activation and Effector Phase



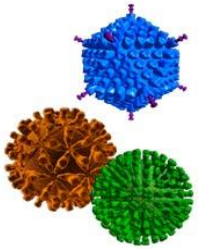
Induction of Inflammation following recognition of pathogens



Phagocytosis



Summary



Immune response

Innate

Acquired

Barriers
Cells
Soluble factors

Prevent entry

extracelular killing by NK cells, eosino, baso

Intracellular killing (phagocytosis) by neutro, macro

Inflammation induced by soluble mediators

Summary

- Features
- Components
- Differences b/w innate and adaptive
- Recognition
- Activation
- effector

Please study

- Fever in infections (systemic inflammatory response)
- ADCC (Ab dependant cell mediated cytotoxicity)
- Phagocytosis
- Innate immune responses in different systems (RT, GIT)
- Role of innate immunity in stimulating adaptive immune response
- Expand the list of differences b/w innate and adaptive responses